3/2022/0032
recd 21/1/2022

320160711P

Land at 9 Downham Road Chatburn

Flood risk and drainage assessment for 2 houses

Postcode BB7 4AU

Centre

Y

Version 01

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1.0 Introduction

The land at 9 Downham Road is to the rear of the existing house. Two houses are proposed. Heys Brook flows past the site at the southern boundary and this report covers flood risk from all sources and assesses drainage.

2.0 Executive summary

The Environment Agency does not have a hydraulic model of Heys Brook so a river survey has been commissioned and a river model has been built by us plus calculating risk flows and running our Hec Ras 4.1 river model to establish risk water levels and then zoning the site. This has shown that the site is floodzone 1 above any Heys Brook 1 in 1000 year risk levels. It is currently a garage building and storage area and housing is proposed. Foul flows will drain to the public sewer system. New surface water flows will drain to Heys Brook via a new outfall.

To comply with DEFRA's guidelines in SC030219 'rainfall runoff management for developments' the development will limit its new surface water peak outflow rate to 5 l/sec. Surface water storage will be provided to suit. The site is not at risk from other sources of flood risk.

Two ground reports are available for the site and these show that the site is clayey made ground on top of rock plus there is contamination and sustainable drainage techniques are unsuitable in this instance.

3.0 Existing site, flood risk modelling, flood risk, site floodzone.

The land is to the rear of the existing house and the southern boundary is a vertical stone walled channel which is Heys Brook. The site has its access past the existing house. The gross site area is approx 1100m2 and the level range is approx 97.2 AOD to 99.

Heys Brook drains the Downham area and flows through Chatburn and down to the Ribble. At Downham Downham Beck flows into it. As it flows into Chatburn from the east it passes under the A59 trunk road and then the railway prior to passing the site in a stone walled channel with a rough rock bed. As it passes the site its bed level is 92.6 to 93.2 which is 4 to 6m lower than the site.

Heys Brook has a catchment area of 4.39 km2, annual rainfall is 1287mm, and BFIHOST is 0.357 indicating a non absorbent catchment. SPRHOST is 41.19 which is an average runoff percentage. The catchment is hillside and rural with an average bedslope of 117.2 m/km. and the catchment is responsive to 3.1 hour time length storms.

Heys Brook risk levels were requested from the Environment Agency however the EA does not have a river model of the Brook. River survey work plus photos and structure measurements were instructed and assembled survey data etc was provided under contract by Site Surveying Services of Grindleton. Downstream of the site the Brook flows under Clough Bank, a footbridge, and then Bridge Road. After Bridge Road there is a channel bed drop of 3m which was very likely part of the former

Victoria Mill water system. An hydraulic model of the Brook was built using Hec Ras 4.1 software and 1 in 100 year and 1 in 1000 year risk flows run through the model. The ReFSR/FEH spreadsheet equation was used to calculate 1 in 100 year risk flows and a growth factor of 1.9 used to uprate the 1 in 100 year flow rate to a 1 in 1000 year flow rate. These rates were:-

1 in 100 year - 13.1 m3/sec
1 in 1000 year - 24.9 m3/sec

1 in 1000 year water levels at the site were 95.132 to 96.040. With existing ground levels of 97.2 to 99 the site is thus above any 1 in 1000 year risk levels and is therefore floodzone 1.

4.0 Proposals, new drainage.

The proposals are to build 2 houses on the site with the access from Downham Road. The houses will be a minimum of 15m away from the Brook channel wall. Heys Brook is classed as 'main river' and as such an 8m width easement either side of the brook should be kept clear of any building work to allow maintenance work should it be needed- this has been done.

Both houses will have rear gardens and the new hard areas plus access road area will be approx 600m2. New drainage will be separate system with separate foul and surface water drains, the foul drains will connect to the public sewer system either directly or via the existing house drainage. All new developments must comply with DEFRA's SC030219 guidance 'rainfall runoff management for developments' and this requires that new greenfield developments limit their new surface water outflow rates to a greenfield runoff rate known as QBAR which is defined as a 1 in 2.3 year greenfield flow rate. This can be obtained from the www.uksuds.com website which is a public sector website sponsored by Wallingford. This flow rate for the Chatburn site is 1.5 l/sec-FEH method- and the site limiting flow rate will thus be the minimum flow rate of 5 l/sec. The minimum flow rate of 5 l/sec is the lowest flow rate achievable by a vortex flow controller in a manhole because lower flow rates than this require too small an outlet diameter which will from experience cause repetitive blockages. The new surface water drainage system will connect to Heys Brook and this will be the subject of a post consent Environmental Permitting Regime application. New slab levels will be 99.00 subject to the final post consent detail design.

There are two ground reports for the site. The first is a walkover desk study by Wormseye which describes a site walkover and contains a historic Chatburn plan showing the now demolished Victoria Mill downstream of Bridge Road. The second is an intrusive ground investigation by PSA which has logs for window samples WS1 to WS6 and also lists contamination. It can be seen from the PSA report that the site is mainly clayey made ground over rock- the rock can of course be seen in the river survey photos. Because of the risk of contamination surface water soakage techniques will not be proposed and there is no scope for sustainable drainage.

However water butts will be provided to all houses and driveway runoff will drain into channel drains at the back of footpath which where practical will have land drain outlets into planted beds subject to the post consent detail design phase.

There are two river structures that could partially or fully block. The first is Clough End bridge which is an upside down U, the second is the arch under Bridge Street. In both cases should debris build up flow will find its way round without affecting the two new houses.

5.0 Strategic Flood Risk Assessments (SFRA) and planning.

The Ribble Valley BC website has a May 2010 Strategic Flood Risk Assessment report available for download. This lists historic floods and provides tailored area general policies P1 to P6. For the Upper Ribble area policy P1 is advised which is 'no active intervention'. There is no requirement for Critical Drainage Areas as in the larger metropolitan areas of the UK.

6.0 National Planning Policy Framework and Technical Guidance and EA mapping.

The site is floodzone 1 above any local 1 in 1000 year risk levels. The proposed new housing is classed as 'more vulnerable' in Table 2 and is 'appropriate' in floodzone 1 as per Table 3. There is no need for the exception test, or the sequential test.

Types of flooding that could affect the site are:-

1. River- Heys Brook is next to the site and the site is floodzone 1
2. Sea- no tidal influence
3. Land- no undrained land slopes towards the site.
4. Groundwater- no springs or weep areas on the actual site
5. Sewers- no local internet reports of sewer surcharge
6. Reservoirs canals- none close by.

Environment Agency mapping is as follows:-

Flood map for Planning- the site is floodzone 1

Risk of flooding from rivers and sea- this shows the effect of any flood defences- this is not applicable.

Flood warning- this is not applicable

Groundwater- the site is not in a groundwater protection zone.

Risk of flooding from reservoirs- this shows reservoir risk- all utility company reservoirs are maintained to a 1 in 10,000 year risk standard under the Reservoirs legislation and this is a very rare and unlikely risk. No risk for this site.

Risk of flooding from surface water- this mapping shows the effect of various types of storms and is an approximate guide to low spots. The Environment Agency guidance report of November 2013 re the updated flood map for surface water stated -

'Although the maps appear to show flooding from ordinary watercourses, they should not be taken as definitive mapping of flood risk from these as the conveyance effect of ordinary watercourses or drainage channels is not explicitly modelled. In urban areas existing drainage systems are taken into account by subtracting 12 mm/hr from the Jflow 2D storm profiles input to the software, also there is a 30% reduction to allow for average infiltration and the resulting runoff is then routed over a digital terrain map.'

The mapping shows a blue spillpath line along the line of Heys Brook channel. The site is not affected.

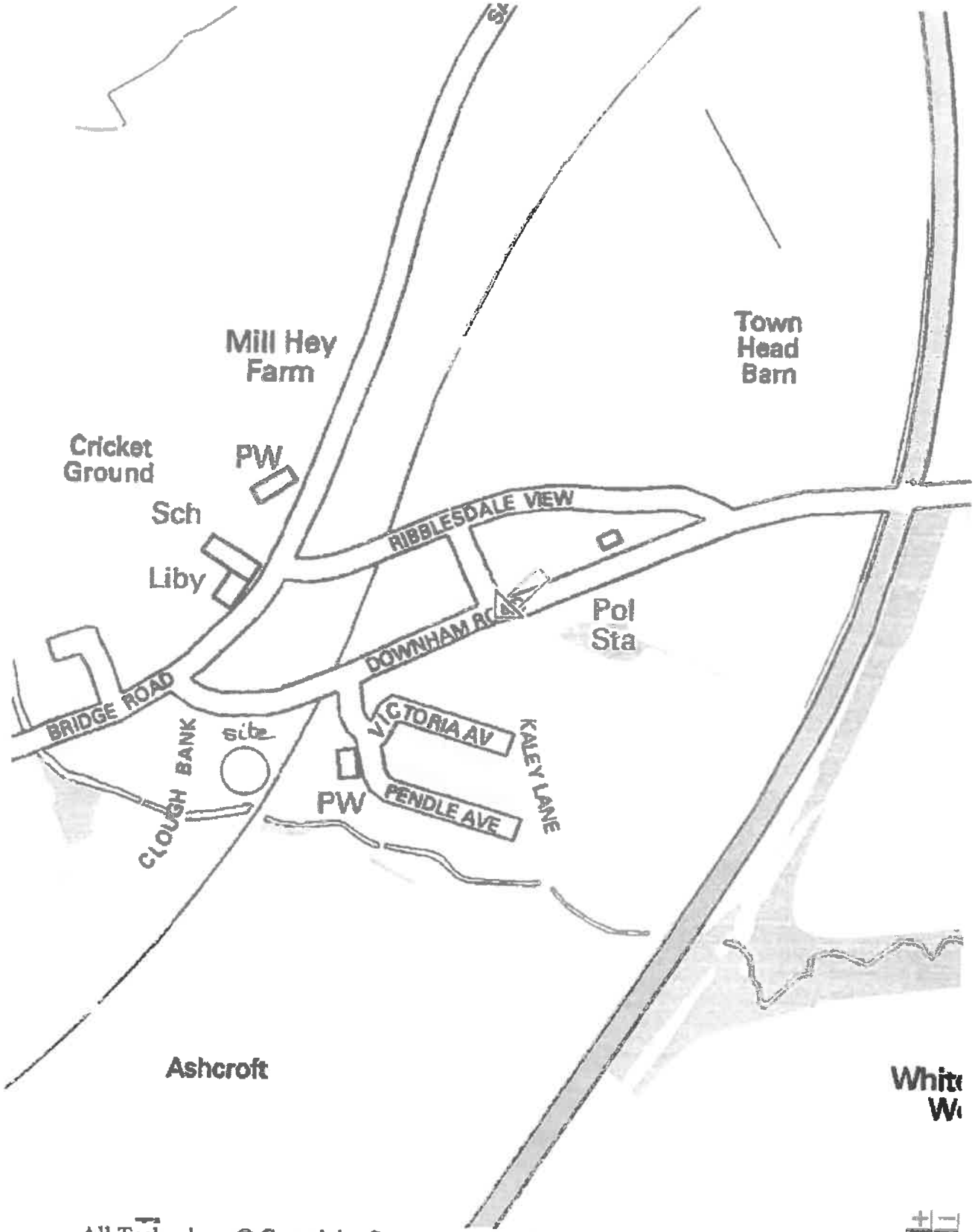
7.0 Attachments

Attachment	Number	Size
Location plans	1, 2	A4
Proposals	3	A4
Ground reports	4 to 23	A4
Historic map	24	A3
Sewer records	25	A3
River survey	26, 27	A3
OS area map	28	A3
Site survey	29, 30	A3
Proposals	31 to 34	A3
FEH data	35 to 38	A4
River model outputs	39 to 42	A4
River model cross sections	43 to58	A4
Hec Ras report	59 to 71	A4
HRW runoff report	72 , 73	A4
Ribble Valley SFRA extracts	74 to 78	A4
EA mapping	79 to 81	A3

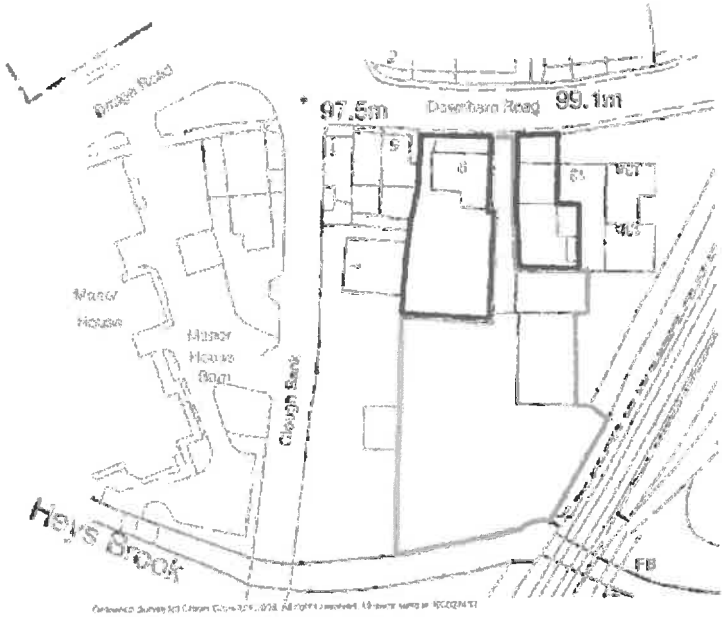
This report is a copyright email report and attachments are grouped together in A4 and A3 for scanning and can be put in order using the top RH corner lettering. Should you require survey data, survey photos, or river model files please email:-

floodriskengineer@gmail.com

Email files
160714fra01
160714attach1-A4
160714attach2-A4
160714attach3-A3
160714attach4-A3
River survey photos are attached as individual files



Print



Location PLAN

Site: 9 Downham Road
Chatburn
BB7 4AU

Client: Alan Jackson	
Drawn: HA	
Date: 17.06.14	
Scale: 1:1250 @ A4	
Project No: JACKS-04 / Dwg 02	
Amendments:	A

Notes:
All work is to be carried out to the latest current British standards Codes of Practice and recognised working practices.
All work and materials should comply with Health and Safety legislation and to be approved by the Local Authority Planning / Building Control Officer.
All dimensions are in millimetres unless where explicitly shown otherwise. The contractor should check and clarify all dimensions as work proceeds and notify the design team of any discrepancies. Do not scale off the drawings, if in doubt ask.
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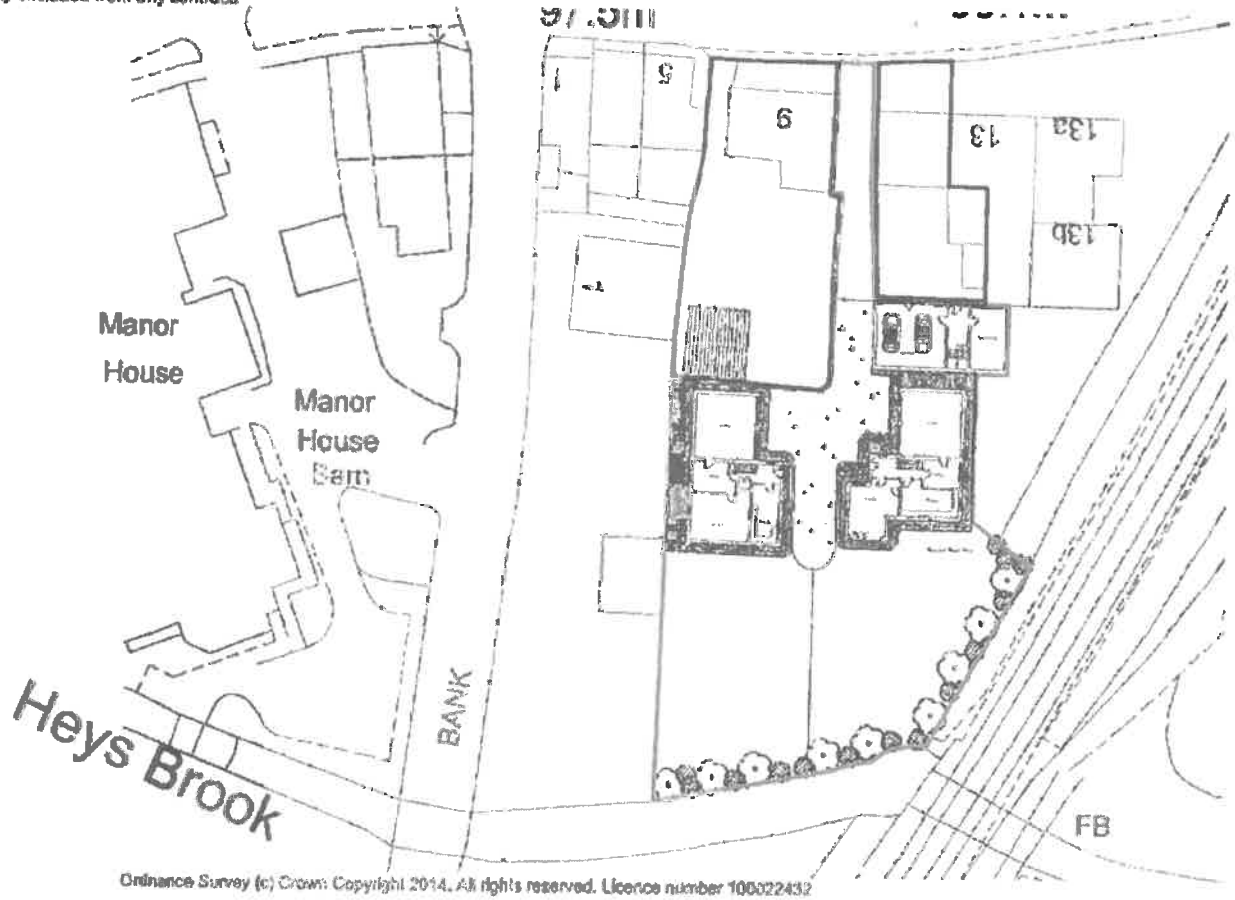

SITE PLAN

Site: 9 Downham Road
Chatburn
BB7 4AU

Client: Alan Jackson
Drawn: HA
Date: 28.01.15
Scale: 1:500 @ A3
Project No: JACKS/04 - Dwg 01
Amendments:

Notes:
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Electronic Report

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01282 414649 / 458410

Our Ref: Downham Road/BB7 4AV/2015

Date: 20/7/2015

Leanne Flynn
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Reedley
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PROPOSED HOUSES BEHIND 9 DOWNHAM ROAD, CHATBURN, CLITHEROE, BB7 4AV
PRELIMINARY RISK ASSESSMENT (DESK STUDY)

INTRODUCTION

It is proposed to build two detached houses. The objective is to carry out a desk study, supplemented with a walk over survey, to form a Preliminary Risk Assessment to consider contamination, landfill gas and geotechnical issues.

SITE DESCRIPTION

The site is located to the South of Downham Road in Chatburn, Clitheroe, and at OS Grid Reference 376970, 444080. The site was inspected on 06/07/15 by Simon Gimeno and is about 30 by 40 metres with a 30 metre access coming in from the north. The site comprises a dilapidated, unused, workshop/garage with a builders' yard surrounding the south and west.

The workshop/garage comprises two sections one to the north running west to east and another section going north to south together, forming a 'T' shape. The northern section was made of breeze block to the west and stone to the east with a slate roof. The southern section again comprised a slate roof but with red brick walls. The building was being used to store materials, tractors, forklift trucks and gardening tools.

The builders' yard was surfaced with gravel creating a pathway through the centre of the site and then the remainder of the site was unkempt grass and weeds. The southwest corner appeared to have been used as a bonfire. Along the west of the yard was a porta cabin, JCB, skip and again various building materials. In the northwest corner was a canopy with a steam roller and building materials.

South of the building was a service pit with an old disused boiler, further to the south there was an abandoned truck/lorry, a shipping container storing various lengths of timber and an old rusted through steam roller.

Throughout the yard there are piles of scrap materials, oil drums, rubble and asbestos cement pieces.

To the north and northeast are houses, to the southeast is a railway line, and Chatburn Brook (at a lower level) forms the south boundary.

TREES

The southern boundary is bordered by deciduous trees up to 12 metres high these being mainly Sycamores, Elms and Ash. Along the west boundary to the south is a conifer tree standing at about 10 metres high with two deciduous trees thought to be Ash trees.

This is not an accurate arboricultural survey.

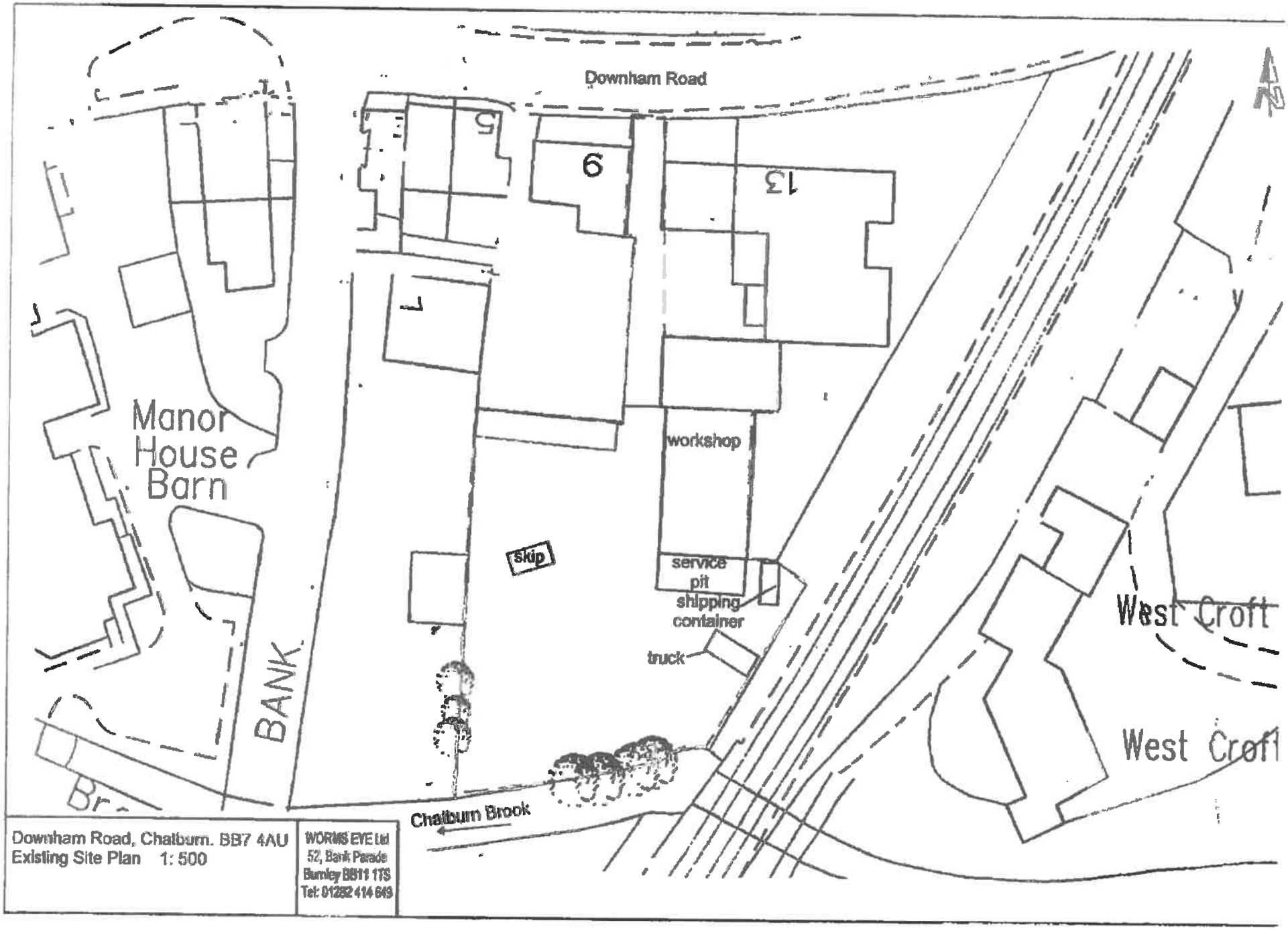
PROPOSED DEVELOPMENT

It is proposed to build two detached houses, each having a garden to the rear (south). At the northeast corner of the site will be a garage with adjacent workshop.

DATA SOURCES

The following data sources have been viewed in compiling this report.

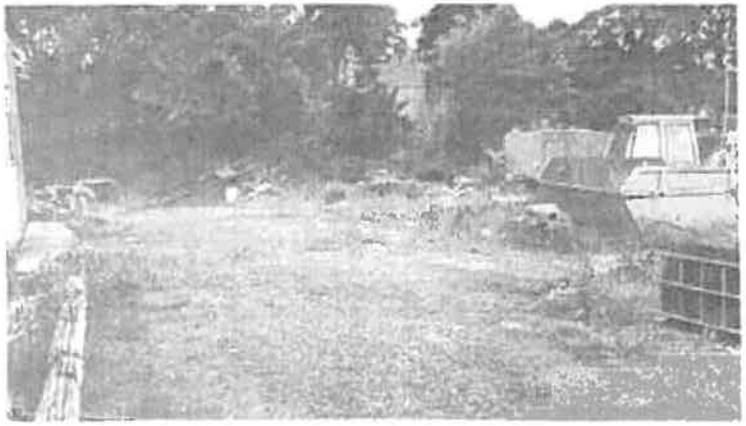
- BGS, Geology Map, 1:50000 scale, Sheet 68, Clitheroe, Solid and Drift Edition
- BGS, on-shore boreholes scans (no nearby relevant records)
- Environment Agency, What's In Your Backyard
  - Groundwater
  - Landfill Sites
  - Pollution
- Landmark Envirocheck Report
- Ordnance Survey, Historical Maps, 1:10000 and 1:2500 scale
- Walkover Survey, 6/7/15.


Downham Road
5
6
13
7
Manor House Barn
BANK
workshop
skip
service pit
shipping container
truck
West Croft
West Croft
Chatburn Brook
Downham Road, Chatburn. BB7 4AU
Existing Site Plan 1: 500
WORMS EYE Ltd
52, Bank Parade
Burnley BB11 1TS
Tel: 01282 414 649

Downham Road, Chatburn, BB7 4AU

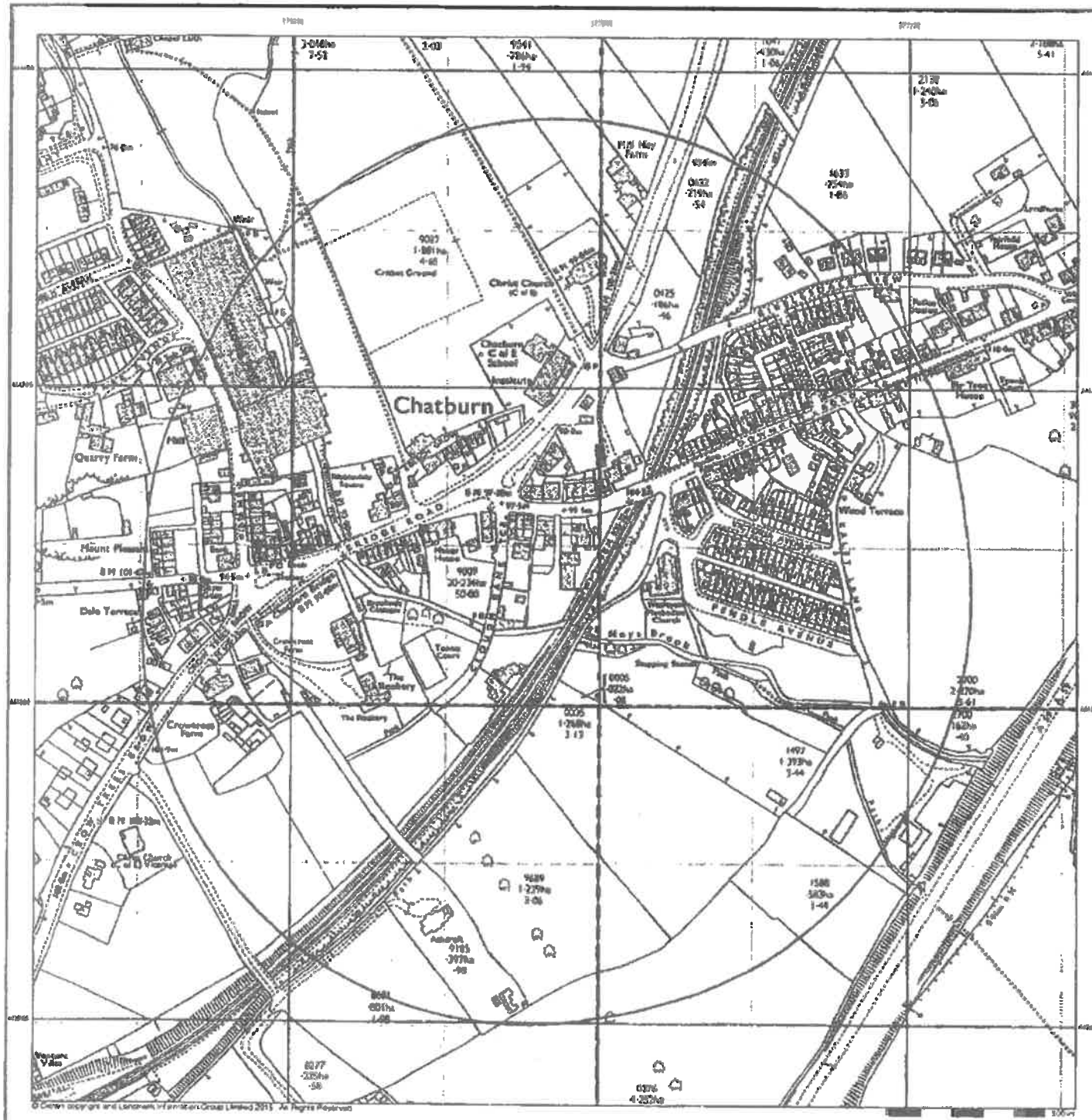
view of site looking northeast

bonfire remains and asbestos fragments in southwest corner



view of site looking southwest

service pit

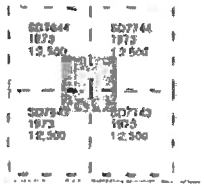


Envirocheck®

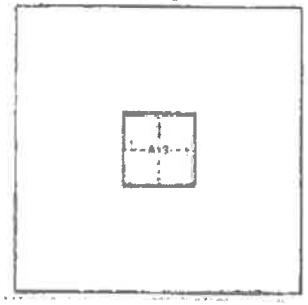
Ordnance Survey Plan
Published 1973
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly built at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1893 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1935, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in matching areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	69227855_1_1
Customer Ref:	BB7 4AU
National Grid Reference:	376970, 444080
Slice:	A
Site Area (Ha):	0.14
Search Buffer (m):	250

Site Details

9 Downham Road, Chatburn, CLITHEROE, Lancashire, BB7 4AU

PSA DESIGN

engineering your environment

CIVIL, STRUCTURAL, GEOTECHNICAL, TRANSPORT

A Jackson

Downham Road, Chatburn
Phase 2 Geo-Environmental Investigation & Assessment

G2235-GR-02

6th June 2016

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7.0 CONTAMINATION RESULTS & ANALYSIS

7.1 *Introduction*

The 2016 Ground Investigation by PSA Design was conducted to develop an understanding of the extent (if any) of the contamination. The PSA Design investigation recorded results with evidence of contamination within the fill materials across the site. Chemical testing results are presented within Appendix B.

7.2 *Chemical Analysis*

7.2.1 In view of the site history, selected soil samples were taken during the ground investigation and were analysed for a screening suite. On the basis of the Conceptual Environmental Risk Model, it has been considered that a range of potential contaminants could exist in soils at the site, as follows:

- Elements which could pose a risk to human health and/or controlled water: arsenic, cadmium, chromium, lead, mercury, nickel, selenium;
- Potentially phyto-toxic elements: boron, copper & zinc;
- Inorganic chemicals which could pose a risk to human health, buildings and/or controlled water: cyanide, nitrate, sulphate & sulphide;
- Other inorganic contaminants: pH conditions;
- Organic contaminants: Polynuclear Aromatic Hydrocarbons (PAH's with split of 16 priority EPA PAH's);
- Speciated And Total Hydrocarbons;
- Asbestos ID;
- VOC and SVOC.

7.2.2 Samples from the ground investigation were chemically tested at Envirolab Laboratories Ltd, a UKAS accredited laboratory.

7.2.3 Chemical testing was targeted at all the various surface strata identified within the ground investigation that would be deemed a threat to human health. This could be broken down into the following:

- Made Ground – Clay Fill;
- Made Ground – Granular Fill

7.2.4 Sample selection criteria for chemical testing included good coverage of the site area at various depths and lithologies. The samples to volume ratio reflected not only the spatial element of the various compositions of the ground but also represented the %composition of the particular lithological fill type in the total volume of the most recent fill, situated in the site. The sampling was in accordance with BS 10175:2011, Investigation of potentially contaminated sites- Code of Practice.

7.2.5 5No. soil samples obtained from the site, were tested in total with 4 No. analysed for the following suite of chemical determinands:

- Arsenic, cadmium, total & hexavalent chromium, lead, mercury, nickel, selenium
- Boron (water soluble), copper, zinc
- Cyanide (total)
- Sulphide (acid soluble)
- Nitrate (soluble)
- Phenol (total)
- PAH's (speciated)

7.2.6 4No. samples of the various sub-surface materials were analysed for the following suite of determinands:

- Sulphate (water soluble, 2:1 extract)
- pH conditions

7.2.7 4No. samples of the various sub-surface materials were analysed for the following suite of determinands:

- Aliphatic & Aromatic Hydrocarbons (speciated)

7.2.8 1No. sample of the various sub-surface materials were analysed for the following suite of determinands:

- VOC and SVOC

7.2.9 1No. sample of sub-surface material was analysed for the following suite of determinands:

- Leachate extract

7.2.10 5No. samples of the various sub-surface materials were analysed for the following suite of determinands:

- Asbestos ID

7.2.11 The analytical results of all the chemical testing undertaken are presented in full in Appendix B.

7.3 ***Current Guidance on Interpretation of Analytical Data***

7.3.1 The UK approach to contaminated land is based upon the principles of risk assessment. This in turn is founded upon the use of so called source→pathway→receptor/target principles in order to establish the presence, or potential presence, of a pollutant linkage.

7.3.2 PSA Design adopts a tiered approach to risk assessment that is consistent with UK guidance. The initial step (tier 1) is the comparison of site data with published guidance levels or remedial targets. In March 2002 DEFRA and the Environment Agency published a series of technical research papers (R&D Publications CLR7,8,9 &10) introducing a new approach to the assessment of risk to human health from land contamination. This research includes the development of the new CLEA model and the Soil Guidance Values (SGV's).

7.3.3 Currently, these guidelines only address seven contaminants and the development of both the CLEA model and additional SGV's is ongoing. Where published, SGV's have been utilised as intervention values for the purpose of a Tier 1 assessment.

7.3.4 For chemical determinants that have yet to have an SGV published alternative literature guidance sources have been used to create a generic assessment criteria (GAC). These sources are as follows:

- LQM/CIEH (2015) *Suitable 4 Use Levels for Human Health Risk Assessment*
- EIC/AGS/CL:AIRE (2009) *Soil Generic Assessment Criteria for Human Health Risk Assessment*
- BRE (2005) *Concrete in Aggressive Ground* BRE Special Digest SD1
- ICRCL (1987) *Guidance on the Assessment and Redevelopment of Contaminated Land Note 59/83* (Landscaped/buildings), DoE
- CIRIA C733 (2014) *Asbestos in soil and made ground: a guide to understanding and managing risks.*

7.3.5 The potential risk to building material is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest SD1, 2005: "Concrete in Aggressive Ground".

7.3.6 Tier 1 groundwater risk assessments are undertaken by comparing leachate concentrations with the appropriate water quality standard. Depending upon the specific characteristics of the site, the appropriate standard may be one of the following:

- Water Supply (Water Quality) Regulations, 1989.
- Environmental Quality Standards (for freshwater)
- The surface Waters (abstraction for drinking water) Regulations
- United Utilities (water supply pipes) Trigger and Action Levels for inorganic and organic contaminants.
- Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (10/WM/03/21) [UK Water Industry Research], 2011.
- United Utilities Water Supplementary guidance for the selection of water pipes in land potentially affected by contamination, July 2011

7.3.7 Since the withdrawal of the ICRCL values in December 2002, there has seemingly been no direct reference for the assessment of potential phyto-toxic effects of contaminants. PSA Design continue to use the former ICRCL values for copper, nickel and zinc as the withdrawal was in relation to human health implications.

7.3.8 Should any Tier 1 criteria-in terms of human health, environment and groundwater be exceeded, then two courses of action are available. The first is to 'break' the pollutant linkage by recommending an appropriate level of remedial action – removal of

contaminated material for example. The alternative approach is to carry out a detailed risk assessment in order to determine whether contamination risks actually exist.

7.4 *Contamination Results*

7.4.1 The analytical results certificates are presented in Appendix B. Statistical analysis has been carried out on each sample as presented in Appendix C.

7.4.2 The preliminary screening process has been compared with the relevant SGV's and GAC's for a *residential* end land use, as the most suitable equivalent for the proposed development.

7.4.3 The *residential* development will be covered with associated hard standing and some landscaping/garden zones.

7.4.4 Several elevated US_{95} concentrations have been calculated for the following CLEA deteminands by the statistical analysis within the made ground material:

- Lead
- Benzo-a-pyrene [PAH]
- Dibenzo-ah-anthracene [PAH]
- Benzo-b-fluoranthene [PAH]
- Sulphate

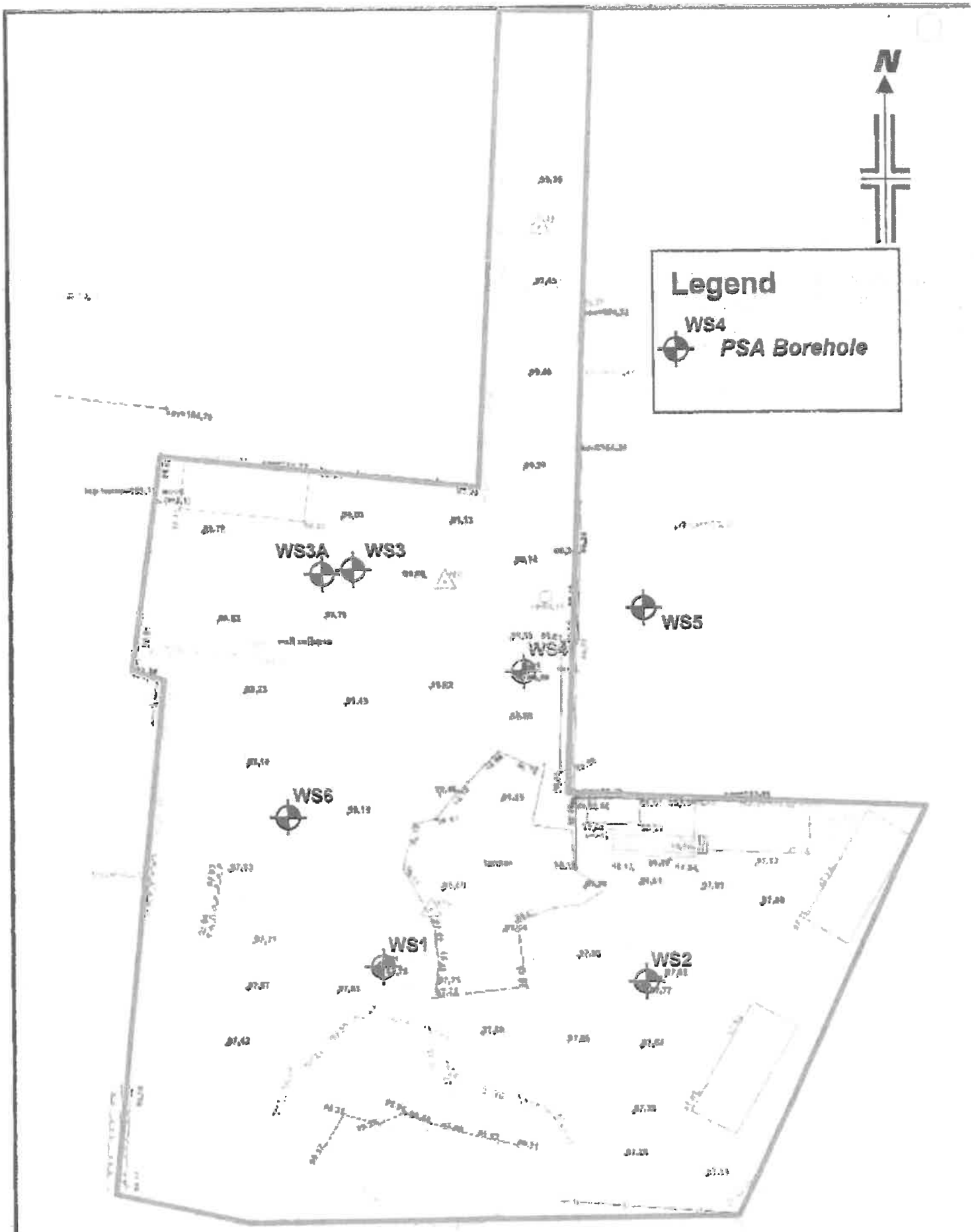
Raised levels of contamination were found within the various types of made ground across the site and at various depths. Slightly elevated levels of PAH were also found in the leachate test. The main contamination risk from hydrocarbons leaking from the tank appears not to have occurred, with testing across the site showing low values.

7.4.5 The chemical testing has confirmed that the *residential* development is at risk from significant contamination. The values would suggest that a suitable simple remediation strategy could be adopted to alleviate the risks.

7.4.6 No raised levels (compared to United Utilities trigger levels for ground surrounding water supply pipes on new developments) of hydrocarbons, VOC and SVOC, cresols and phenols prove that PE water supply pipes are suitable for the development.

Source	Pathway	Receptor	Consequence	Probability	Risk Classification	Remediation Measures
On-site historic sources of ground contamination arising from *infill materials*, including metalloids, PAHs, sulphates & asbestos	Inhalation, ingestion, skin contact	Re-development workers	medium	low	Moderate/low risk	*PPC required during ground-works.*
		End users-residents	medium	low	Moderate/low risk	*Remediation required. Options include either containment (by hard-standing barrier and/or removal of contaminated fill). In addition, effected garden areas will require remediation measures, either 600mm cover system &/or removal of contaminated soils.*
	Root Uptake	Landscaping Vegetation	minor	likely	Low risk	*Imported topsoil to be validated.*
	Groundwater	Chatburn Brook	medium	low	Moderate/low risk	*Due to the low testing levels for the leachate testing from the GI remediation is unlikely to be required.*
		Groundwater	mild	unlikely	Low risk	*Due to the low testing levels for the leachate testing from the GI remediation is unlikely to be required.*
	Direct Contact	Buildings and Services	medium	low	Moderate/low risk	*For utility pipes, no higher specification barrier pipe materials are required with PE OK according to UU guidelines. Upgraded concrete specification to AC-3 for foundations.*

Source	Pathway	Receptor	Consequence	Probability	Risk Classification	Remediation Measures
On & off-site sources of ground contamination (gas) arising from *landfill* (CO_2 and CH_4 gas).	Inhalation, ingestion, skin contact	Re-development workers	Severe	unlikely	Low/moderate risk	*Following 3 month gas monitoring and a risk analysis based on the site conceptual model, no gas protection measures will be required (methane & carbon dioxide) for the proposed new dwelling, however basic radon protection measures are required.*
		End users- residents	Severe	unlikely	Low/moderate risk	
	Direct Contact	Buildings and Services	Medium	unlikely	Low risk	



Base on Site Survey Services Drawing No. SSS6693.

PSA	PSA Design The Old Bank House 6 Berry Lane, Longridge Preston, PR3 3JA Tel. 01772 786066	Client	A Jackson	Scale	NTS		Dwg No. G2235-06
		Job	Downham Road, Chatburn	Drawn JSB	Check JSB	Appr JSB	Date 03-06-2016
		Title	Ground Investigation Plan				Rev

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Borehole No
WS1
Sheet 1 of 1

Project Name: Downham Road	Project No.: G2235	Co-ords: -	Hole Type: WS
Location: Chatburn		Level: -	Scale: 1:50
Client: Alan Jackson		Dates: 11/02/2016	Logged By: JSB

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.30-0.60	ES					MADE GROUND: Medium dense (Driller's description), dark brown-grey, slightly sandy, occasionally slightly clayey GRAVEL. Gravel is predominantly fine to coarse, occasionally cobble sized, sub-angular to angular composed of limestone, shale with rare tarmac, road planings, brick, concrete, coal, ash and clinker (Granular Fill). (MADE GROUND)
					1.00			MADE GROUND: Firm, grey brown, gravelly-very gravelly CLAY. Gravel is predominantly fine to coarse, sub-angular, comprised of limestone, brick and shale. (Cohesive Fill). (MADE GROUND)
					2.10			MADE GROUND: Medium dense (Driller's description), dark brown-grey, slightly sandy, occasionally slightly clayey GRAVEL. Gravel is predominantly fine to coarse, occasionally cobble sized, sub-angular to angular composed of limestone, shale and brick (Granular Fill). (MADE GROUND)
					3.20			MADE GROUND: Firm, occasionally soft, dark grey, gravelly-very gravelly CLAY. Gravel is predominantly fine to coarse, sub-angular, comprised of limestone shale. (Cohesive Fill). (MADE GROUND)
					3.40			Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragements. (possible weathered bedrock - Chatburn Limestone)
					3.45			Refusal of drilling (possible bedrock)
								End of Borehole at 3.45 m

Type | Results

Remarks: Premier Plant Hydraulic Compact Rubber Tracked Percussion Drilling Rig In-situ shear strength (IVN) in kPa, based on avg of 3 tests using Geonor H-60 Vane. 50mm HDPE Gas/Groundwater Standpipe Installation.

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Borehole No
WS2
Sheet 1 of 1

Project Name: Downham Road	Project No.: G2235	Co-ords: -	Hole Type: WS
Location: Chatburn		Level: -	Scale: 1:50
Client: Alan Jackson		Dates: 11/02/2016	Logged By: JSB

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.30-0.70	ES					MADE GROUND: Dense (Driller's description), dark brown-grey, slightly sandy, occasionally slightly clayey GRAVEL. Gravel is predominantly fine to cobble sized, sub-angular to angular composed of limestone, shale, road planings and rare brick, concrete, coal, ash and clinker (Granular Fill). (MADE GROUND)
					2.00			MADE GROUND: Soft-firm, grey brown, very gravelly CLAY. Gravel is predominantly fine to coarse, sub-angular, comprised of limestone and rare brick, pottery and shale. (Cohesive Fill). (MADE GROUND)
					3.10			MADE GROUND. Firm, occasionally soft, dark grey, gravelly-very gravelly CLAY. Gravel is predominantly fine to coarse, sub-angular, comprised of limestone shale. (Cohesive Fill). (MADE GROUND)
					3.30 3.35			Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragments. (possible weathered bedrock - Chatburn Limestone) Refusal of drilling (possible bedrock) End of Borehole at 3.35 m

Type | Results

Remarks: Premier Plant Hydraulic Compact Rubber Tracked Percussion Drilling Rig.In-situ shear strength (IVN) in kPa, based on avg of 3 tests using Geonor H-60 Vane. 50mm HDPE Gas/Groundwater Standpipe Installation.

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Borehole No
WS3
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Downham Road	G2235		WS
Location: Chatburn		Level: -	Scale 1:50
Client: Alan Jackson		Dates: 11/02/2016	Logged By JSB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.30	IVN	125	0.05			TOPSOIL:Turf over grey brown slightly organic CLAY with common fine rootlets. (TOPSOIL)
					0.50			Stiff, light brown, mottled grey, gravelly CLAY with fine rootlets. Gravel is fine to coarse, sub-angular, comprised of limestone & shale. (Glacial Till). (GLACIAL TILL)
					0.60			Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragements. (possible weathered bedrock - Chatburn Limestone). Refusal of drilling (possible bedrock). End of Borehole at 0.60 m

Type | Results

Remarks: Premier Plant Hydraulic Compact Rubber Tracked Percussion Drilling Rig.In-situ shear strength (IVN) in kPa, based on avg of 3 tests using Geonor H-60 Vane.

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Borehole No	Sheet
WS03A	1 of 1

Project Name	Project No.	Co-ords:	Hole Type
Downham Road	G2235	-	WS
Location: Chatburn		Level: -	Scale 1:50
Client: Alan Jackson		Dates: 11/02/2016	Logged By JSB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.30	IVN 1	128	0.08			TOPSOIL:Turf over grey brown slightly organic CLAY with common fine rootlets. (TOPSOIL)
					0.68			Stiff, light brown, mottled grey, gravelly CLAY with fine rootlets. Gravel is fine to coarse, sub-angular, comprised of limestone & shale. (Glacial Till). (GLACIAL TILL)
					1.10			Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragements. (possible weathered bedrock - Chatburn Limestone). Refusal of drilling (possible bedrock).
								End of Borehole at 1.10 m
			Type	Results				

Remarks: Premier Plant Hydraulic Compact Rubber Tracked Percussion Drilling Rig.In-situ shear strength (IVN) in kPa, based on avg of 3 tests using Geonor H-60 Vane.

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Borehole No
WS4
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Downham Road	G2235		WS
Location: Chatburn		Level: -	Scale 1:50
Client: Alan Jackson		Dates: 11/02/2016	Logged By JSB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.50-0.90	ES		0.20			MADE GROUND: Dense (Driller's description), dark brown-grey, slightly sandy GRAVEL. Gravel is predominantly fine to coarse, sub-angular to angular composed of limestone and road planings (Granular Fill). (MADE GROUND)
					0.80			MADE GROUND: Firm, grey brown, gravelly-very gravelly CLAY. Gravel is predominantly fine to coarse, sub-angular, comprised of limestone, brick and shale. (Cohesive Fill). (MADE GROUND)
					1.75			MADE GROUND: Soft-firm, occasionally stiff, grey brown, gravelly CLAY. Gravel is predominantly fine to coarse, sub-angular, comprised of limestone. (Cohesive Fill). (MADE GROUND)
					1.80			Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragements. (possible weathered bedrock - Chatburn Limestone). Refusal of drilling (possible bedrock)
								End of Borehole at 1.80 m

Type	Results

Remarks: Premier Plant Hydraulic Compact Rubber Tracked Percussion Drilling Rig.In-situ shear strength (IVN) in kPa, based on avg of 3 tests using Geonor H-60 Vane. 50mm HDPE Gas/Groundwater Standpipe Installation.

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Borehole No
WS5
Sheet 1 of 1

Project Name: Downham Road	Project No.: G2235	Co-ords: -	Hole Type: WS
Location: Chatburn		Level: -	Scale: 1:50
Client: Alan Jackson		Dates: 11/02/2016	Logged By: JSB

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.14			MADE GROUND: Weak, grey CONCRETE (Concrete Slab). (MADE GROUND)
		0.20-0.50	ES		0.50			MADE GROUND: Dense (Driller's description), dark brown-grey, slighty sandy GRAVEL. Gravel is predominantly fine to coarse, sub-angular to angular composed of limestone (Granular Fill). (MADE GROUND)
					0.60			Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragements. (possible weathered bedrock - Chatburn Limestone). Refusal of drilling (possible bedrock).
								End of Borehole at 0.60 m

Type	Results

Remarks: Premier Plant Hydraulic Compact Rubber Tracked Percussion Drilling Rig.In-situ shear strength (IVN) in kPa, based on avg of 3 tests using Geonor H-60 Vane.

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Borehole No
WS6
Sheet 1 of 1

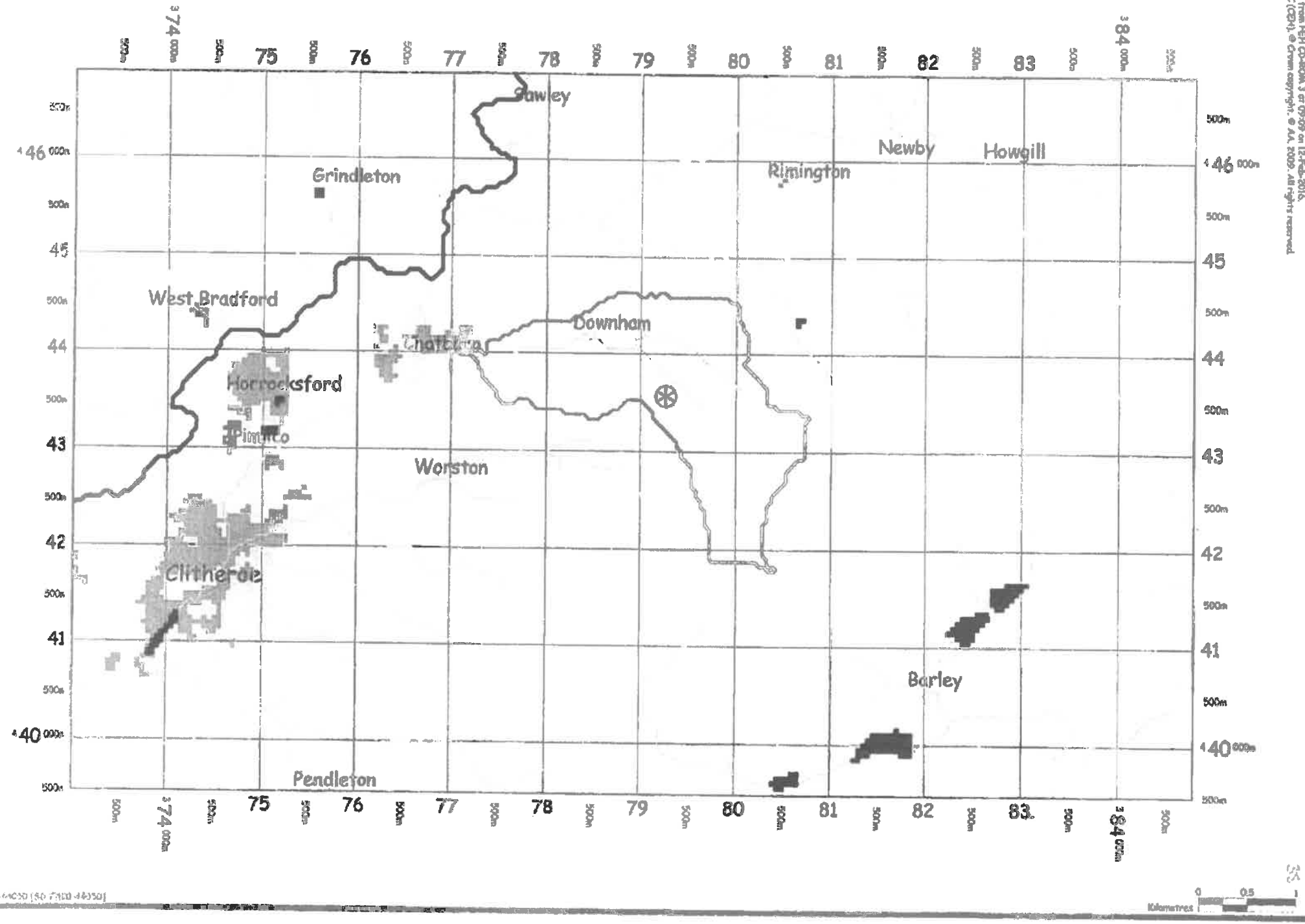
Project Name	Project No.	Co-ords: -	Hole Type
Downham Road	G2235		WS
Location: Chatburn		Level:	Scale 1:50
Client: Alan Jackson		Dates: 11/02/2016	Logged By JSB

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.30-0.60	ES		0.30			MADE GROUND: Dense (Driller's description), dark brown-grey, slightly sandy, occasionally slightly clayey GRAVEL. Gravel is predominantly fine to cobble sized, sub-angular to angular composed of limestone, shale, road planings and rare brick, concrete, coal, ash and clinker (Granular Fill). (MADE GROUND)
					1.50			MADE GROUND: Firm, grey brown, gravelly-very gravelly CLAY. Gravel is predominantly fine to coarse, sub-angular, comprised of limestone, brick and shale. (Cohesive Fill). (MADE GROUND)
					2.35			MADE GROUND: Medium dense (Driller's description), dark grey, slightly clayey GRAVEL. Gravel is predominantly fine to coarse, occasionally cobble sized, sub-angular to angular, composed of limestone (Granular Fill). (MADE GROUND)
					2.40			Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragements. (possible weathered bedrock - Chatburn Limestone). Refusal of drilling (possible bedrock).
								End of Borehole at 2.40 m

Type	Results

Remarks: Premier Plant Hydraulic Compact Rubber Tracked Percussion Drilling Rig.In-situ shear strength (IVN) in kPa, based on avg of 3 tests using Geonor H-60 Vane.

AGS



VERSION	FEH CD-R Version	3	exported at	09:09:00	GMT	Fri	12-Feb-16
CATCHMENT	GB	377100	444050	SD 77100 44050			
AREA	4.39						
ALTBAR	214						
ASPBAR	331						
ASPVAR	0.52						
BFIHOST	0.357						
DPLBAR	2.92						
DPSBAR	117.2						
FARL	1						
LDP	5.61						
PROPWET	0.6						
RMED-1H	10.9						
RMED-1D	44						
RMED-2D	59.1						
SAAR	1267						
SAAR4170	1279						
SPRHOST	41.19						
URBCONC1990	-999999						
URBEXT1990	0.0005						
URBLOC1990	-999999						
URBCONC2000	0.429						
URBEXT2000	0.0069						
URBLOC2000	0.492						
C	-0.026						
D1	0.42685						
D2	0.36255						
D3	0.4197						
E	0.30324						
F	2.47855						
C(1 km)	-0.026						
D1(1 km)	0.429						
D2(1 km)	0.368						
D3(1 km)	0.439						
E(1 km)	0.302						
F(1 km)	2.483						

VERSION	FEH CD-R Version		3	exported a	09:10:08	GMT	Fri	12-Feb-16		B1852
Parameters				Chatburn area				mal		
Calculation	Design rainfall			Point rainfall depths unadjusted						
Calculation	For a point									
Calculation	1 km point GS		377000	444000	SD 77000	44000				
Duration=	6	1	(hours)							
Fixed dura	no									
Return per	100.	1	(years)							
Annual ma	yes									

c	d1	d2	d3	e	f
-0.026	0.429	0.368	0.439	0.302	2.463

A design rainfall of 82.6 mm was calculated.
No warning(s) or note(s) were present for this calculation.
The data in the following table have been computed using sliding durations.

Duration minutes	Duration hours	Duration days	10 year rainfa mm	20 year rainfa mm	50 year rainfa mm	100 year rainfa mm	200 year rainfa mm	500 year rainfall mm
15	0.25	0.010417	13.86	17.68	24.22	30.67	38.8	52.92
30	0.5	0.020833	17.82	22.56	30.4	38.01	47.49	63.7
45	0.75	0.03125	20.62	26.02	34.71	43.09	53.44	70.99
60	1	0.041667	23.16	28.79	38.14	47.1	58.11	76.67
75	1.25	0.052083	25.16	31.14	41.04	50.47	62.01	81.39
90	1.5	0.0625	26.92	33.2	43.56	53.39	65.4	85.45
105	1.75	0.072917	28.5	35.05	45.82	56	68.4	89.05
120	2	0.083333	29.95	36.74	47.87	58.36	71.11	92.29
135	2.25	0.09375	31.28	38.29	49.75	60.53	73.59	95.24
150	2.5	0.104167	32.53	39.74	51.5	62.54	75.89	97.96
165	2.75	0.114583	33.7	41.09	53.13	64.41	78.02	100.49
180	3	0.125	34.8	42.37	54.67	66.16	80.03	102.86
195	3.25	0.135417	35.85	43.58	56.12	67.82	81.92	105.08
210	3.5	0.145833	36.85	44.73	57.5	69.4	83.7	107.19
225	3.75	0.15625	37.8	45.83	58.81	70.89	85.4	109.18
240	4	0.166667	38.71	46.88	60.07	72.32	87.02	111.08
255	4.25	0.177083	39.59	47.89	61.27	73.69	88.57	112.9
270	4.5	0.1875	40.44	48.87	62.43	75.01	90.06	114.64
285	4.75	0.197917	41.26	49.8	63.55	76.27	91.49	116.31
300	5	0.208333	42.05	50.71	64.62	77.49	92.87	117.91
315	5.25	0.21875	42.82	51.59	65.65	78.67	94.2	119.46
330	5.5	0.229167	43.56	52.44	66.67	79.81	95.48	120.96
345	5.75	0.239583	44.29	53.27	67.65	80.92	96.73	122.4
360	6	0.25	44.99	54.07	68.6	81.99	97.93	123.81
375	6.25	0.260417	45.68	54.86	69.52	83.03	99.11	125.16
390	6.5	0.270833	46.34	55.61	70.42	84.05	100.24	126.48
405	6.75	0.28125	47	56.36	71.3	85.03	101.35	127.77
420	7	0.291667	47.63	57.08	72.15	86	102.43	129.02
435	7.25	0.302083	48.26	57.79	72.99	86.93	103.48	130.23
450	7.5	0.3125	48.87	58.49	73.8	87.85	104.51	131.42
465	7.75	0.322917	49.48	59.18	74.6	88.75	105.51	132.58
480	8	0.333333	50.05	59.83	75.38	89.62	106.49	133.71
495	8.25	0.34375	50.62	60.48	76.14	90.48	107.45	134.81
510	8.5	0.354167	51.19	61.12	76.89	91.32	108.39	135.89
525	8.75	0.364583	51.74	61.75	77.62	92.14	109.31	136.95
540	9	0.375	52.28	62.36	78.34	92.95	110.21	137.99
555	9.25	0.385417	52.82	62.96	79.05	93.74	111.1	139
570	9.5	0.395833	53.34	63.56	79.74	94.52	111.98	140
585	9.75	0.40625	53.86	64.14	80.42	95.28	112.81	140.97
600	10	0.416667	54.36	64.71	81.09	96.03	113.65	141.93
615	10.25	0.427083	54.86	65.28	81.75	96.77	114.47	142.87
630	10.5	0.4375	55.36	65.84	82.4	97.49	115.27	143.79
645	10.75	0.447917	55.84	66.38	83.04	98.2	116.07	144.7
660	11	0.458333	56.32	66.92	83.66	98.9	116.86	145.59
675	11.25	0.46875	56.79	67.45	84.28	99.59	117.61	146.47
690	11.5	0.479167	57.25	67.96	84.89	100.27	118.37	147.33
705	11.75	0.489583	57.71	68.49	85.49	100.94	119.11	148.18
720	12	0.5	58.16	69	86.08	101.6	119.85	149.02
735	12.25	0.510417	58.59	69.44	86.59	102.17	120.47	149.72
750	12.5	0.520833	58.95	69.88	87.1	102.72	121.08	150.41
765	12.75	0.53125	59.34	70.31	87.59	103.27	121.68	151.08
780	13	0.541667	59.72	70.74	88.08	103.81	122.27	151.75
795	13.25	0.552083	60.09	71.16	88.56	104.34	122.86	152.4
810	13.5	0.5625	60.46	71.57	89.04	104.87	123.43	153.05
825	13.75	0.572917	60.83	71.98	89.51	105.38	124	153.68
840	14	0.583333	61.19	72.39	89.97	105.89	124.56	154.31
855	14.25	0.59375	61.55	72.79	90.43	106.4	125.11	154.93
870	14.5	0.604167	61.9	73.18	90.88	106.9	125.66	155.55
885	14.75	0.614583	62.25	73.57	91.33	107.39	126.2	156.15

Revitalised FSR/FEH rainfall runoff method

Spreadsheet application report

User name	mikel	**Catchment name**		**Date/time modelled**	29-Jun-2016 12:11
Company name	mls	**Catchment easting**	377100	**Version**	1.4
Project name	chatburn brook	**Catchment northing**	444050		
		Catchment area	4.99		

Summary of model setup

Design rainfall parameters		Loss model parameters		Routing model parameters		Baseflow model parameters	
Return period (yr)	100	**C_{max} (mm)**	254	**T_p (hr)**	1.36	**BL (hr)**	25.7
Duration (hr)	3.1	**C_{ini} (mm)**	138	**U_p**	0.65	**BR**	1.03
Timestep (hr)	0.1	**α factor**	0.83	**U_k**	0.8	**BF_0 (m^3/s)**	0.4
Season	Winter						

Summary of results

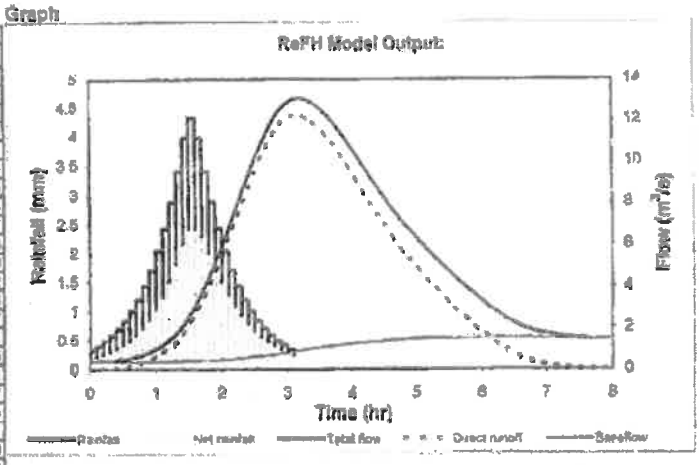
FEH DDF rainfall (mm)	68.1	**Peak rainfall (mm)**	4.9
Design rainfall (mm)	51.1	**Peak flow (m^3/s)**	13.1

1 in 100 yr flow 13.1 m^3/sec

Results

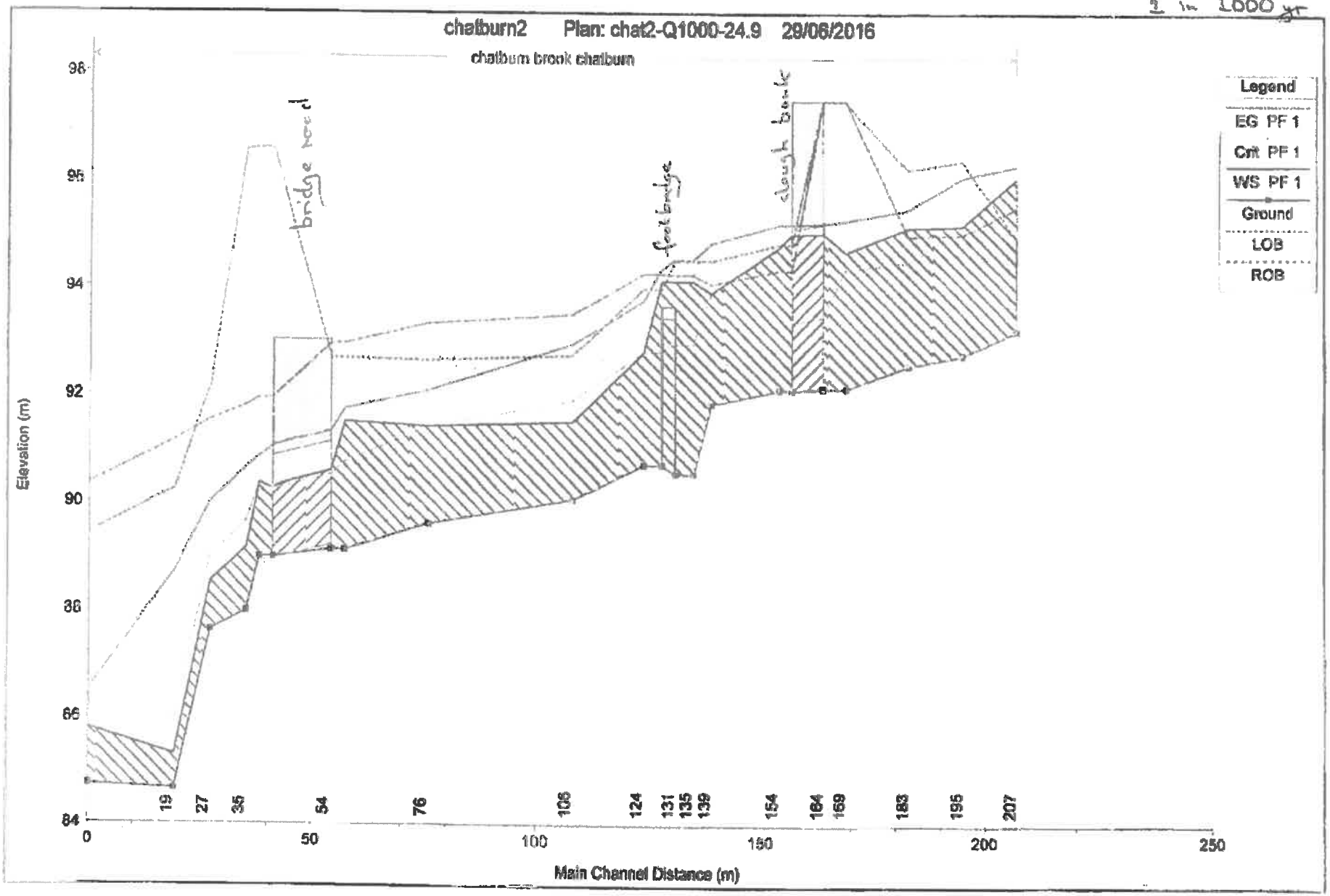
Series	Design rainfall	Net rainfall	Direct runoff	Baseflow	Total flow
Unit	mm	mm	m^3/s	m^3/s	m^3/s
0.0	0.3	0.2	0.0	0.4	0.4
0.1	0.4	0.2	0.0	0.4	0.4
0.2	0.5	0.2	0.0	0.4	0.4
0.3	0.6	0.3	0.0	0.4	0.4
0.4	0.7	0.3	0.1	0.4	0.4
0.5	0.8	0.4	0.1	0.4	0.5
0.6	1.0	0.5	0.2	0.4	0.5
0.7	1.2	0.6	0.2	0.4	0.6
0.8	1.4	0.7	0.3	0.4	0.7
0.9	1.7	0.8	0.5	0.4	0.8
1.0	2.0	1.0	0.6	0.4	1.0
1.1	2.4	1.2	0.8	0.4	1.2
1.2	2.9	1.5	1.0	0.4	1.4
1.3	3.4	1.8	1.3	0.4	1.7
1.4	4.0	2.1	1.7	0.4	2.1
1.5	4.3	2.4	2.2	0.4	2.5
1.6	4.0	2.3	2.7	0.4	3.1
1.7	3.4	2.0	3.3	0.4	3.7
1.8	2.9	1.7	4.0	0.4	4.4
1.9	2.4	1.5	4.7	0.4	5.1
2.0	2.0	1.3	5.5	0.4	5.9
2.1	1.7	1.1	6.3	0.6	6.8
2.2	1.4	0.9	7.1	0.5	7.6
2.3	1.2	0.8	7.9	0.5	8.5
2.4	1.0	0.6	8.7	0.6	9.3
2.5	0.8	0.5	9.5	0.6	10.1
2.6	0.7	0.4	10.2	0.6	10.8
2.7	0.6	0.4	10.9	0.7	11.5
2.8	0.5	0.3	11.4	0.7	12.1
2.9	0.4	0.3	11.8	0.7	12.5
3.0	0.3	0.2	12.1	0.8	12.9
3.1	0.0	0.0	12.2	0.8	13.0
3.2	0.0	0.0	12.2	0.9	13.1
3.3	0.0	0.0	12.1	0.9	13.0
3.4	0.0	0.0	11.9	1.0	12.8
3.5	0.0	0.0	11.8	1.0	12.6
3.6	0.0	0.0	11.2	1.0	12.3
3.7	0.0	0.0	10.8	1.1	11.9
3.8	0.0	0.0	10.4	1.1	11.5
3.9	0.0	0.0	9.9	1.2	11.1
4.0	0.0	0.0	9.4	1.2	10.6
4.1	0.0	0.0	8.9	1.2	10.1
4.2	0.0	0.0	8.4	1.3	9.6
4.3	0.0	0.0	7.9	1.3	9.2
4.4	0.0	0.0	7.4	1.3	8.7
4.5	0.0	0.0	6.9	1.3	8.3
4.6	0.0	0.0	6.6	1.4	7.8
4.7	0.0	0.0	6.1	1.4	7.4
4.8	0.0	0.0	5.7	1.4	7.1
4.9	0.0	0.0	5.3	1.4	6.7
5.0	0.0	0.0	4.9	1.4	6.3
5.1	0.0	0.0	4.6	1.4	6.0
5.2	0.0	0.0	4.2	1.4	5.7
5.3	0.0	0.0	3.9	1.5	5.3
5.4	0.0	0.0	3.6	1.5	5.0
5.5	0.0	0.0	3.2	1.5	4.7
5.6	0.0	0.0	2.9	1.5	4.4
5.7	0.0	0.0	2.6	1.5	4.1
5.8	0.0	0.0	2.4	1.5	3.9
5.9	0.0	0.0	2.1	1.5	3.6
6.0	0.0	0.0	1.8	1.5	3.3
6.1	0.0	0.0	1.6	1.5	3.1
6.2	0.0	0.0	1.3	1.5	2.8
6.3	0.0	0.0	1.1	1.5	2.6
6.4	0.0	0.0	0.9	1.5	2.4
6.5	0.0	0.0	0.7	1.5	2.2
6.6	0.0	0.0	0.6	1.5	2.1
6.7	0.0	0.0	0.5	1.5	2.0
6.8	0.0	0.0	0.4	1.5	1.9
6.9	0.0	0.0	0.3	1.5	1.8
7.0	0.0	0.0	0.2	1.5	1.7
7.1	0.0	0.0	0.2	1.5	1.6
7.2	0.0	0.0	0.1	1.5	1.6
7.3	0.0	0.0	0.1	1.5	1.5
7.4	0.0	0.0	0.1	1.5	1.5
7.5	0.0	0.0	0.0	1.4	1.5

Graph



Q1000 24.9 Growth factor 1.9

1 in 1000 yr


chatburn2 Plan: chat2-Q1000-24.9 29/06/2016
chatburn brook chatburn
bridge road
footbridge
slough bank
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
LOB
ROB
Elevation (m)
98
96
94
92
90
88
86
84
19
27
35
54
76
106
124
131
135
139
154
164
169
183
195
207
0
50
100
150
200
250
Main Channel Distance (m)

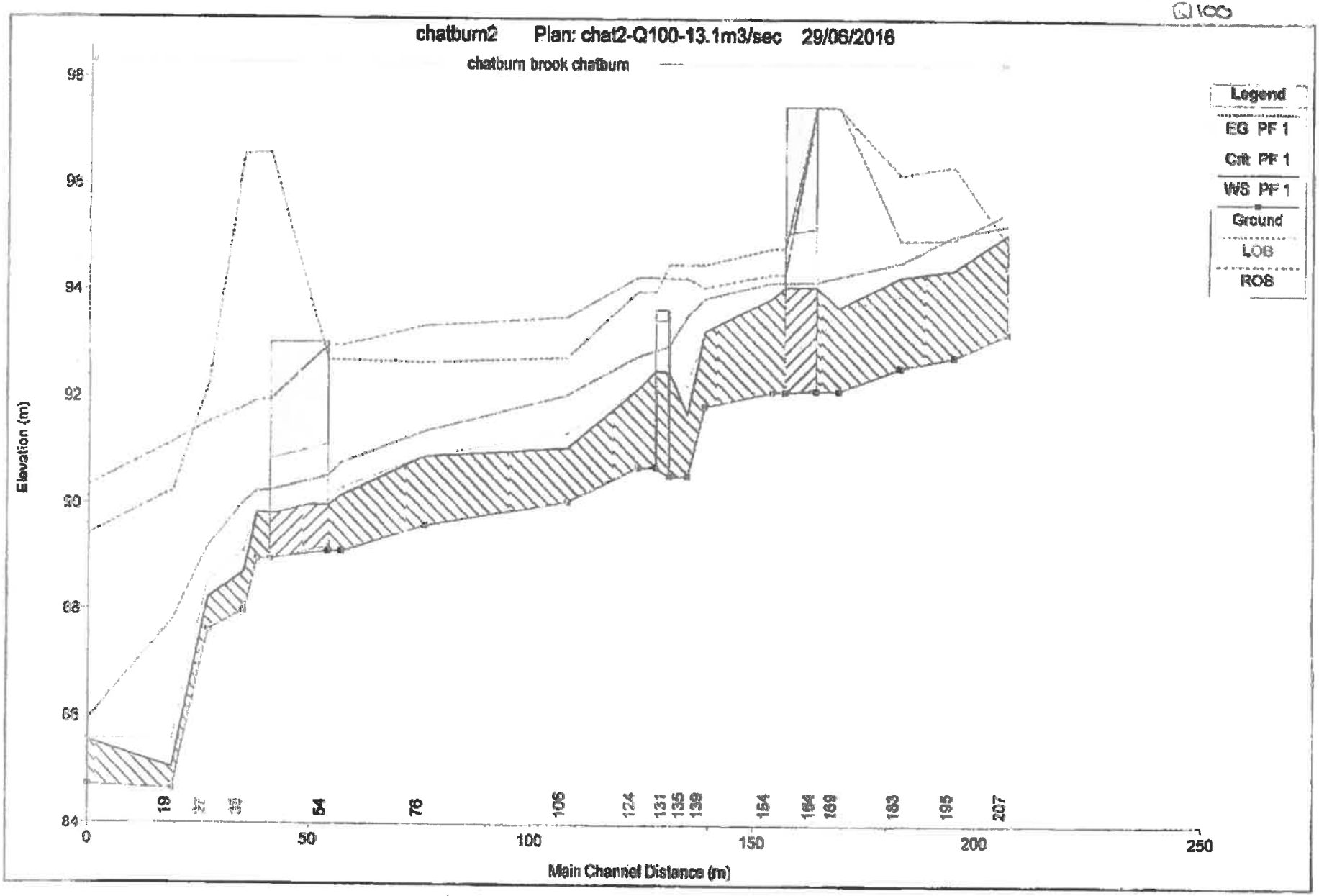
HEC-RAS Plan: p02 River: chatburn brook Reach: chatburn Profile: PF 1

1 in 1000 year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
chatburn	207	PF 1 13	24.900	93.210	96.040	95.03	96.26	0.005	2.08	11.96	5.13	0.43
chatburn	195	PF 1 12	24.900	92.770	95.163	95.16	96.06	0.034	4.20	5.93	3.31	1.00
chatburn	183	PF 1 11	24.900	92.580	95.132	94.50	95.47	0.009	2.59	9.62	5.13	0.60
chatburn	169	PF 1 10	24.900	92.140	94.670	94.37	95.27	0.019	3.43	7.27	3.86	0.80
chatburn	164		Culvert									
chatburn	154	PF 1 9	24.900	92.120	94.760		95.19	0.013	2.91	8.55	3.59	0.60
chatburn	139	PF 1 8	24.900	91.850	93.904	93.90	94.84	0.035	4.29	5.81	3.14	1.01
chatburn	135	PF 1 7a	24.900	90.550	94.122	92.98	94.54	0.013	2.85	8.74	2.85	0.52
chatburn	131		Bridge									
chatburn	124	PF 1 7	24.900	90.710	92.817	92.82	93.75	0.034	4.28	5.81	3.14	1.01
chatburn	106	PF 1 6a	24.900	90.060	91.504	91.91	92.95	0.060	5.35	4.66	3.85	1.55
chatburn	76	PF 1 6	24.900	89.600	91.414	91.41	92.09	0.023	3.64	6.84	5.12	1.01
chatburn	57	PF 1 5	24.900	89.110	91.501	90.75	91.74	0.006	2.18	11.41	5.76	0.50
chatburn	54		Culvert									
chatburn	38	PF 1 4	24.900	88.980	90.360	90.36	90.84	0.022	3.08	8.09	8.38	1.00
chatburn	35	PF 1 3a	24.900	87.970	89.149	89.64	90.83	0.074	5.40	4.61	5.25	1.84
chatburn	27	PF 1 3	24.900	87.620	88.520	88.99	90.01	0.062	5.41	4.60	5.80	1.34
chatburn	19	PF 1 2	24.900	84.650	85.293	85.98	88.71	0.284	8.19	3.04	5.33	3.46
chatburn	0	PF 1 1	24.900	84.730	85.768	85.96	86.51	0.033	3.77	6.60	7.67	1.30

site 97-5

Q100


chatburn2 Plan: chat2-Q100-13.1m3/sec 29/06/2016
chatburn brook chatburn
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
LOB
ROB
Elevation (m)
98
96
94
92
90
88
86
84
19
54
76
105
124
131
135
139
154
164
169
183
195
207
0
50
100
150
200
250
Main Channel Distance (m)

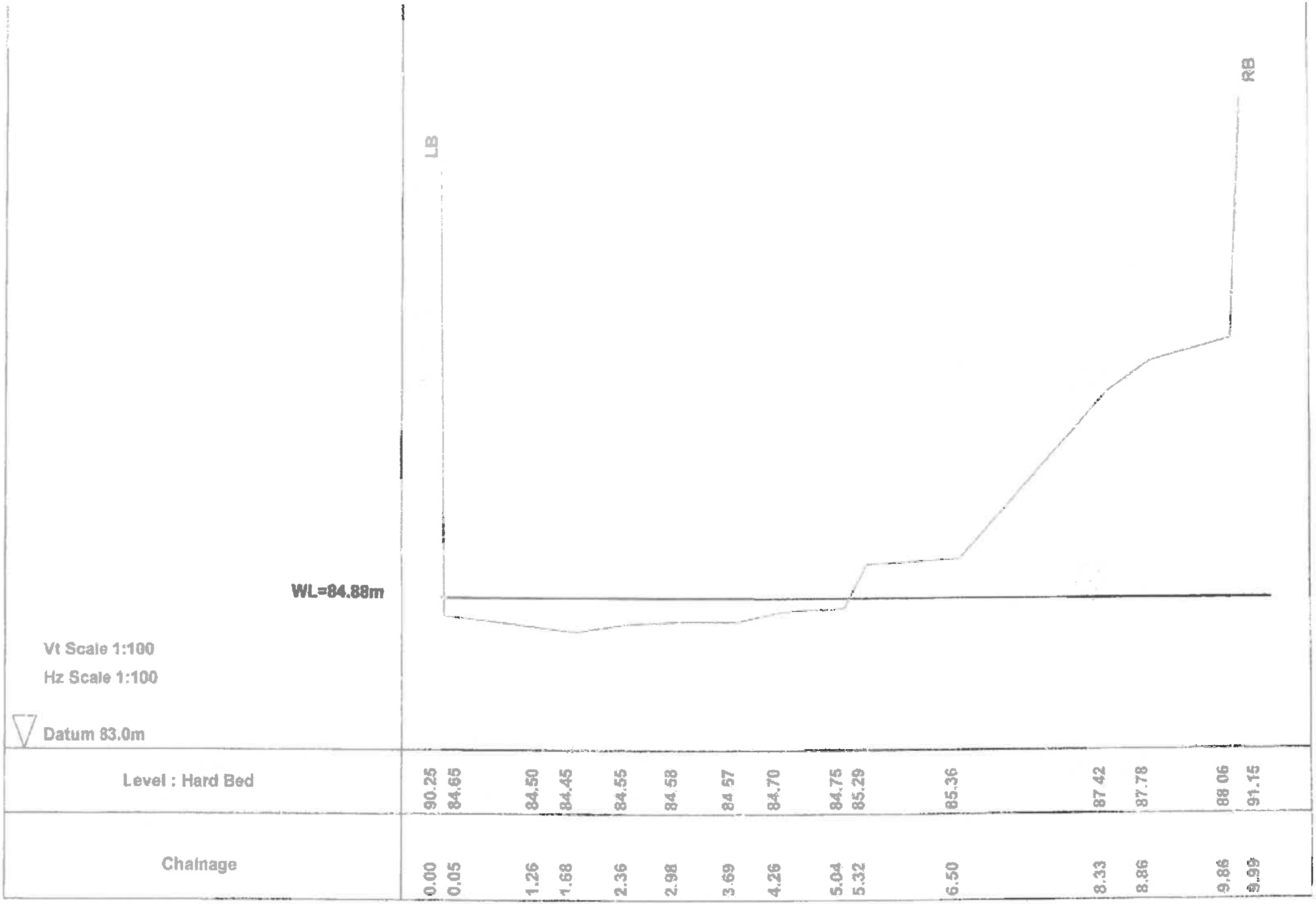
water levels ↓

1 in 100 year

HEC-RAS Plan: p01 River: chatburn brook Reach: chatburn Profile: PF 1

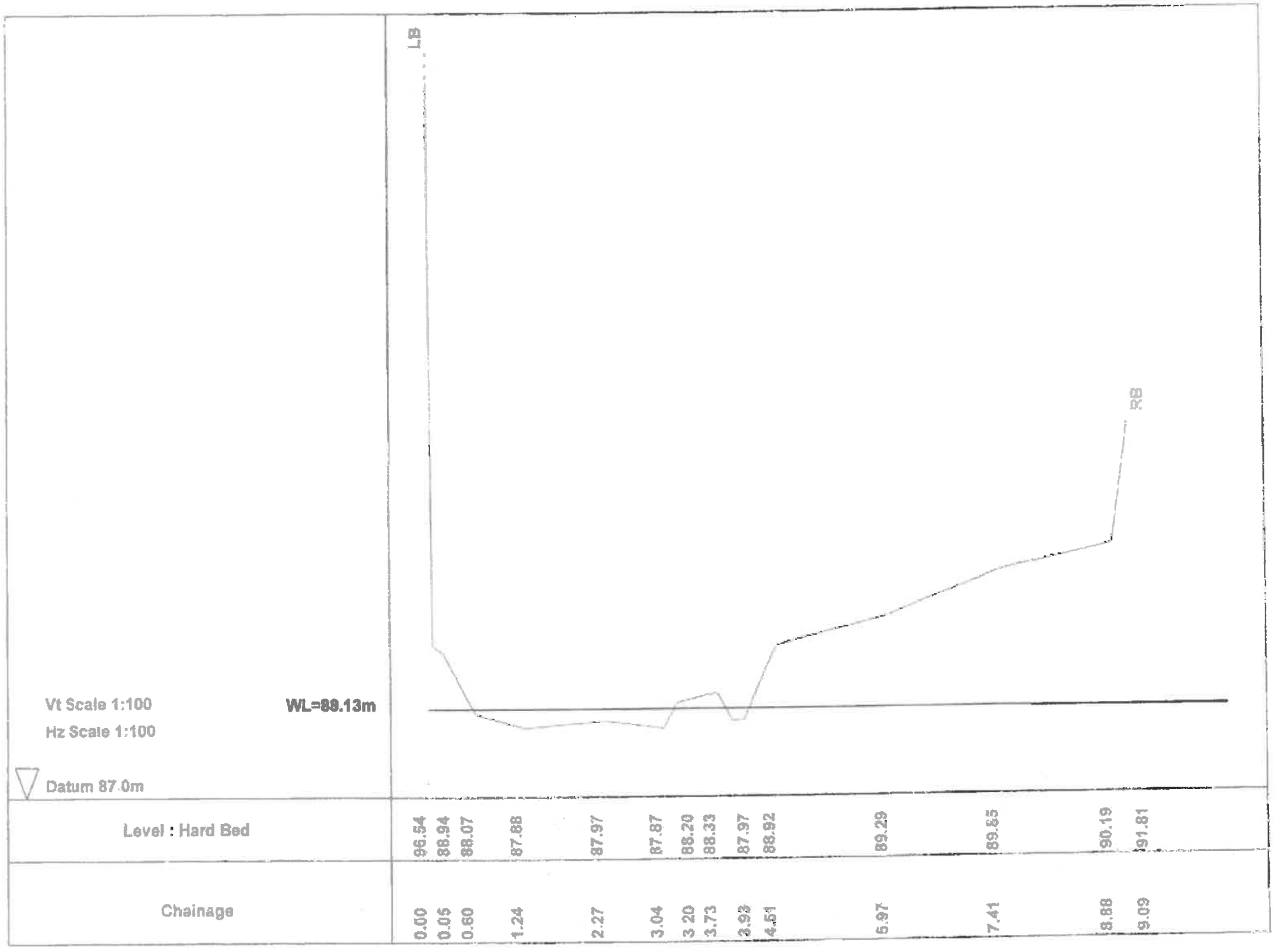
Reach	River Sta	Profile		Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		
chatburn	207	PF 1	13	13.100	93.210	95.096	94.45	95.27	0.006	1.83	7.15	5.07	0.49	site 97 S
chatburn	195	PF 1	12	13.100	92.770	94.422	94.42	95.07	0.033	3.56	3.66	2.81	1.00	
chatburn	183	PF 1	11	13.100	92.580	94.278	93.92	94.56	0.011	2.34	5.59	4.30	0.66	
chatburn	169	PF 1	10	13.100	92.140	93.689	93.69	94.29	0.028	3.44	3.81	3.18	1.00	
chatburn	164			Culvert		clough bank								
chatburn	154	PF 1	9	13.100	92.120	93.865		94.17	0.012	2.44	5.36	3.52	0.63	
chatburn	139	PF 1	8	13.100	91.850	93.241	93.24	93.66	0.031	3.48	3.76	3.05	1.00	
chatburn	135	PF 1	7a	13.100	90.550	91.707	92.24	93.52	0.121	5.97	2.20	2.57	2.06	
chatburn	131			Bridge		footbridge								
chatburn	124	PF 1	7	13.100	90.710	92.161	92.16	92.78	0.030	3.48	3.77	3.09	1.00	
chatburn	106	PF 1	6a	13.100	90.080	91.063	91.35	92.05	0.066	4.41	2.97	3.81	1.60	
chatburn	76	PF 1	6	13.100	89.600	90.905	90.90	91.37	0.023	3.03	4.33	4.72	1.01	
chatburn	57	PF 1	5	13.100	89.110	90.167	90.32	90.78	0.042	3.46	3.78	5.68	1.35	
chatburn	54			Culvert		bridge rd								
chatburn	38	PF 1	4	13.100	88.960	89.846	89.85	90.25	0.023	2.82	4.65	5.81	1.01	
chatburn	35	PF 1	3a	13.100	87.970	88.704	89.12	90.03	0.100	5.10	2.57	4.18	2.09	
chatburn	27	PF 1	3	13.100	87.620	88.234	88.53	89.21	0.061	4.37	3.00	5.41	1.87	
chatburn	19	PF 1	2	13.100	84.650	85.053	85.58	87.79	0.407	7.33	1.79	5.15	3.97	
chatburn	0	PF 1	1	13.100	84.730	85.550	85.58	85.93	0.023	2.72	4.62	7.28	1.07	

CS01
Chainage
Level : Hard Bed
Datum 84.0m
Vt Scale 1:100
Hz Scale 1:100
WL=84.74m
LB
RB
0.00 89.42
0.41 86.36
0.62 86.20
0.99 84.93
1.65 84.67
2.27 84.59
2.82 84.61
4.04 84.61
5.08 84.71
5.93 84.67
6.96 84.73
9.68 86.91
10.28 87.05
10.34 90.35

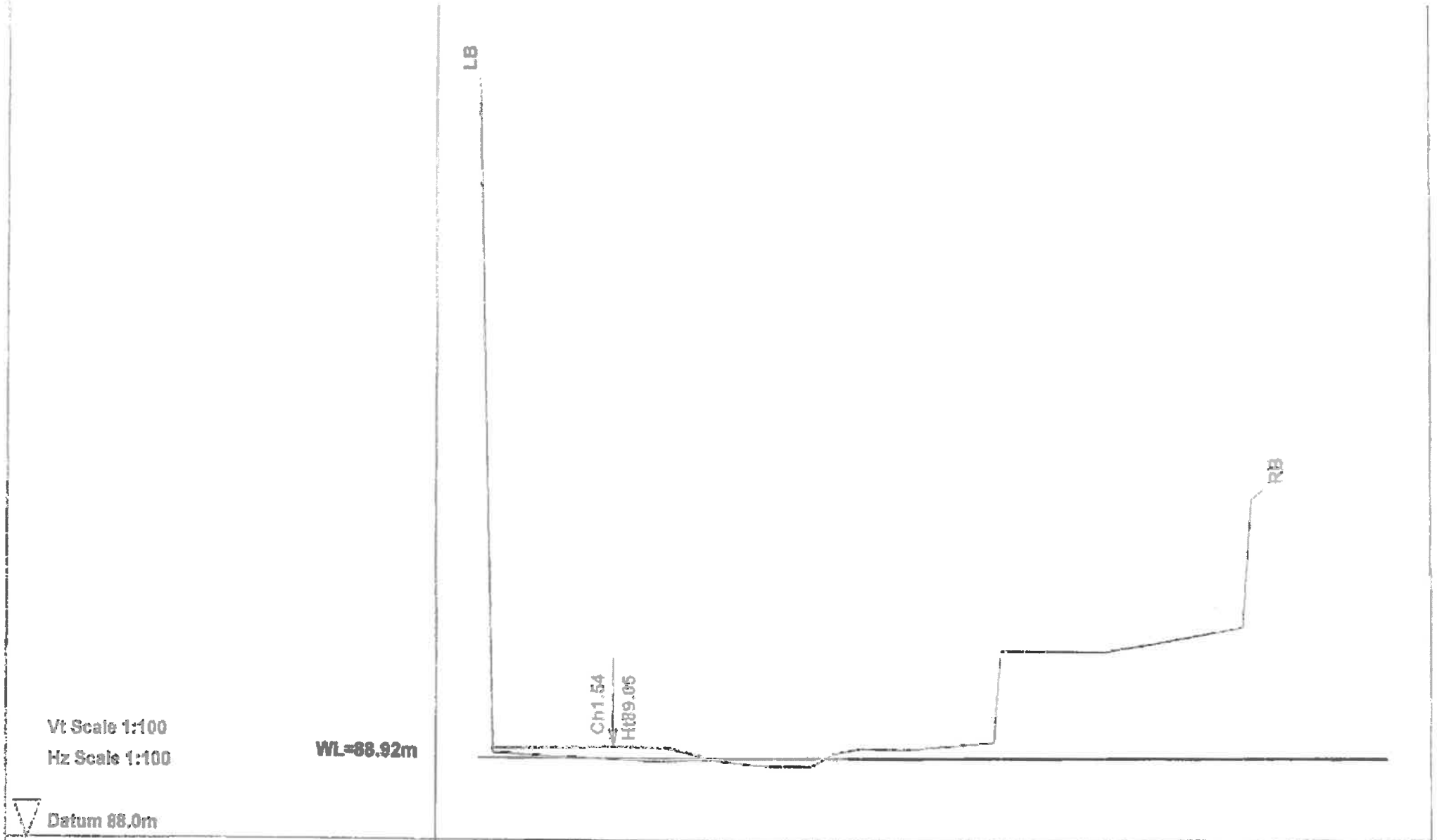

LB
RB
WL=84.88m
Vt Scale 1:100
Hz Scale 1:100
Datum 83.0m
Level : Hard Bed
90.25 84.65 84.50 84.45 84.55 84.58 84.57 84.70 84.75 85.29 85.36 87.42 87.78 88.06 91.15
Chainage
0.00 0.05 1.26 1.68 2.36 2.98 3.69 4.26 5.04 5.32 6.50 8.33 8.86 9.86 9.99

CS02

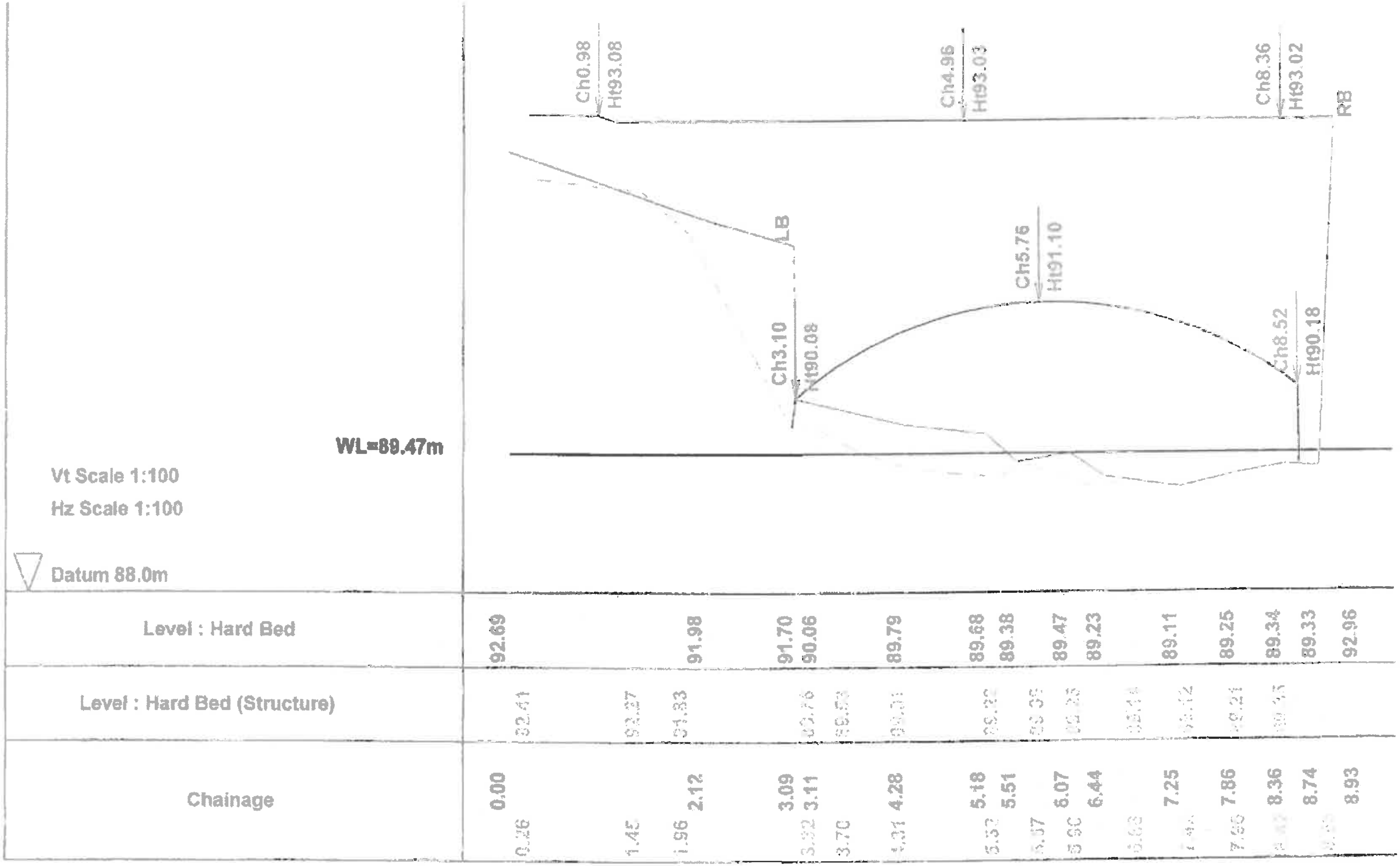
CS03
Chainage
Level : Hard Bad
Datum 86.0m
Vt Scale 1:100
Hz Scale 1:100
WL=87.62m
LB
RB
Ch0.34
H187.65
Ch2.73
H187.72
Ch4.12
H187.81
0.00 92.21
0.02 87.62
0.64 87.60
1.32 87.58
1.86 87.51
2.40 87.50
3.13 87.53
3.53 87.49
3.58 87.58
4.64 87.65
5.33 88.11
6.34 88.91
8.50 89.52
9.47 89.87
9.62 91.63



Level : Hard Bed	96.54	88.94	88.07	87.88	87.97	87.87	88.20	88.33	87.97	88.92	89.29	89.85	90.19	91.81
Chainage	0.00	0.05	0.80	1.24	2.27	3.04	3.20	3.73	3.93	4.51	5.97	7.41	8.88	9.09


LB
RB
Ch1.54
Ht89.05
Vt Scale 1:100
Hz Scale 1:100
WL=88.92m
Datum 88.0m
Level : Hard Bed
96.57 88.98 88.92 88.89 88.90 88.85 88.84 88.84 88.96 89.03 89.02 89.10 90.13 90.12 90.40 91.94
Chainage
0.00 0.16 1.31 2.05 2.63 3.12 3.47 3.80 4.03 4.36 4.84 5.89 5.97 7.17 8.73 8.98

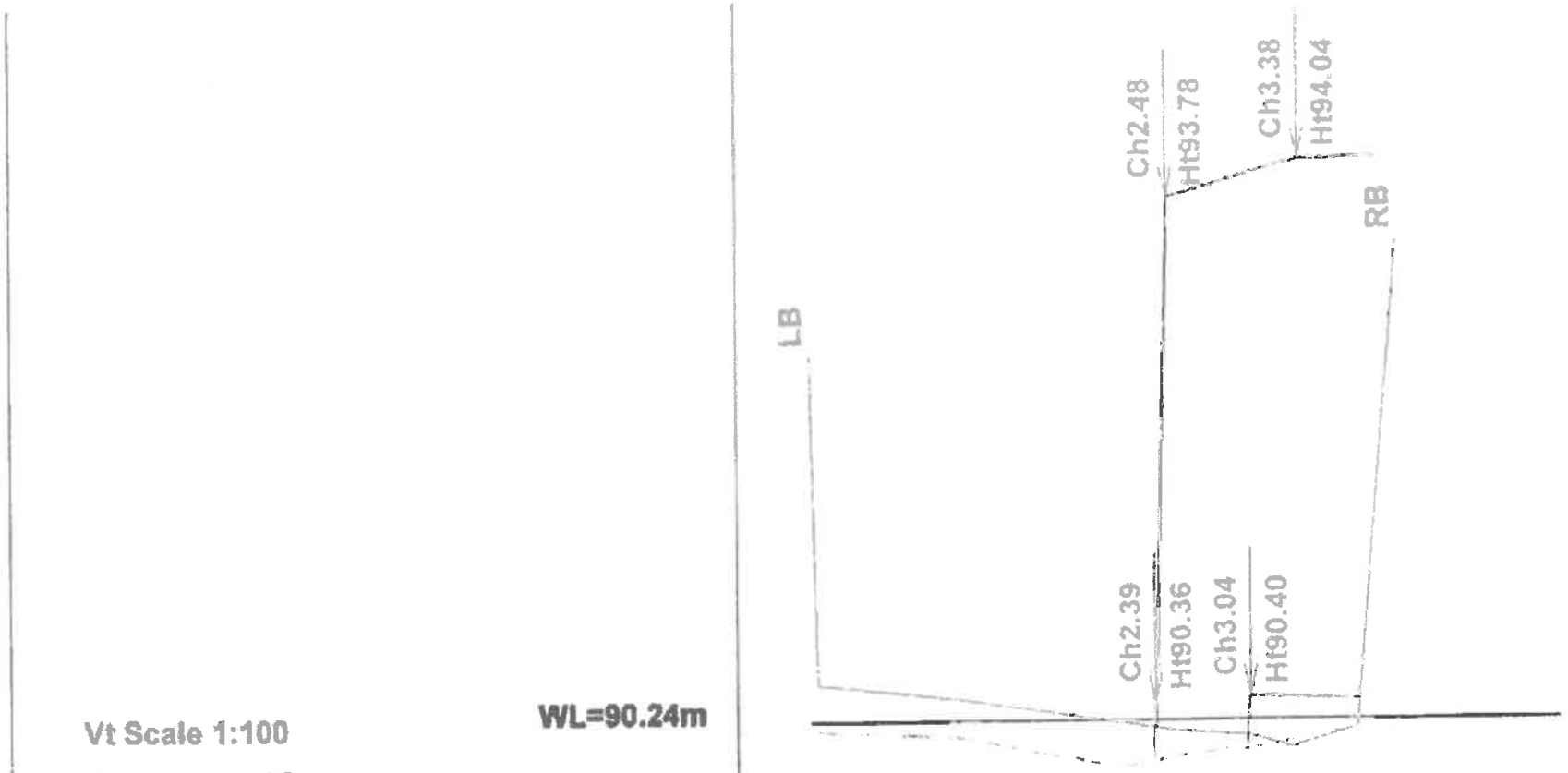
CS04

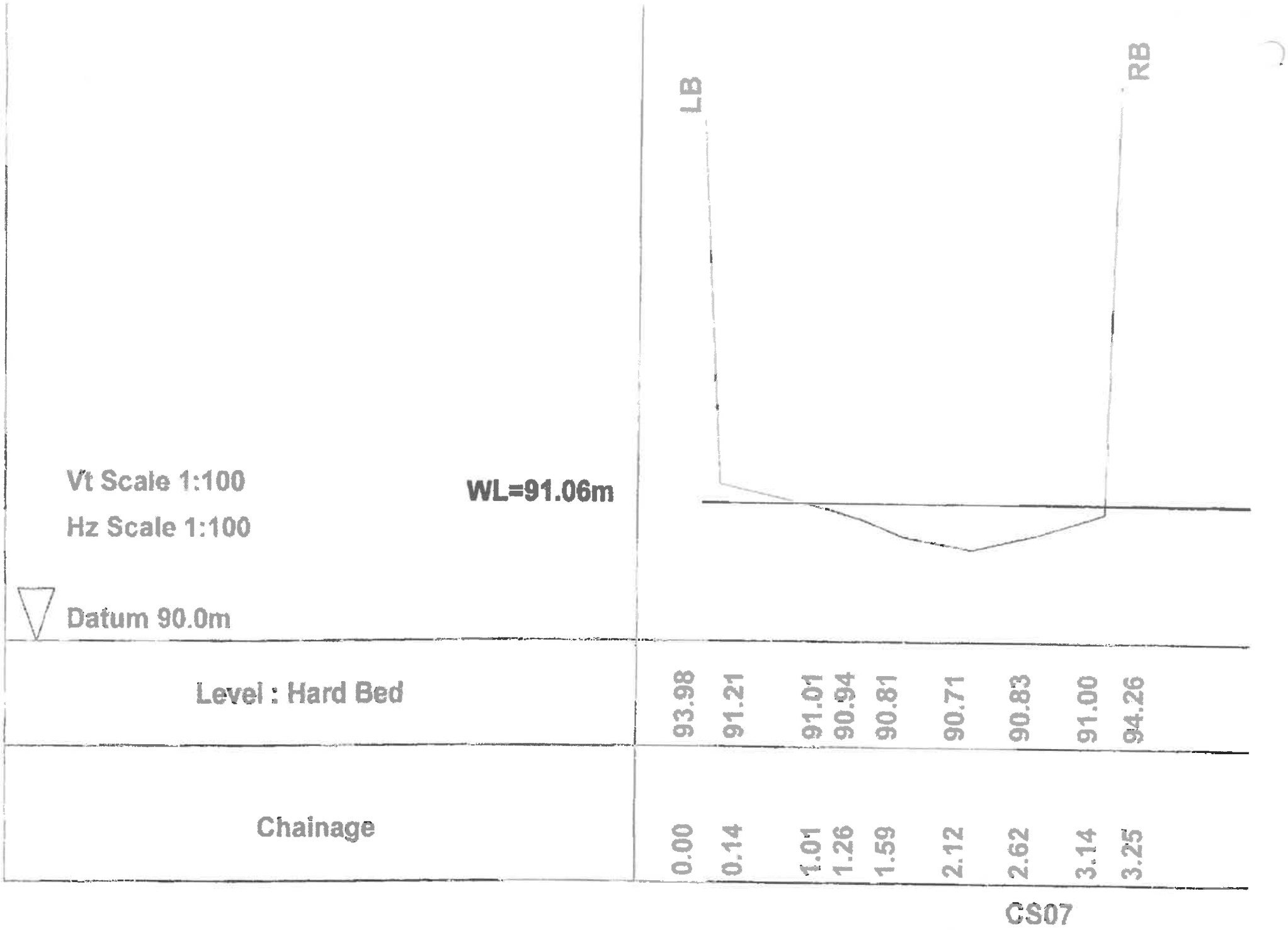

Ch0.98
Ht93.08
Ch4.96
Ht93.03
Ch8.36
Ht93.02
RB
LB
Ch5.76
Ht91.10
Ch3.10
Ht90.08
Ch8.52
Ht90.18
WL=89.47m
Vt Scale 1:100
Hz Scale 1:100
Datum 88.0m
Level : Hard Bed
92.69 91.98 91.70 90.06 89.79 89.68 89.38 89.47 89.23 89.11 89.25 89.34 89.33 92.96
Level : Hard Bed (Structure)
Chainage
0.00 2.12 3.09 3.11 4.28 5.18 5.51 6.07 6.44 7.25 7.86 8.36 8.74 8.93

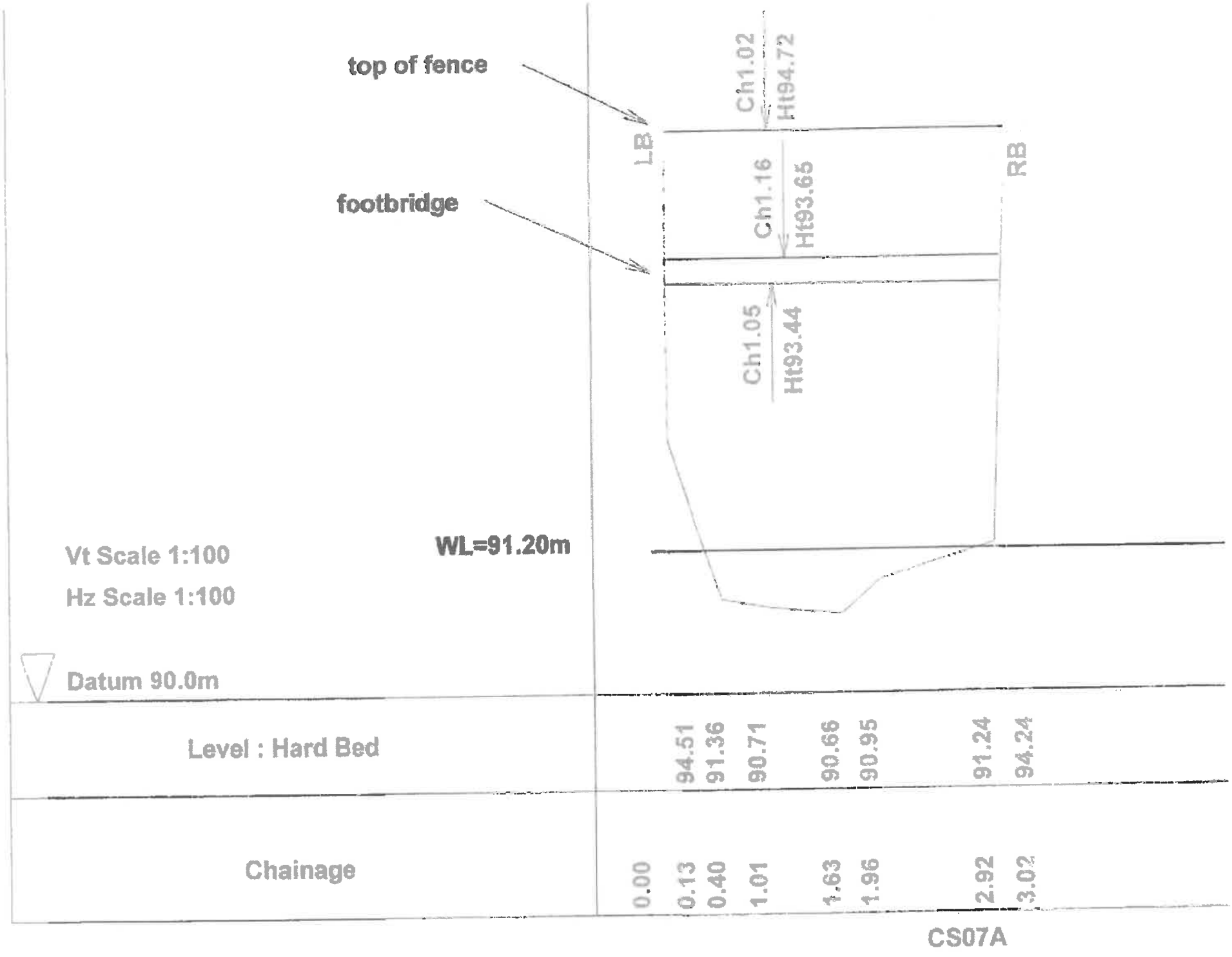
CS05

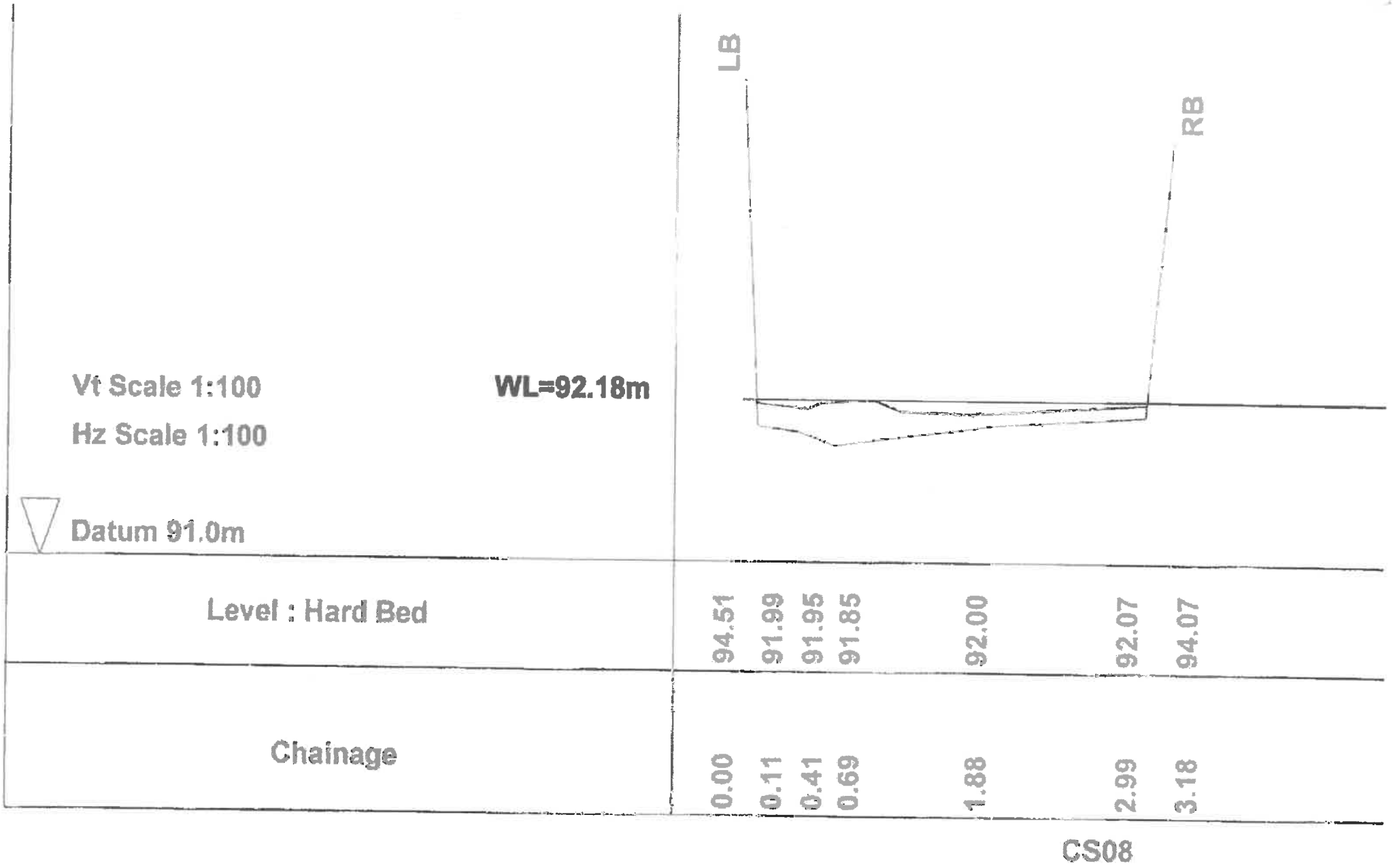
Chainage	Level : Hard Bed
0.00	92.65
1.40	92.28
3.44	91.79
4.23	91.42
4.44	91.11
4.91	89.72
5.35	89.66
5.76	89.60
6.14	89.64
6.82	89.70
7.40	89.79
8.07	89.92
8.32	90.11
9.31	90.27
9.40	92.43
9.86	93.33

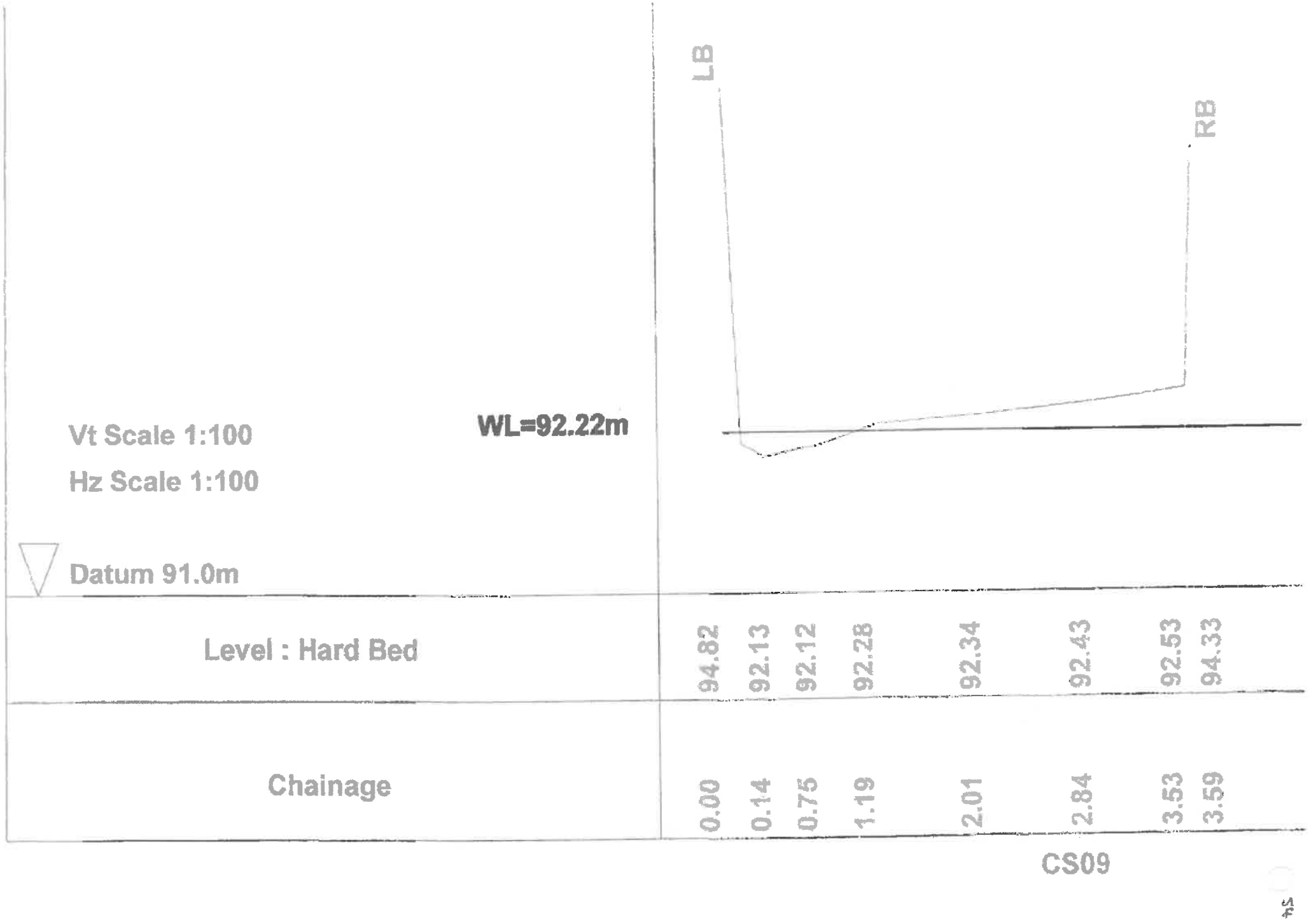
CS06


LB
Ch2.48
Ht93.78
Ch3.38
Ht94.04
RB
Ch2.39
Ht90.36
Ch3.04
Ht90.40
WL=90.24m
Vt Scale 1:100
Hz Scale 1:100
Datum 89.0m
Level : Hard Bed
92.75
90.49
90.40
90.28
90.17
90.14
90.06
90.19
93.50
Level : Hard Bed (Structure)
90.18
90.18
Chainage
0.00
0.05
0.05
0.99
0.96
1.79
2.54
2.82
3.04
3.07
3.32
3.73
3.77
CS06A

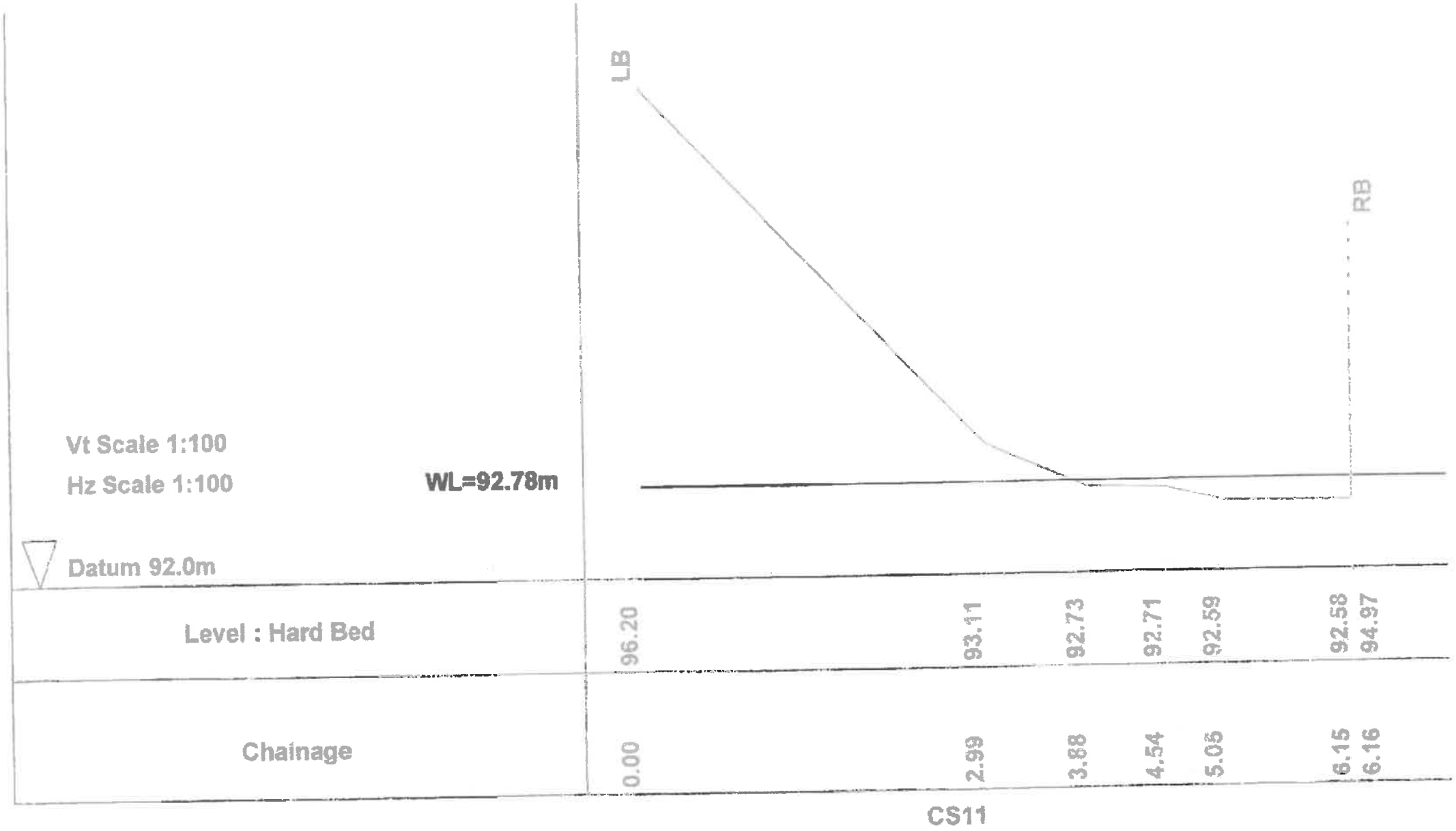

LB
RB
Vt Scale 1:100
Hz Scale 1:100
WL=91.06m
Datum 90.0m
Level : Hard Bed
93.98
91.21
91.01
90.94
90.81
90.71
90.83
91.00
94.26
Chainage
0.00
0.14
1.01
1.26
1.59
2.12
2.62
3.14
3.25
CS07

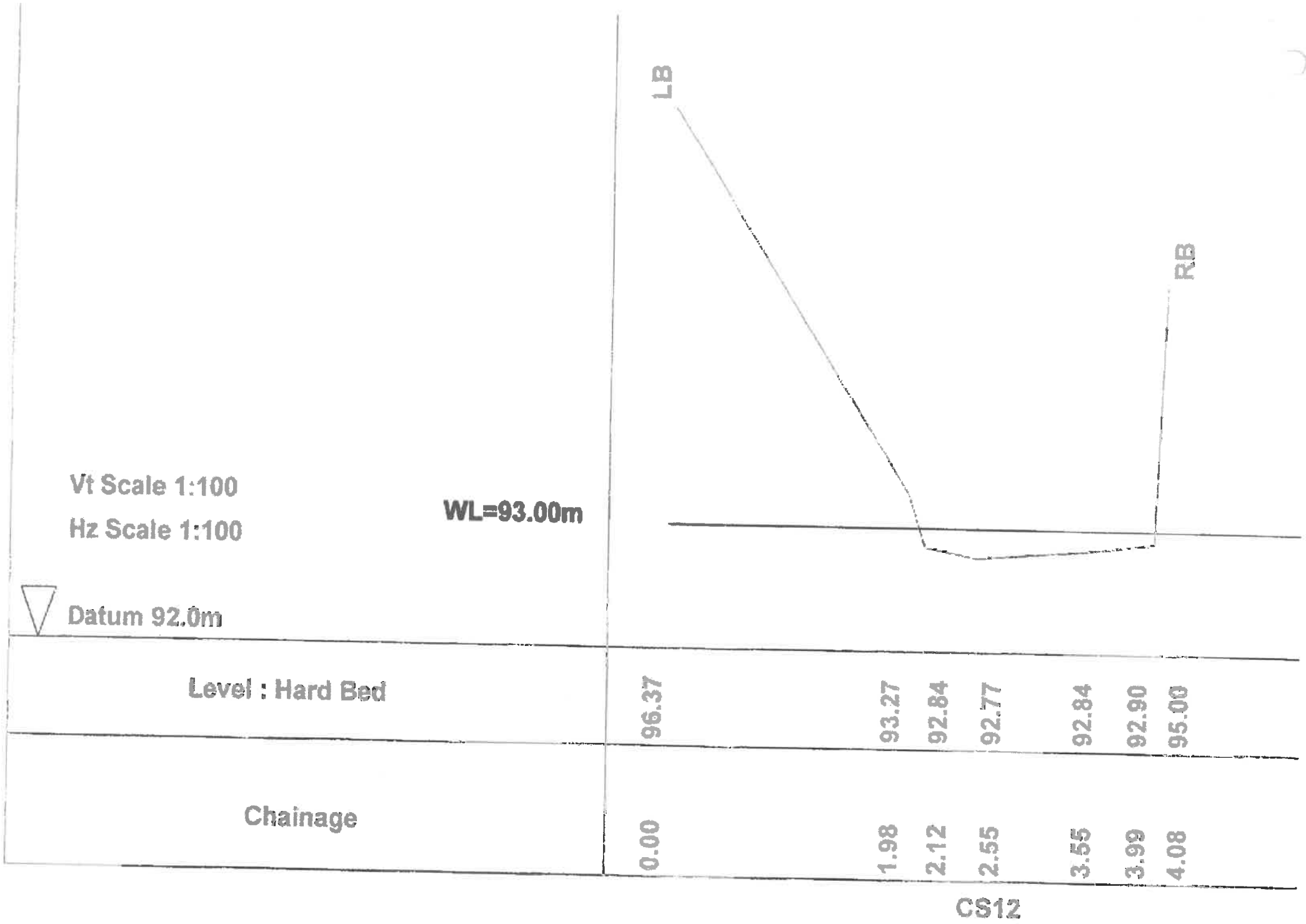

top of fence
footbridge
LB
RB
Ch1.02
Ht94.72
Ch1.16
Ht93.65
Ch1.05
Ht93.44
WL=91.20m
Vt Scale 1:100
Hz Scale 1:100
Datum 90.0m
Level : Hard Bed
94.51
91.36
90.71
90.66
90.95
91.24
94.24
Chainage
0.00
0.13
0.40
1.01
1.63
1.96
2.92
3.02
CS07A

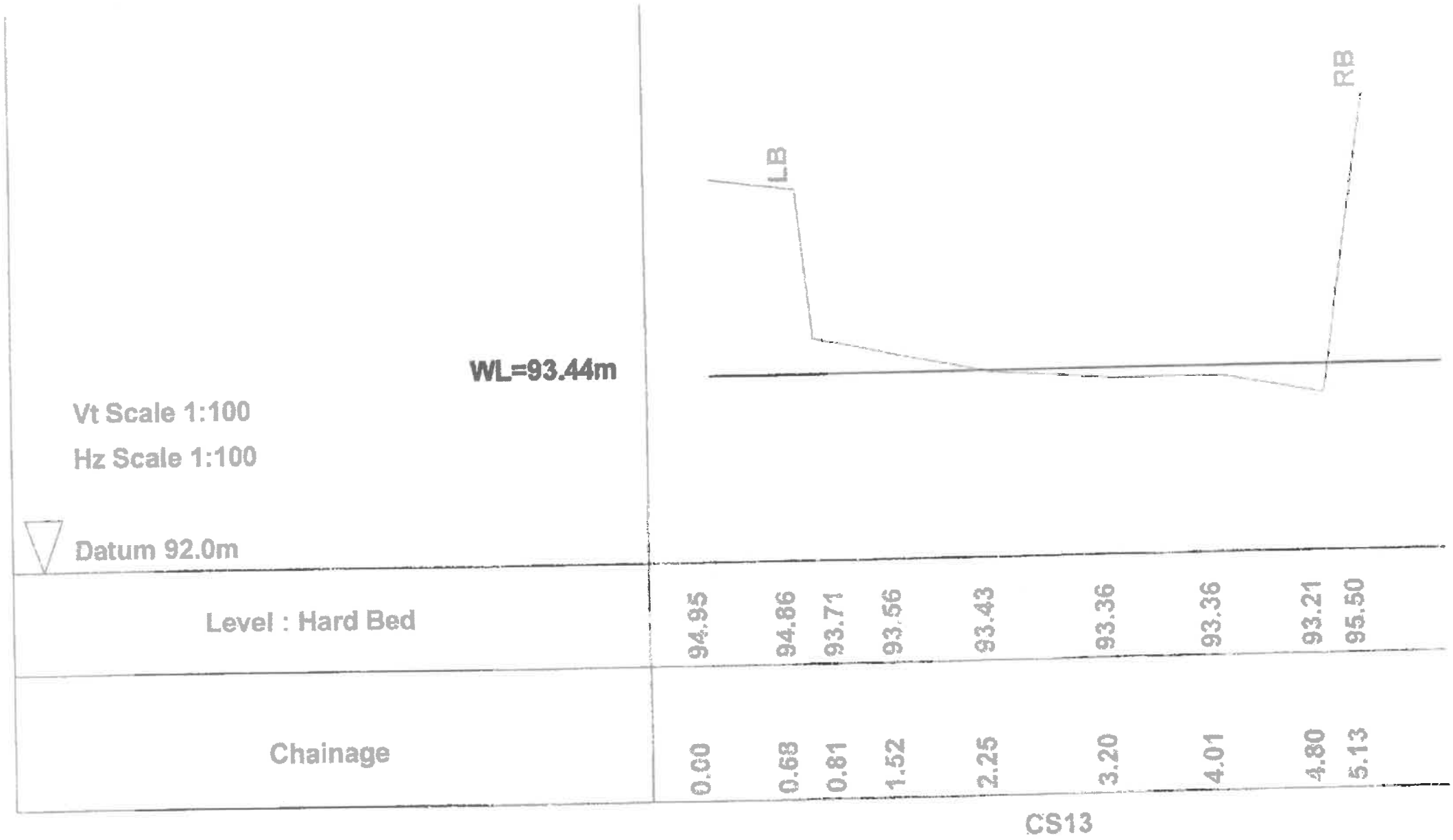

LB
RB
Vt Scale 1:100
Hz Scale 1:100
WL=92.18m
Datum 91.0m
Level : Hard Bed
94.51
91.99
91.95
91.85
92.00
92.07
94.07
Chainage
0.00
0.11
0.41
0.69
1.88
2.99
3.18
CS08


LB
RB
WL=92.22m
Vt Scale 1:100
Hz Scale 1:100
Datum 91.0m
Level : Hard Bed
94.82
92.13
92.12
92.28
92.34
92.43
92.53
94.33
Chainage
0.00
0.14
0.75
1.19
2.01
2.84
3.53
3.59
CS09

CS10
Chainage
Level : Hard Bed (Structure)
Level : Hard Bed
Datum 91.0m
Hz Scale 1:100
Vt Scale 1:100
WL=92.49m
0.00
1.94
2.07
2.16
2.61
3.11
3.58
3.48
4.13
4.15
4.82
4.66
5.46
5.39
5.65
9.04
92.65
92.63
92.40
92.31
92.29
92.23
92.36
94.03
92.44
92.14
Ch0.00
Ch1.63
Ch3.61
Ch4.80
Ch6.02
Ch9.04
Hl97.48
Hl93.76
Hl95.14
Hl97.43
Hl97.49
Hl93.77
Hl97.43
LB
RB
Ch5.61


LB
RB
Vt Scale 1:100
Hz Scale 1:100
WL=92.78m
Datum 92.0m
Level : Hard Bed
96.20
93.11
92.73
92.71
92.59
92.58
94.97
Chainage
0.00
2.99
3.88
4.54
5.05
6.15
6.16
CS11


LB
RB
Vt Scale 1:100
Hz Scale 1:100
WL=93.00m
Datum 92.0m
Level : Hard Bed
96.37
93.27
92.84
92.77
92.84
92.90
95.00
Chainage
0.00
1.98
2.12
2.55
3.55
3.99
4.08
CS12


LB
RB
WL=93.44m
Vt Scale 1:100
Hz Scale 1:100
Datum 92.0m
Level : Hard Bed
94.95
94.86
93.71
93.56
93.43
93.36
93.36
93.21
95.50
Chainage
0.00
0.68
0.81
1.52
2.25
3.20
4.01
4.80
5.13
CS13

chatburn2.rep

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX         XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X     X
X     X  X        X            X   X     X    X   X
XXXXXXX  XXXX     X       XXX  XXXX      XXXXXX   XXXX
X     X  X        X            X  X      X    X       X
X     X  X        X    X       X   X     X    X       X
X     X  XXXXXX    XXXX         X    X   X    X   XXXXX
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PROJECT DATA
Project Title: chatburn2
Project File : chatburn2.prj
Run Date and Time: 29/06/2016 12:19:19

Project in SI units

PLAN DATA

Plan Title: chat2-Q1000-24.9
Plan File :
C:\Users\Public\Documents\rivermodels\presentmodels\chatburn2\chatburn2.p02

Geometry Title: chatburn2
Geometry File :
C:\Users\Public\Documents\rivermodels\presentmodels\chatburn2\chatburn2.g01

Flow Title : chatburnQ1000-24.9
Flow File :
C:\Users\Public\Documents\rivermodels\presentmodels\chatburn2\chatburn2.f02

Plan Summary Information:

Number of:	Cross Sections	= 16	Multiple Openings	=	0
	Culverts	= 2	Inline Structures	=	0
	Bridges	= 1	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	= 0.003
Critical depth calculation tolerance	= 0.003
Maximum number of iterations	= 20
Maximum difference tolerance	= 0.1
Flow tolerance factor	= 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: chatburnQ1000-24.9
Flow File :
C:\Users\Public\Documents\rivermodels\presentmodels\chatburn2\chatburn2.f02

chatburn2.rep

Flow Data (m3/s)

River	Reach	RS	PF 1
chatburn brook	chatburn	207	24.9

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
chatburn brook	chatburn	PF 1	Normal S = 0.026	Normal S = 0.026

GEOMETRY DATA

Geometry Title: chatburn2
Geometry File :
C:\Users\Public\Documents\rivermodels\presentmodels\chatburn2\chatburn2.g01

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 207

INPUT
Description: cs13-ch207
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	94.95	.68	94.86	.81	93.71	1.52	93.56	2.25	93.43
3.2	93.36	4.01	93.36	4.8	93.21	5.13	95.5		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	5.13	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	5.13	12	12	.1	.3

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 195

INPUT
Description: cs12-ch195
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	96.37	1.98	93.27	2.12	92.84	2.55	92.77	3.55	92.84
3.99	92.9	4.08	95						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	4.08	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr. Expan.
0	4.08	12	12	.1 .3

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 183

INPUT
Description: cs11-ch183
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	96.2	2.99	93.11	3.88	92.73	4.54	92.71	5.05	92.59
6.15	92.58	6.16	94.97						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	6.16	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr. Expan.
0	6.16	14	14	.1 .3

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 169

INPUT
Description: cs10-ch169
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	97.48	2.07	94.03	3.11	92.44	4.15	92.14	5.39	92.36
5.55	94.81	5.55	97.5						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	5.55	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr. Expan.
0	5.55	15	15	.1 .3

CULVERT

RIVER: chatburn brook
REACH: chatburn RS: 164

INPUT
Description: clough bank bridge
Distance from Upstream XS = 5
Deck/Roadway Width = 7
Weir Coefficient = 1.4
Upstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	97.5		20	97.5	

Upstream Bridge Cross Section Data
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	97.48	2.07	94.03	3.11	92.44	4.15	92.14	5.39	92.36
5.55	94.81	5.55	97.5						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	5.55	.02

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	5.55	.1	.3

Downstream Deck/Roadway Coordinates
num= 2

Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord
0	97.5	20	97.5

Downstream Bridge Cross Section Data
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	94.82	.14	92.13	.75	92.12	1.19	92.28	2.01	92.34
2.84	92.43	3.53	92.53	3.59	94.33				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	3.59	.02

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	3.59	.1	.3

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name	Shape	Rise	Span
Culvert #1	Arch	3	5.5

FHWA Chart # 41- Arch; Corrugated metal
FHWA Scale # 1 - 90 Degree headwall
Solution Criteria = Highest U.S. EG

Culvert	Upstrm Dist	Length	Top n	Bottom n	Depth Blocked	Entrance Loss Coef	Exit Loss Coef
	5	7	.015	.04	0	.3	.3

Upstream Elevation = 92.2
Centerline Station = 3
Downstream Elevation = 92.1
Centerline Station = 3

CULVERT OUTPUT Profile #PF 1 Culv Group: Culvert #1

Q Culv Group (m3/s)	24.90	Culv Full Len (m)	
# Barrels	1	Culv Vel US (m/s)	1.96
Q Barrel (m3/s)	24.90	Culv Vel DS (m/s)	1.93
E.G. US. (m)	95.27	Culv Inv El Up (m)	92.20
W.S. US. (m)	94.67	Culv Inv El Dn (m)	92.10
E.G. DS (m)	95.19	Culv Frctn Ls (m)	0.02
W.S. DS (m)	94.76	Culv Exit Loss (m)	0.00
Delta EG (m)	0.08	Culv Entr Loss (m)	0.06
Delta WS (m)	0.09	Q Weir (m3/s)	
E.G. IC (m)	94.24	Weir Sta Lft (m)	

E.G. OC (m)	95.27	Weir Sta Rgt (m)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (m)	95.02	Weir Max Depth (m)	
Culv WS Outlet (m)	95.00	Weir Avg Depth (m)	
Culv Nml Depth (m)	1.39	Weir Flow Area (m2)	
Culv Crt Depth (m)	1.27	Min El Weir Flow (m)	97.50

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 154

INPUT
Description: cs9-ch154
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	94.82	.14	92.13	.75	92.12	1.19	92.28	2.01	92.34
2.84	92.43	3.53	92.53	3.59	94.33				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	3.59	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	3.59	15	15	15	.1 .3

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 139

INPUT
Description: cs8-ch139
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	94.51	.11	91.99	.41	91.95	.69	91.85	1.88	92
2.99	92.07	3.18	94.07						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	3.18	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	3.18	4	4	4	.1 .3

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 135

INPUT
Description: cs7a-ch135
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	94.5	.13	94.51	.4	91.36	1.01	90.71	1.63	90.66
1.96	90.55	2.92	91.24	3.02	94.24				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	.13	.04	3.02	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
.13	3.02	11	11	11	.1

.3

BRIDGE

RIVER: chatburn brook
REACH: chatburn RS: 131

INPUT
Description: footbridge
Distance from Upstream XS = 4
Deck/Roadway Width = 3
Weir Coefficient = 1.4
Upstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	93.65	93.44	20	93.65	93.44

Upstream Bridge Cross Section Data
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	94.5	.13	94.51	.4	91.36	1.01	90.71	1.63	90.66
1.96	90.55	2.92	91.24	3.02	94.24				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	.13	.04	3.02	.02

Bank Sta: Left	Right	Coeff Contr.	Expan.
.13	3.02	.1	.3

Downstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	93.65	93.44	20	93.65	93.44

Downstream Bridge Cross Section Data
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	93.98	.14	91.21	1.01	91.01	1.26	90.94	1.59	90.81
2.12	90.71	2.62	90.83	3.14	91	3.25	94.26		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	3.25	.02

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	3.25	.1	.3

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Energy

High Flow Method
Pressure and Weir flow
Submerged Inlet Cd =
Submerged Inlet + Outlet Cd = .5
Max Low Cord =

Additional Bridge Parameters
Add Friction component to Momentum
Do not add weight component to Momentum
Class B flow critical depth computations use critical depth inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT Profile #PF 1

E.G. US. (m)	94.54	Element	Inside BR US
Inside BR DS			
W.S. US. (m)	94.12	E.G. Elev (m)	94.54
94.36			
Q Total (m3/s)	24.90	W.S. Elev (m)	94.12
94.12			
Q Bridge (m3/s)	21.57	Crit W.S. (m)	92.98
92.83			
Q Weir (m3/s)	3.33	Max Chl Dpth (m)	3.57
3.41			
Weir Sta Lft (m)	0.00	Vel Total (m/s)	0.00
0.00			
Weir Sta Rgt (m)	3.02	Flow Area (m2)	
Weir Submerg	0.00	Froude # Chl	0.52
0.46			
Weir Max Depth (m)	0.89	Specif Force (m3)	21.48
22.18			
Min El Weir Flow (m)	93.65	Hydr Depth (m)	
Min El Prs (m)	93.44	W.P. Total (m)	13.85
15.13			
Delta EG (m)	0.78	Conv. Total (m3/s)	
Delta WS (m)	1.30	Top Width (m)	2.85
3.25			
BR Open Area (m2)	6.82	Frctn Loss (m)	
BR Open Vel (m/s)	3.16	C & E Loss (m)	
Coef of Q		Shear Total (N/m2)	
Br Sel Method	Press/Weir	Power Total (N/m s)	0.00
0.00			

Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.
Note: For the cross section inside the bridge at the upstream end, the water surface and energy have been projected from the upstream cross section. The selected bridge modeling method does not compute answers inside the bridge.
Note: For the cross section inside the bridge at the downstream end, the energy is based on critical depth over the weir. The water surface has been projected.

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 124

INPUT
Description: cs7-ch124
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	93.98	.14	91.21	1.01	91.01	1.26	90.94	1.59	90.81
2.12	90.71	2.62	90.83	3.14	91	3.25	94.26		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	3.25	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	3.25	16	16	16	.1 .3

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 106

INPUT
Description: cs6a-ch106
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	92.75	.05	90.49	.99	90.4	1.79	90.28	2.54	90.17
3.04	90.14	3.32	90.06	3.77	90.19	4.05	93.5		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	4.05	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	4.05	32	32	32	.1 .3

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 76

INPUT
Description: cs6-ch76
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	92.65	1.4	92.28	3.44	91.79	4.23	91.42	4.44	91.11
5.76	89.6	8.07	89.92	8.32	90.11	9.31	90.27	9.4	92.43
9.86	93.33								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	9.86	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	9.86	19	19	19	.1 .3

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 57

INPUT
Description: cs5-ch57
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	92.69	3.09	91.7	3.11	90.06	4.28	89.79	5.18	89.68
5.51	89.38	6.07	89.47	6.44	89.23	7.25	89.11	7.86	89.25
8.36	89.34	8.74	89.33	8.93	92.96				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	8.93	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	8.93	19	19	.1	.3

CULVERT

RIVER: chatburn brook
REACH: chatburn RS: 54

INPUT
Description: arch road bridge-bridge rd
Distance from Upstream XS = 3
Deck/Roadway Width = 13
Weir Coefficient = 1.4
Upstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	93.03		20	93.03	

Upstream Bridge Cross Section Data
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	92.69	3.09	91.7	3.11	90.06	4.28	89.79	5.18	89.68
5.51	89.38	6.07	89.47	6.44	89.23	7.25	89.11	7.86	89.25
8.36	89.34	8.74	89.33	8.93	92.96				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	8.93	.02

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	8.93	.1	.3

Downstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	93.03		20	93.03	

Downstream Bridge Cross Section Data
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	96.57	.16	88.98	5.89	89.1	5.97	90.13	7.17	90.12

8.73 90.4 8.98 91.94

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	8.98	.02

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	8.98	.1	.3

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name	Shape	Rise	Span
Culvert #1	Arch	1.9	5.3

FHWA Chart # 41- Arch; Corrugated metal
FHWA Scale # 1 - 90 Degree headwall
Solution Criteria = Highest U.S. EG

Culvert	Upstrm Dist	Length	Top n	Bottom n	Depth Blocked	Entrance Loss Coef	Exit Loss Coef
	3	13	.015	.04	0	.4	.4

Upstream Elevation = 89.22
Centerline Station = 6
Downstream Elevation = 88.95
Centerline Station = 3

CULVERT OUTPUT Profile #PF 1 Culv Group: Culvert #1

Q Culv Group (m3/s)	24.90	Culv Full Len (m)	
# Barrels	1	Culv Vel US (m/s)	3.80
Q Barrel (m3/s)	24.90	Culv Vel DS (m/s)	3.97
E.G. US. (m)	91.74	Culv Inv El Up (m)	89.22
W.S. US. (m)	91.50	Culv Inv El Dn (m)	88.95
E.G. DS (m)	90.84	Culv Frctn Ls (m)	0.28
W.S. DS (m)	90.36	Culv Exit Loss (m)	0.20
Delta EG (m)	0.90	Culv Entr Loss (m)	0.42
Delta WS (m)	1.14	Q Weir (m3/s)	
E.G. IC (m)	91.74	Weir Sta Lft (m)	
E.G. OC (m)	91.62	Weir Sta Rgt (m)	
Culvert Control	Inlet	Weir Submerg	
Culv WS Inlet (m)	90.59	Weir Max Depth (m)	
Culv WS Outlet (m)	90.24	Weir Avg Depth (m)	
Culv Nml Depth (m)	1.37	Weir Flow Area (m2)	
Culv Crt Depth (m)	1.29	Min El Weir Flow (m)	93.03

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 38

INPUT
Description: cs4-ch38
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	96.57	.16	88.98	5.89	89.1	5.97	90.13	7.17	90.12
8.73	90.4	8.98	91.94						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	8.98	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr. Expan.
0	8.98	3	3	3 .1

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 35

INPUT
Description: cs3a-ch35
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	96.54	.05	88.94	.6	88.07	3.93	87.97	4.51	88.92
8.88	90.19	9.09	91.81						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	9.09	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr. Expan.
0	9.09	8	8	8 .1

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 27

INPUT
Description: cs3-ch27
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	92.21	.02	87.62	4.64	87.65	6.34	88.91	9.47	89.87
9.62	91.53								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	9.62	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr. Expan.
0	9.62	8	8	8 .1

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 19

INPUT
Description: cs2-ch19
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	90.25	.05	84.65	5.04	84.75	5.32	85.29	6.5	85.36
8.33	87.42	8.86	87.78	9.86	88.06	9.99	91.15		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	9.99	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	9.99	19	19	19	.1

.3

CROSS SECTION

RIVER: chatburn brook
REACH: chatburn RS: 0

INPUT
Description: cs1-ch0
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	89.42	.99	84.93	6.96	84.73	10.28	87.05	10.34	90.35

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.04	10.34	.02

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	10.34	.1	.3

SUMMARY OF MANNING'S N VALUES

River:chatburn brook

Reach	River Sta.	n1	n2	n3
chatburn	207	.02	.04	.02
chatburn	195	.02	.04	.02
chatburn	183	.02	.04	.02
chatburn	169	.02	.04	.02
chatburn	164	Culvert		
chatburn	154	.02	.04	.02
chatburn	139	.02	.04	.02
chatburn	135	.02	.04	.02
chatburn	131	Bridge		
chatburn	124	.02	.04	.02
chatburn	106	.02	.04	.02
chatburn	76	.02	.04	.02
chatburn	57	.02	.04	.02
chatburn	54	Culvert		
chatburn	38	.02	.04	.02
chatburn	35	.02	.04	.02
chatburn	27	.02	.04	.02
chatburn	19	.02	.04	.02
chatburn	0	.02	.04	.02

SUMMARY OF REACH LENGTHS

River: chatburn brook

Reach	River Sta.	Left	Channel	Right
chatburn	207	12	12	12
chatburn	195	12	12	12

chatburn	183	14	14	14
chatburn	169	15	15	15
chatburn	164	Culvert		
chatburn	154	15	15	15
chatburn	139	4	4	4
chatburn	135	11	11	11
chatburn	131	Bridge		
chatburn	124	16	16	16
chatburn	106	32	32	32
chatburn	76	19	19	19
chatburn	57	19	19	19
chatburn	54	Culvert		
chatburn	38	3	3	3
chatburn	35	8	8	8
chatburn	27	8	8	8
chatburn	19	19	19	19
chatburn	0			

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: chatburn brook

Reach	River Sta.	Contr.	Expan.
chatburn	207	.1	.3
chatburn	195	.1	.3
chatburn	183	.1	.3
chatburn	169	.1	.3
chatburn	164	Culvert	
chatburn	154	.1	.3
chatburn	139	.1	.3
chatburn	135	.1	.3
chatburn	131	Bridge	
chatburn	124	.1	.3
chatburn	106	.1	.3
chatburn	76	.1	.3
chatburn	57	.1	.3
chatburn	54	Culvert	
chatburn	38	.1	.3
chatburn	35	.1	.3
chatburn	27	.1	.3
chatburn	19	.1	.3
chatburn	0	.1	.3

HR Wallingford
Working with water

Surface water storage requirements for sites

Site name: downham road
Site location: chatburn

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", WS-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Site coordinates
Latitude: 53.89227° N
Longitude: 2.35184° W

Reference: gcw6d6z3npkb / 0.1
Date: 13 Jul 2016

Site characteristics

Total site area	0.1	ha
Significant public open space	0	ha
Area positively drained	0.1	ha
Impermeable area	0.06	ha
Percentage of drained area that is impermeable	60	%
Impervious area drained via infiltration	0	ha
Return period for infiltration system design	10	year
Impervious area drained to rainwater harvesting systems	0	ha
Return period for rainwater harvesting system design	10	year
Compliance factor for rainwater harvesting system design	66	%
Net site area for storage volume design	0.1	ha

Methodology

Greenfield runoff method	FEH
Volume control approach	Use Long Term Storage
Qmed estimation method	Calculate from BFI and SAAR
BFI and SPR estimation method	Specify BFI and SPR manually
HOST class	N/A
BFI / BFIHOST	0.36
SPR / SPRHOST	0.41
Qmed	1.393 l/s
Qbar / Qmed Conversion Factor	1.075

Hydrological characteristics

	Default	Edited	
SAAR	1252	1252	mm
M5-60 Rainfall Depth	20	20	mm
'r' Ratio M5-60/M5-2 day	0.2	0.2	
FEH/FSR conversion factor	0.85	0.85	
Hydrological region	10	10	
Growth curve factor: 1 year	0.87	0.87	
Growth curve factor: 10 year	1.38	1.38	
Growth curve factor: 30 year	1.7	1.7	
Growth curve factor: 100 year	2.08	2.08	

Design criteria

Climate change allowance factor	1.3	
Urban creep allowance factor	1.1	
Interception rainfall depth	5	mm

Greenfield runoff rates

	Default	Edited	
Qbar	1.50	1.50	l/s
1 in 1 year	5.00	5.00	l/s
1 in 30 years	5.00	5.00	l/s
1 in 100 years	5.00	5.00	l/s

Please note that a minimum flow of 5 l/s applies to any site

Estimated storage volumes

	Default	Edited	
Interception storage	2.40	2.40	m^3
Attenuation storage	0.00	0.00	m^3
Long term storage	0.00	0.00	m^3
Treatment storage	7.20	7.20	m^3
Total storage	2.40	2.40	m^3

HR Wallingford
Working with water

Surface water storage requirements for sites

Site name: downham road
Site location: chatburn

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Site coordinates
Latitude: 53.89227° N
Longitude: 2.35184° W

Reference: gcw6d8z3npkb / 0.1
Date: 13 Jul 2016

Site characteristics

Total site area	0.1	ha
Significant public open space	0	ha
Area positively drained	0.1	ha
Impermeable area	0.06	ha
Percentage of drained area that is impermeable	60	%
Impervious area drained via infiltration	0	ha
Return period for infiltration system design	10	year
Impervious area drained to rainwater harvesting systems	0	ha
Return period for rainwater harvesting system design	10	year
Compliance factor for rainwater harvesting system design	66	%
Net site area for storage volume design	0.1	ha

Methodology

Greenfield runoff method	IH124
Volume control approach	Use Long Term Storage
Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
SOIL type	4
HOST class	N/A
SPR	0.47

Hydrological characteristics

	Default	Edited	
SAAR	1252	1252	mm
M5-60 Rainfall Depth	20	20	mm
'r' Ratio M5-60/M5-2 day	0.2	0.2	
FEH/FSR conversion factor	0.85	0.85	
Hydrological region	10	10	
Growth curve factor: 1 year	0.87	0.87	
Growth curve factor: 10 year	1.38	1.38	
Growth curve factor: 30 year	1.7	1.7	
Growth curve factor: 100 year	2.08	2.08	

Design criteria

Climate change allowance factor	1.3	
Urban creep allowance factor	1.1	
Interception rainfall depth	5	mm

Greenfield runoff rates

	Default	Edited	
Qbar	0.95	0.95	l/s
1 in 1 year	5.00	5.00	l/s
1 in 30 years	5.00	5.00	l/s
1 in 100 years	5.00	5.00	l/s

Please note that a minimum flow of 5 l/s applies to any site

Estimated storage volumes

	Default	Edited	
Interception storage	2.40	2.40	m^3
Attenuation storage	0.00	0.00	m^3
Long term storage	0.00	0.00	m^3
Treatment storage	7.20	7.20	m^3
Total storage	2.40	2.40	m^3

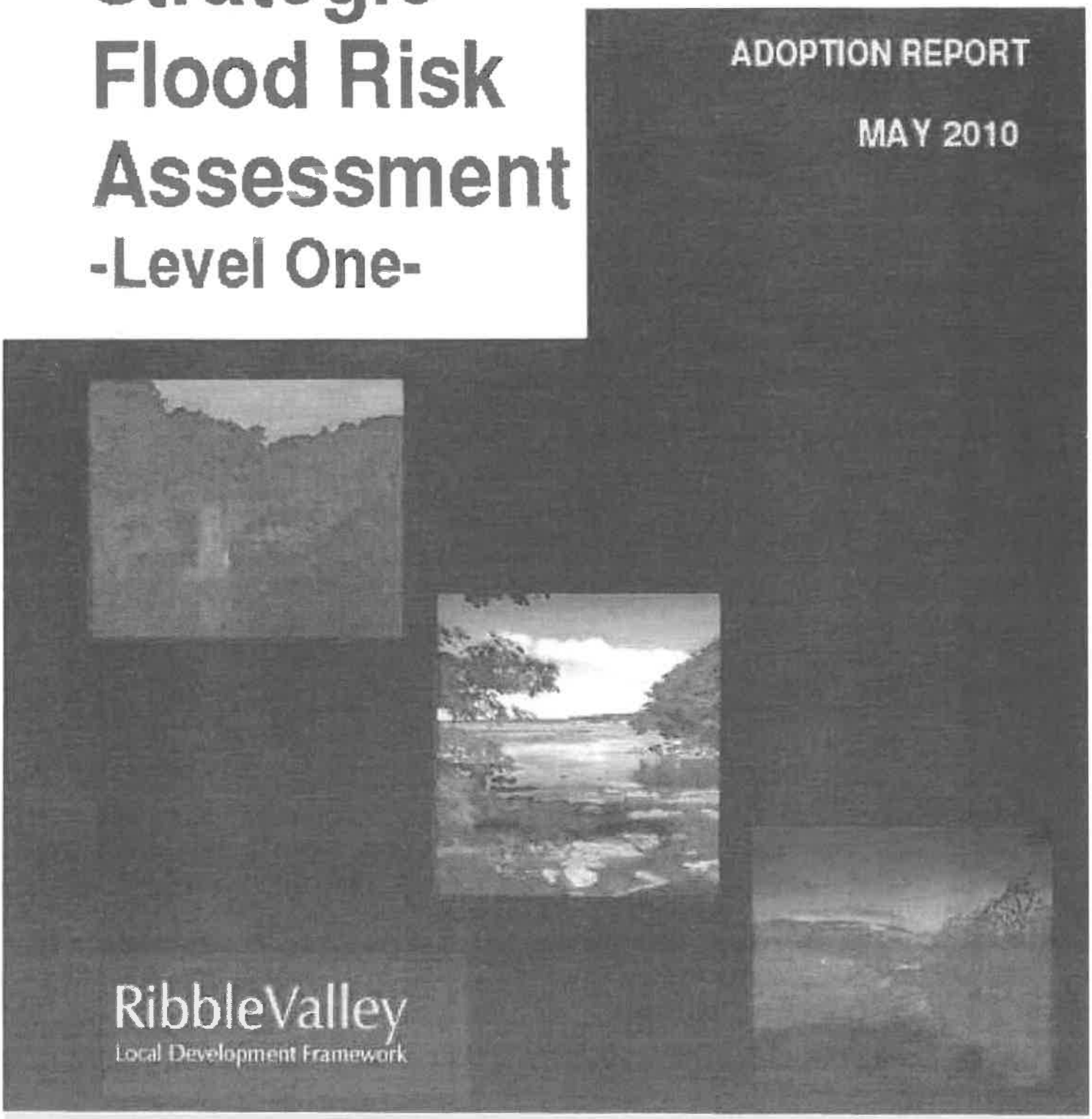
Ribble Valley Borough Council

Strategic Flood Risk Assessment

-Level One-

ADOPTION REPORT

MAY 2010



RibbleValley

Local Development Framework

Sewer Flooding

Rainfall from urban areas is often drained into either man made surface water drains or "combined" surface and waste water sewers. Blockage or intense rainfall beyond the system's capacity can cause flooding. The foul sewage involved in these floods can add pollution to the flood damage.

Reservoir Flooding and Other Artificial Sources

Finally a variety of man-made structures such as reservoirs and canals, quarries and mines or adapted natural water bodies, such as artificially raised lake or ponds that store water, can cause flooding if they fail. These can be sudden and catastrophic events and may involve contaminated water. However, flooding through reservoir failure is a theoretical risk which is very small. Under DEFRA guidelines, United Utilities, which own and manage some reservoir facilities in the area, are subject to strict controls on the publication of information relating to such matters and do not consider that potential reservoir related flooding issues would be used as grounds to refuse planning permission.

4.2 Given the range of flooding sources and the area and diversity of the Borough, it is unsurprising that most of these types of flooding are relevant to the district both in terms of historic events and current risk.

Historic Floods (source Ribble CFMP)

4.3 A record of the major floods that have affected the Ribble catchment since 1600 has been put together from the British Hydrological Society's "Chronology of British Hydrological Events" and from the Environment Agency Section 105 – River Ribble Survey in 1998. The Environment Agency study found major flood events that had been reported in local newspapers. Those which affected RVBC communities are recorded below. Other major floods were reported in 1771 and 1775, but no actual date of occurrence has been identified. The flood of 17 November 1866 caused the most serious and widespread flooding throughout the Ribble catchment over the last 200 years, affecting both upland tributaries and the main river as far as Preston.

4.4 Table 1 shows a list of major historical floods in the Ribble catchment that caused widespread flooding and affected local communities.

Table 1 Major historical floods recorded in the Ribble catchment and RVBC communities worst hit
(Source Ribble CFMP)

1771 Ribble	No information available
1775 Ribble	No information available
1866 Ribble, Calder,	Whalley, Clitheroe, Ribchester,
1881 Ribble, Calder, Hodder	Slaidburn,
1923 Ribble, Calder	Clitheroe

1936 Ribble, Hodder, Calder	Slaidburn, Whalley, Clitheroe, Bolton-by- Bowland
1995 Ribble, Calder, Darwen	Ribchester
2000 Ribble, Calder, Darwen	Ribchester,
2002 Calder, Darwen	Whalley

4.5 Of the major historical flood events recorded there appears to have been a concentration of floods in July and August, many associated with short-lived but very intensive convectional rainstorms, often over built-up areas (for example Preston, Burnley, Blackburn) which produced rapid runoff. The months of March, April and May did not experience any major floods.

4.6 There is also a seasonal aspect to flooding. Research over more recent years has been carried out using flood event data from the Ribble, Calder and Darwen. All these rivers have similar high flow events, with most occurring in the autumn and winter months and fewer in spring and summer. This is what would be expected to happen for relatively large river systems responding to frontal type rainfall. Many of the smaller flooding issues in the headwaters may show a different seasonality as they are caused by short and intense summer thunderstorms rather than longer duration events.

River Flooding

4.7 The Environment Agency (EA) produces and regularly updates a series of Flood Zone maps for the area. The Flood Zones provide an indication of the areas that may be at risk from flooding from tidal or fluvial sources, ignoring the presence of defences or other man made infrastructure.

4.8 The Food Zones in the Ribble Valley District relate to fluvial flooding only. Flood Zone 2 is the extent of the area of medium flood risk, having between a 1 in 100 and 1 in 1000 annual probability of flooding (between a 1% and 0.1% risk). Flood Zone 3 is the area at high flood risk, having a 1 in 100 annual probability or more of flooding (1% or greater risk). An area not within Zone 2 or Zone 3 is designated as Flood Zone 1 ie low risk of flooding with a probability of less than 1 in 1000 (or less than 0.1%). All proposed development within Zones 2 and 3 or over 1 hectare in Zone 1 will require a FRA (see Section 6 below)

4.9 Within PPS25 Table D1, Zone 3 is further sub divided into Zone 3A and Zone 3B. Flood Zone 3B is defined as the functional floodplain (see 4.11 below), while Flood Zone 3A is defined as that part of Flood Zone 3 which is not within the functional flood plain. EA Flood Zone maps do not differentiate between Flood Zones 3A and 3B. Development which is considered appropriate to Flood Zone 3A and 3B are identified in Table D2 and D3 of PPS25 (see Appendix 1)

Flood Zone 3B (Functional Floodplain)

4.10 This is land where water has to flow or be stored in times of flood. It is defined as land which would flood with an annual probability of 1 in 20 (5%)

Appendix 4 - Ribble Catchment Flood Management Plan - Preferred Policies for Ribble Valley Related Policy Areas

PART 1- POLICY SELECTION

For each of the various relevant sub units of the catchment a policy has been attached from the list of generic policy options outlined below.

Policy Description

P1 No active intervention (including flood warning and maintenance). Continue to monitor and advise.

P2 Reduce existing flood risk management actions (accepting that flood risk will increase over time).

P3 Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase from this baseline).

P4 Take further action to sustain the current level of flood risk in to the future (responding to the potential increase in risk from urban development, land use change and climate change).

P5 Take further action to reduce flood risk.

P6 Take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment

Upper Ribble and Hodder Policy Option P1

Preferred Policy -

No active intervention (including flood warning and maintenance),continue to monitor and advise

Justification -

This very large policy unit (600km2) is predominantly rural, with only a few isolated flood risk areas / problems in the distributed villages. One water treatment works and six sewage works are at risk in a 1% event. Flood risk management activities in this policy unit are minimal due to the low numbers of people at risk, with no flood warning areas and very few if any formal flood defences. A 1-in-100 year flood (1% AEP event) would affect 230 properties, one water treatment works, six sewage works, two schools and two Scheduled Ancient Monuments, and cause £27M of damage. Up to 120 extra properties could be at risk in 100 years in a 'do nothing' scenario, as well as one extra school. It is worth noting that the policy unit is very large in area and so the damages per unit area are very low in comparison with the other policy units. Because of this, policy P5 was not chosen, and P4 was also not seen as being suitable given that the area is not earmarked for significant urban

development or land use change. The potential inundation of the Long Preston Deeps floodplain would represent a P6 policy, although this area is a very small part of the unit and initial modelling has shown that downstream benefits to flood risk of inundating this area are not significant. Despite this, during the life of the CFMP it is likely that areas of P6 policy may be developed in this unit. Given that flood risk management activities in the policy unit are minimal, policies P2 and P3 are also not suitable as they refer more to units where flood risk management activities are to maintained or reduced. Policy P1 therefore represents the dominant policy in the unit, despite some potential small areas of policy P6.

Bowland Fell Policy Option P6

Preferred Policy –

Take action with others to store water or manage run off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.

Justification -

This large policy unit (102km2) lies in the upper catchment of the River Hodder, and is entirely rural. It consists mainly of moorland fell areas supporting pastoral farming. Flood risk management activities in the area are minimal, and very few properties are at risk of flooding due to the sparsely populated nature of the policy unit. Because of these reasons, policies P3, P4, and P5 were not deemed suitable due to the very low flood risk. Policy P2 was also not feasible given the already minimal flood risk management activities. Whilst a policy of P1 was feasible due to the low flood risk in the area, because of work progressing under United Utilities' SCaMP project to attenuate flows in the Bowland area, and with further potential for flood storage, policy P6 was chosen to deliver benefits to villages such as Dunsop Bridge and further downstream.

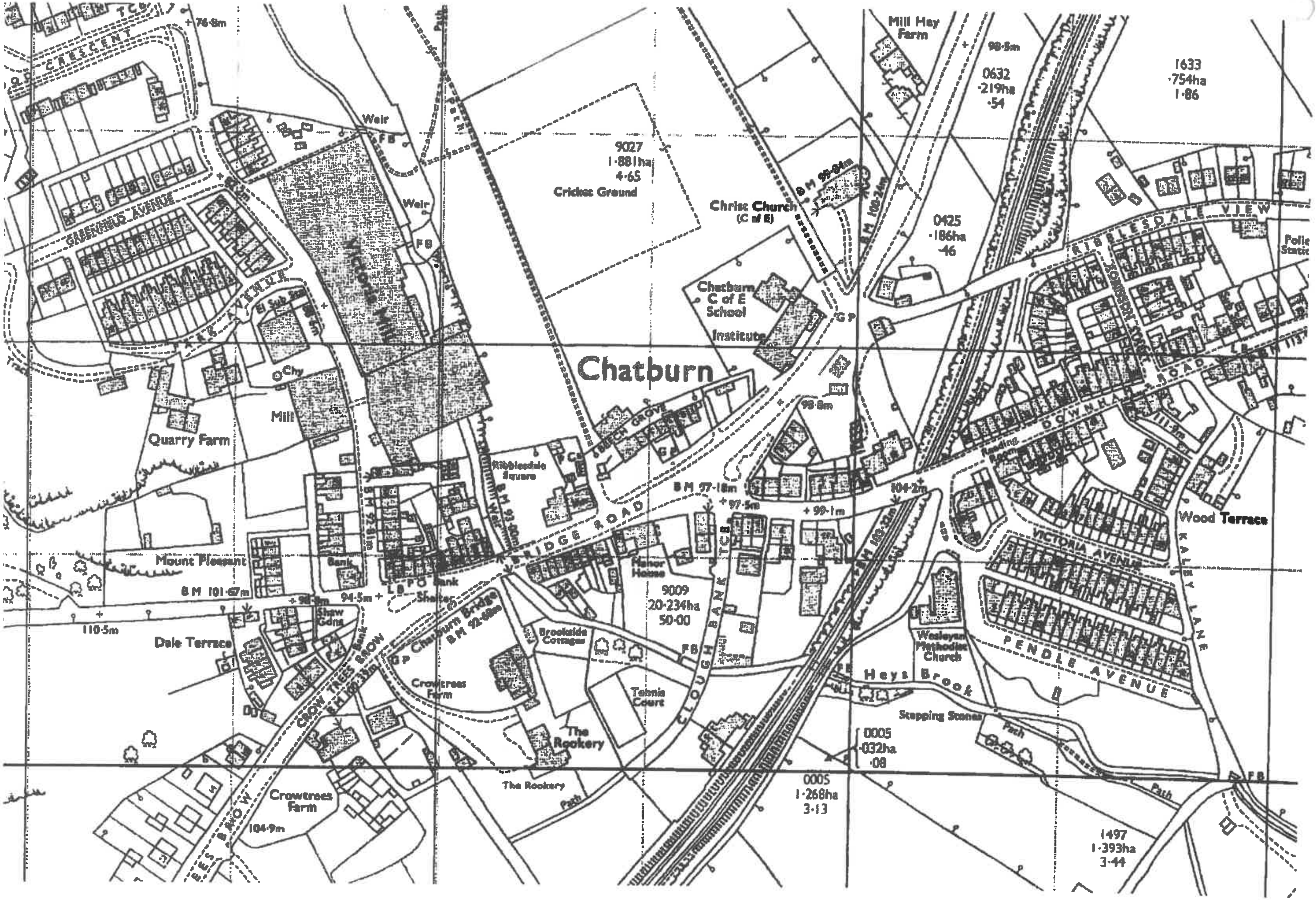
Clitheroe Policy Option P5 –

Preferred Policy –

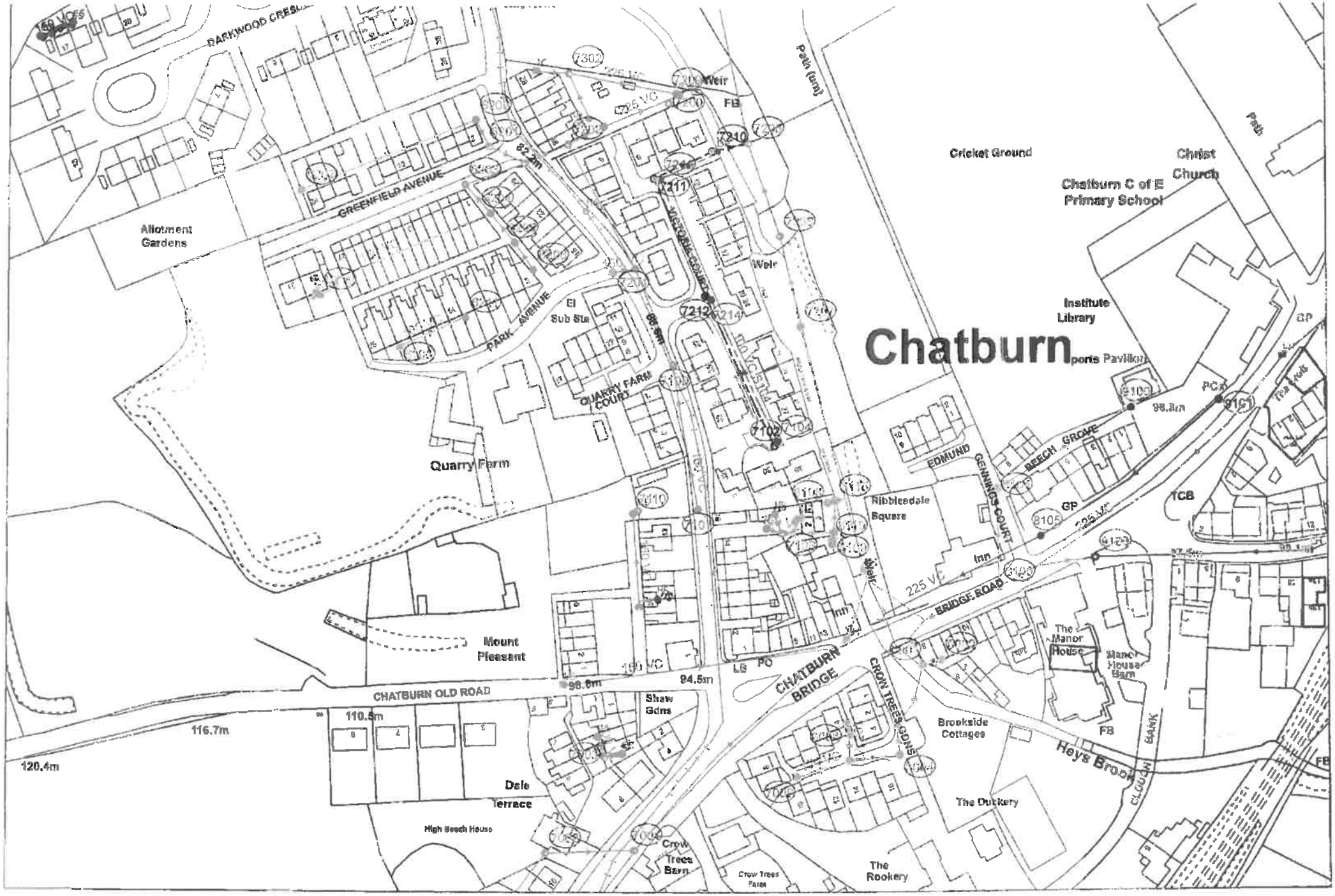
Take further action to reduce flood risk

Justification -

This very small policy unit (4km2) is entirely urban, but set within a much larger rural catchment with considerable landscape, cultural and environmental interests. About 260 properties are at risk of flooding (1% AEP event), at a cost of £38M worth of damage, with a further 230 properties at risk in 100 years with a 'do nothing' scenario. In addition, 3 schools and 1 hospital are currently at risk in a 1% event, which is not forecast to increase in the future. Flood risk management activities in the town include the maintenance of screens on the inlet and outlet of culverted watercourses, general maintenance of banks of open watercourses, and the provision of formal flood warnings to the Clitheroe and Low Moor areas. Further action is



Chatburn
Mill Hay Farm
Cricket Ground
9027
1·881ha
4·65
Christ Church
(C of E)
Chatburn C of E School
Institute
Victoria Mill
Weir
FB
Mill
Quarry Farm
Mount Pleasant
Dale Terrace
Crowtrees Farm
The Rookery
Tennis Court
Brookside Cottages
Manor House
9009
20·234ha
50·00
Ribblesdale Square
BRIDGE ROAD
CLOUGH BANK
CROW TREES BROW
Chatburn Bridge
Hey's Brook
Stepping Stones
Wesleyan Methodist Church
PENDLE AVENUE
VICTORIA AVENUE
KALEY LANE
Wood Terrace
RIBBLESDALE VIEW
DOWNHAM ROAD
GREENFIELD AVENUE
CRESCENT
0425
·186ha
·46
0632
·219ha
·54
1633
·754ha
1·86
0005
·032ha
·08
0005
1·268ha
3·13
1497
1·393ha
3·44
Path


Chatburn
Cricket Ground
Christ Church
Chatburn C of E Primary School
Institute Library
Sports Pavilion
Allotment Gardens
GREENFIELD AVENUE
PARK AVENUE
VICTORIA COURT
QUARRY FARM COURT
El Sub Sta
Weir
FB
Path (um)
Path
Quarry Farm
Mount Pleasant
CHATBURN OLD ROAD
CHATBURN BRIDGE
BRIDGE ROAD
Ribbledale Square
EDMUND GENNINGS COURT
BEECH GROVE
GP
TCB
PC
Inn
LS
PO
The Manor House
Manor House Barn
Brookside Cottages
CROW TREES GDNS
Heys Brook
CLOUGH BANK
The Dukery
The Rookery
Crow Trees Barn
Crow Trees Farm
Shaw Gdns
Dale Terrace
High Beech House
225 VC
150 VC
98.8m
94.5m
110.5m
116.7m
120.4m

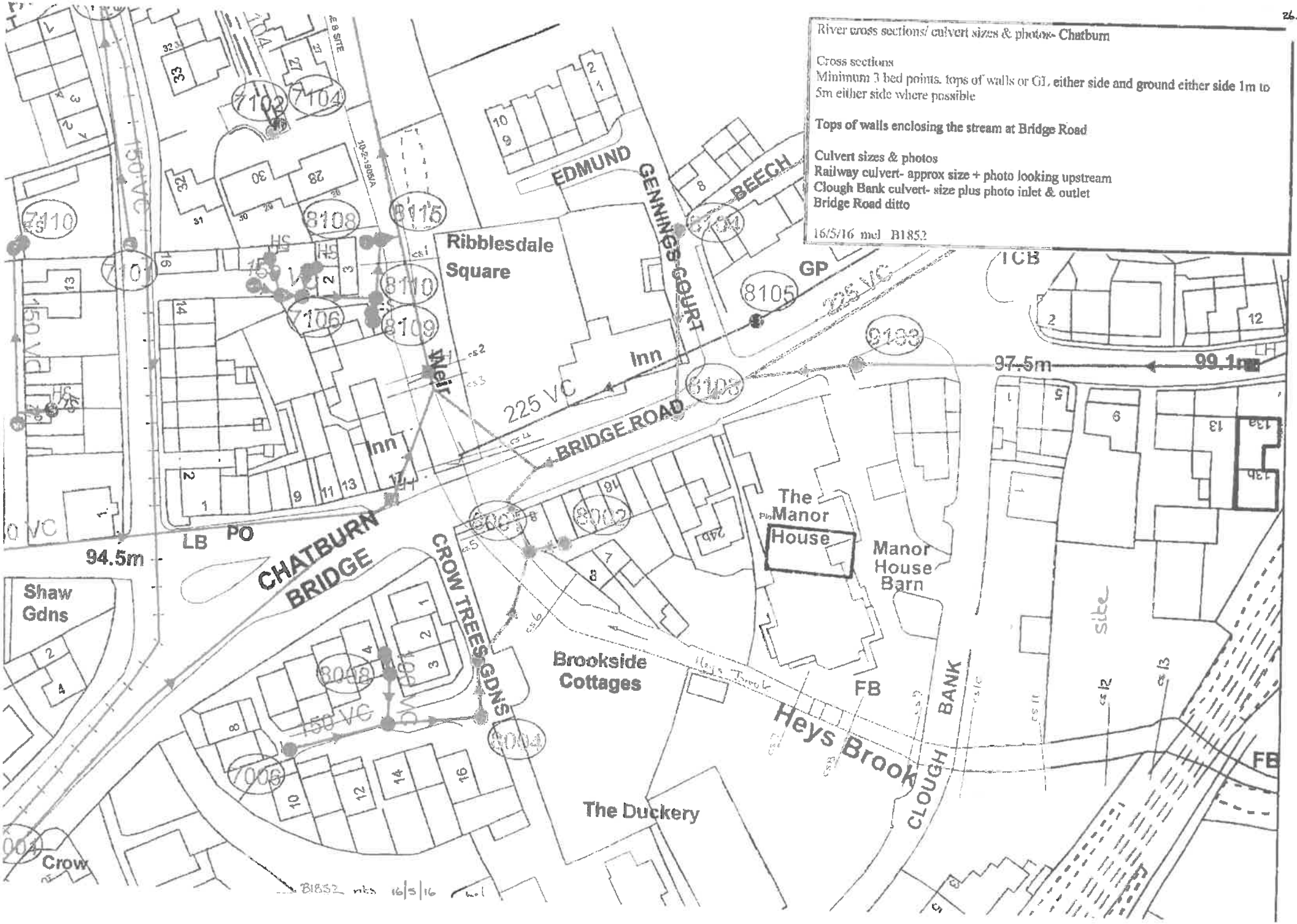
River cross sections/ culvert sizes & photos- Chatburn

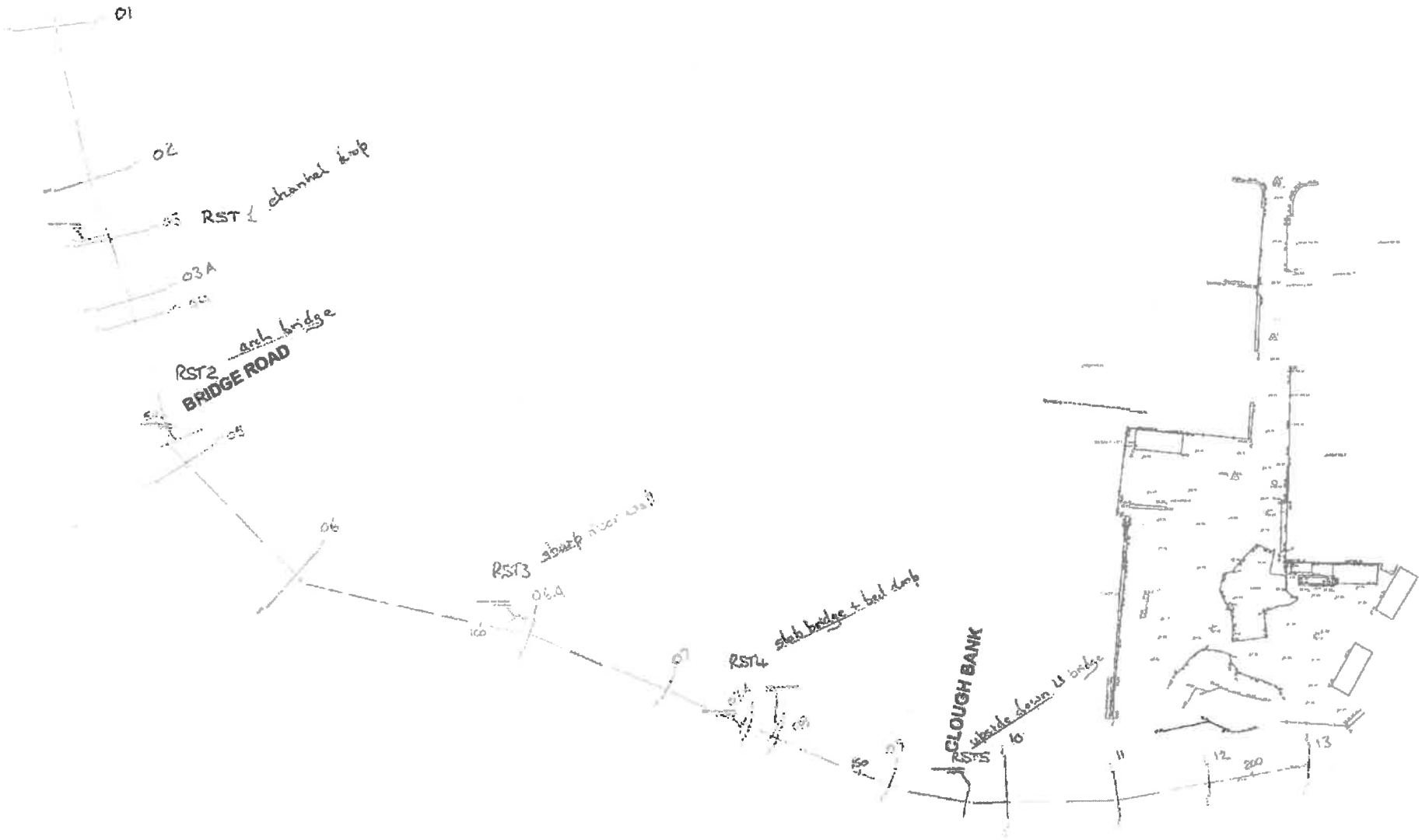
Cross sections
Minimum 3 bed points. tops of walls or GL either side and ground either side 1m to 5m either side where possible

Tops of walls enclosing the stream at Bridge Road

Culvert sizes & photos
Railway culvert- approx size + photo looking upstream
Clough Bank culvert- size plus photo inlet & outlet
Bridge Road ditto

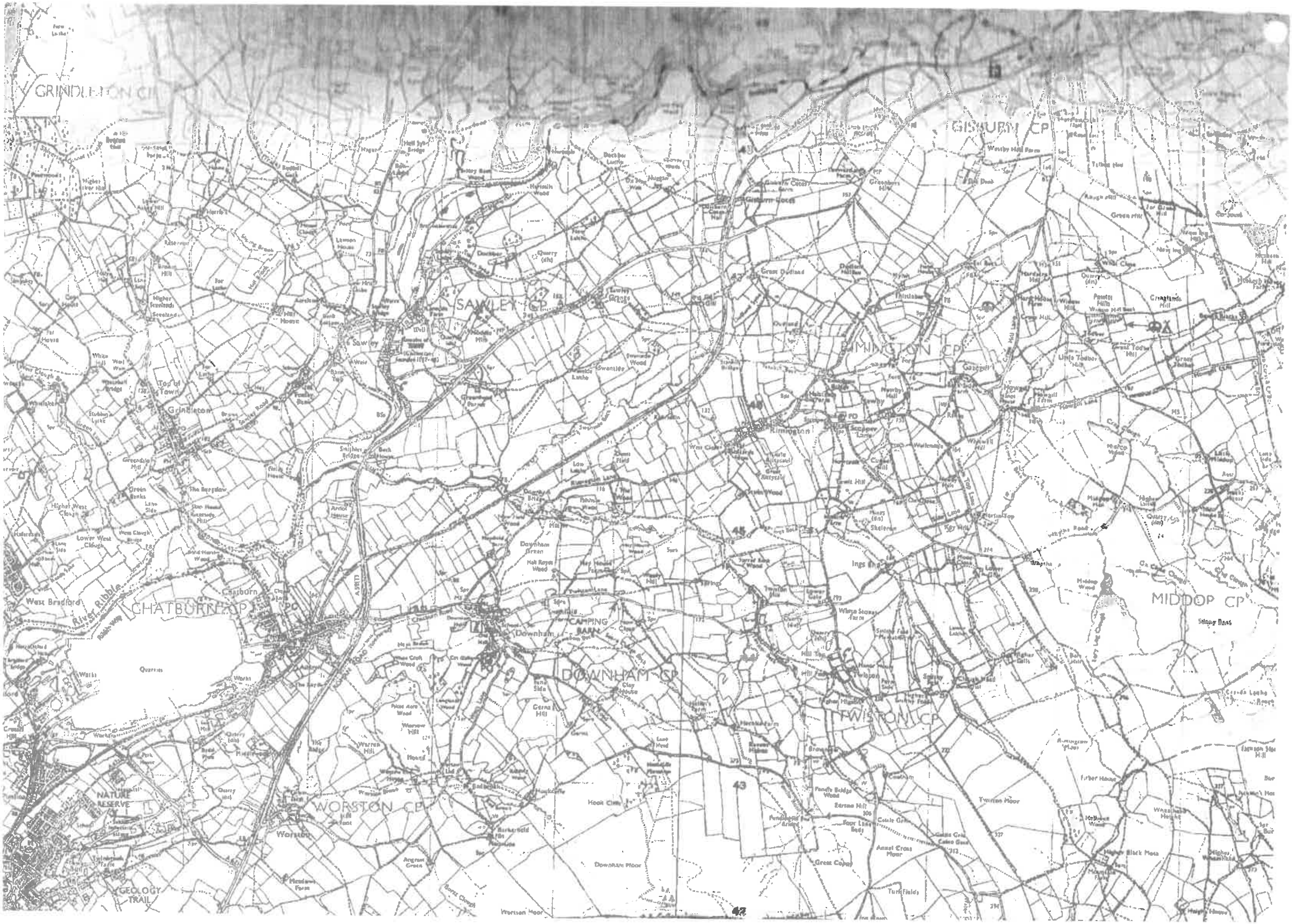
16/5/16 mcl B1852





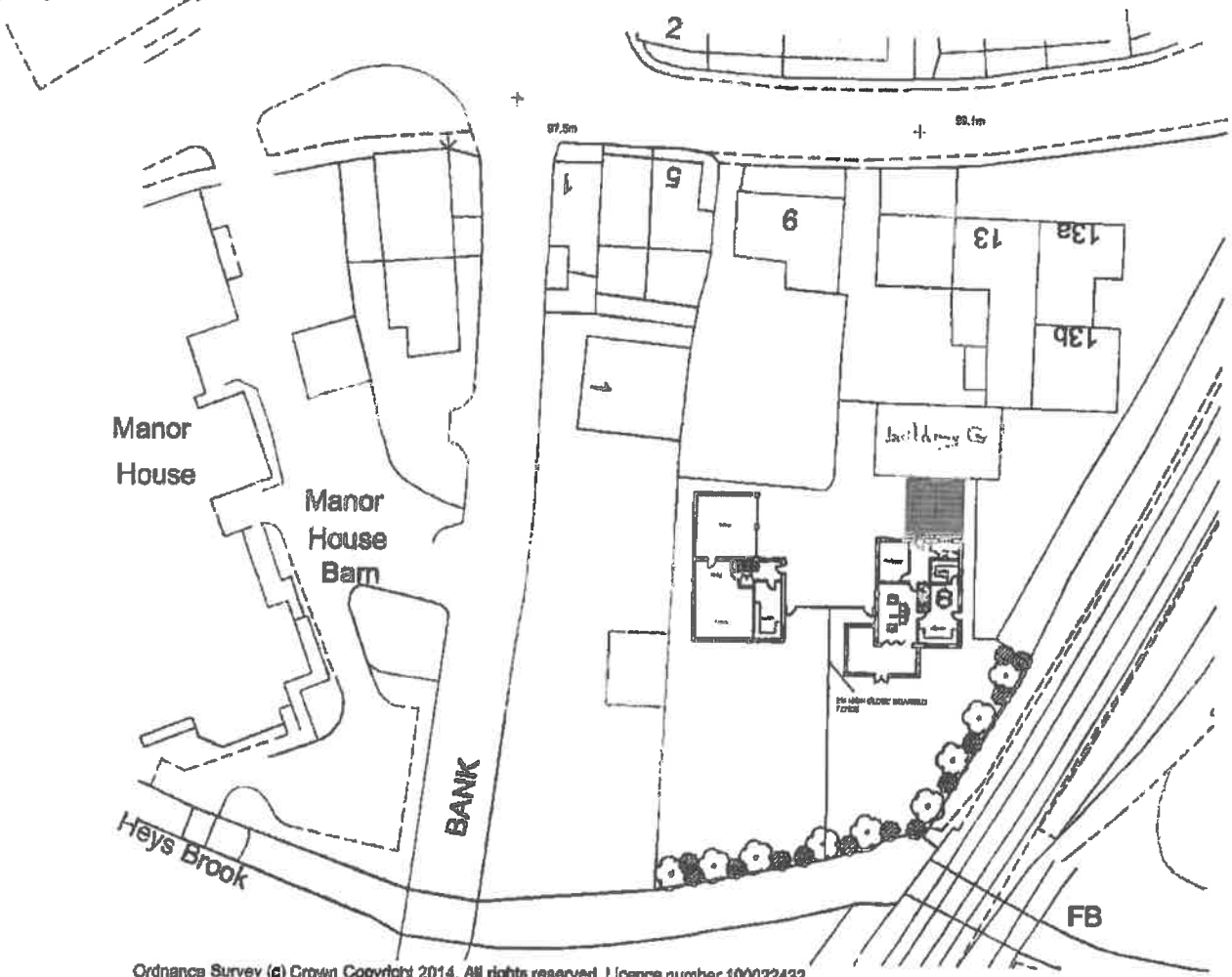
29/6/15 mel TB 1052

1/500
1 cm = 0 5



GRINDLETON CP
GISBURN CP
SAWLEY CP
RIMINGTON CP
MIDDOP CP
CHATBURN CP
DOWNHAM CP
TWISTON CP
WORSTON CP
CAMPING BARN
NATURE RESERVE
GEOLOGY TRAIL
River Ribble
Grindleton
Sawley
Rimington
Downham
Chatburn
Worston
West Bradford
Quarries
Downham Moor
Twiston Moor


top fence
wall collapse
tarmac



A - Amended Boundary

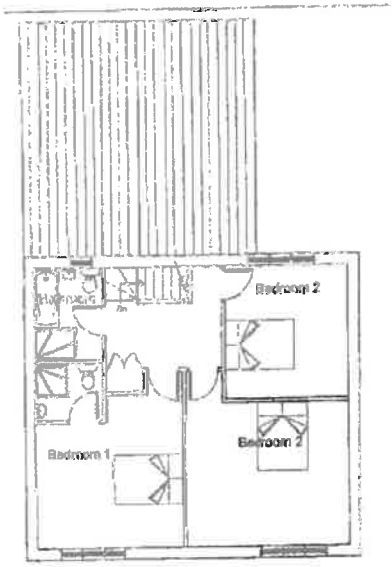
SITE PLAN

Site: 9 Downham Road
Chatburn
BB7 4AU

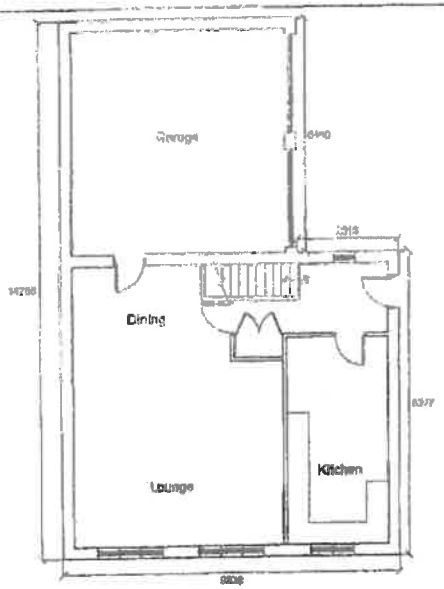
Client: Alan Jackson	
Drawn: HA	
Date: 18.08.15	
Scale: 1:500 @ A3	
Project No: JACKS/04 - Dwg 01	
Amendments:	B

Notes:
All work is to be carried out to the latest current British standards Codes of Practice and recognised working practices.
All work and materials should comply with Health and Safety legislation and to be approved by the Local Authority Planning / Building Control Officer.
All dimensions are in millimetres unless where explicitly shown otherwise. The contractor should check and clarify all dimensions as work proceeds and notify the design team of any discrepancies. Do not scale off the drawings, if in doubt ask.
Avalon Chartered Town Planning are not liable for work undertaken prior to Full Planning Consent and/or Building Regulations Approval

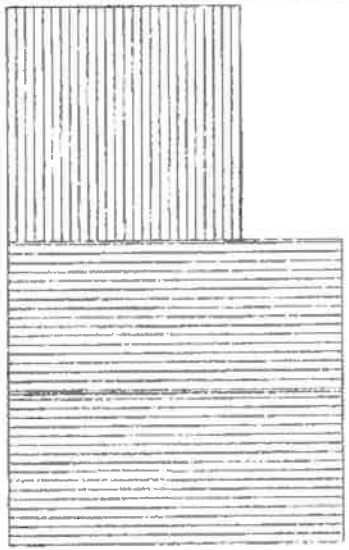
Avalon RTPI
Chartered Town Planning
Town Planning - Architectural Design - Building Regulations - Surveying
Phone: 01282 834834 Fax: 01282 451666
Web: www.avalonlp.co.uk Email: planning@avalonlp.co.uk
2 Rawtey Business Centre, Redman Road, Burnley, Lancashire, BB10 2TY



Ground Floor Plan



First Floor Plan



Roof Plan

Notes:

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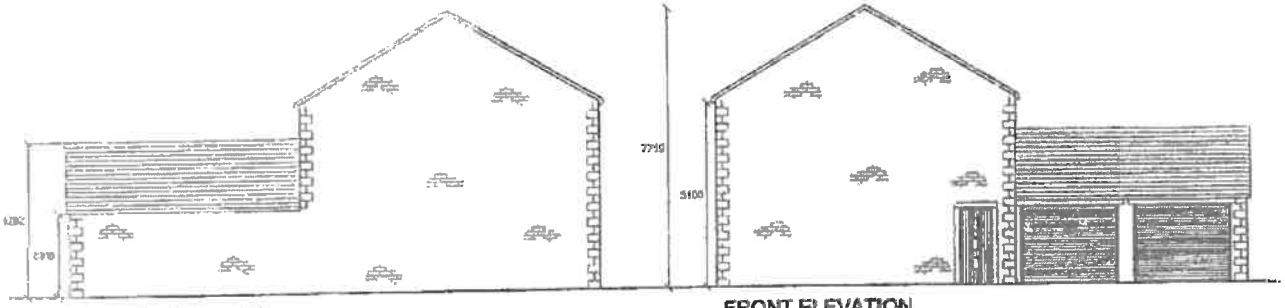
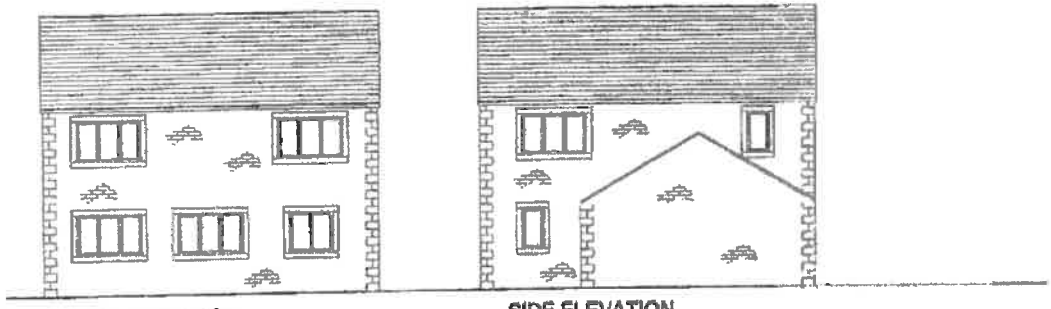


REAR ELEVATION

FRONT ELEVATION



SIDE ELEVATION

SIDE ELEVATION

Avalon

Chartered Town Planning

Town Planning - Architectural Design - Building Regulations - Surveying

Phone: 01282 834834 Fax: 01282 451666

2 Pendle Business Centre, Riverside Road, Barrowford, Lancashire, BB9 6BW

PROPOSED ELEVATIONS

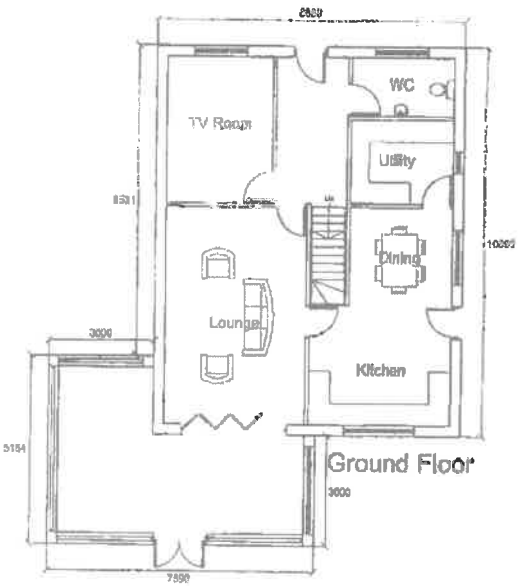
Site: 3 Downham Road
Chatburn
BB7 4AG

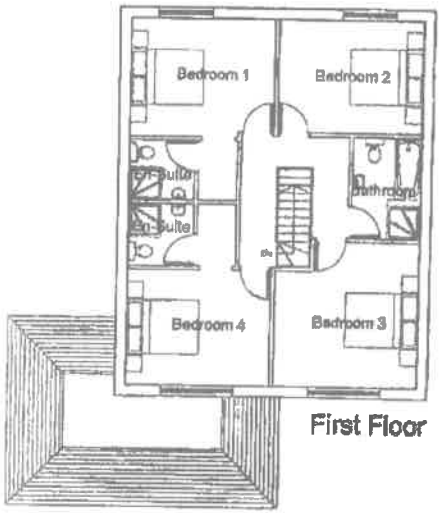
Client: Alan Jackson

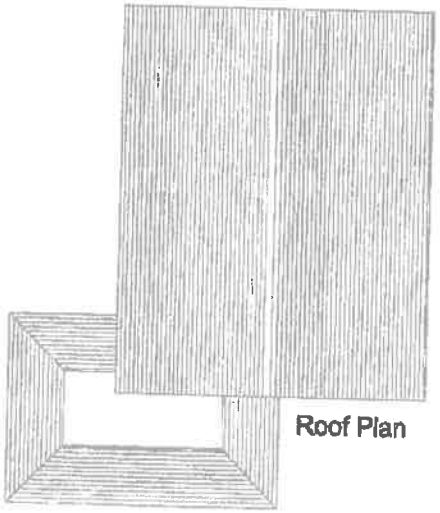
Date: 13.08.15 | Scale: 1:100 @ A2

Project No: JACKS - 04 | Dwg No: | Drawn: HA

Amendments:







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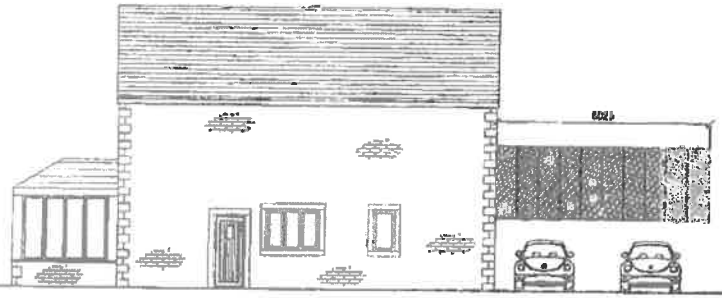
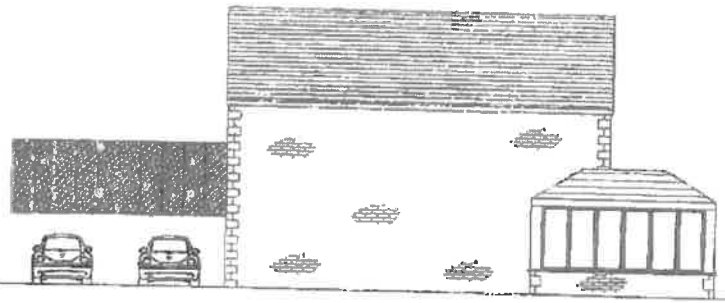




Avalon
Chartered Town Planning
Town Planning - Architectural Design - Building Regulations - Surveying
Phone: 01282 834834 Fax: 01282 451666
1 Hawley Business Centre, Burnley Road, Colne, Lancashire, BB8 8EYY

PROPOSED ELEVATIONS

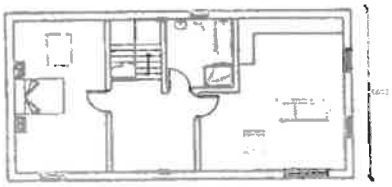
Site: 9 Downham Road
Chatburn
BB7 4AJ

Client: Alan Jackson

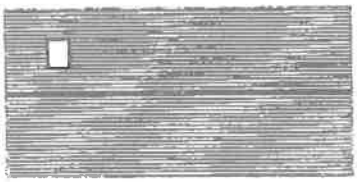
Date: 10.06.15 | Scale: 1:100 @ A2

Project No: JACKS - 04 / Dwg 05 | Drawn: HA

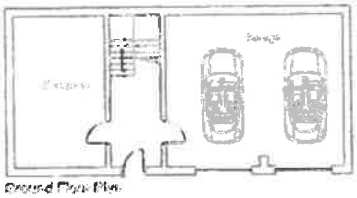
Amendments:



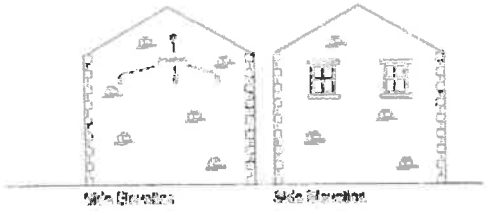
First Floor Plan



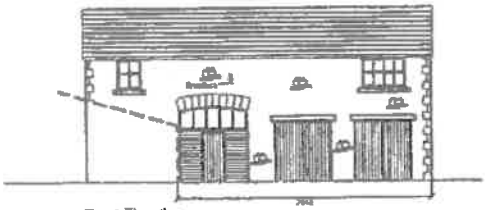
Roof Plan



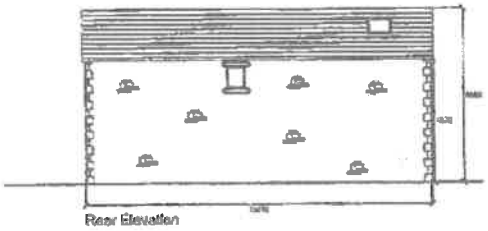
Ground Floor Plan



Side Elevation



Front Elevation



Rear Elevation

building G

Plans and Elevations	Client: Alan Jakson
Site: 9 Downham Road Chatburn BB7 4AU	Drawn: HA
	Date: 19.08.15
	Scale: 1:150 @ A3
	Project No: JACKS-05 / Dwg 04
	Amendments:

Notes:
All work is to be carried out to the latest current British Standards Codes of Practice and recognised working practices. All work and materials should comply with Health and Safety legislation and to be approved by the Local Authority Planning / Building Control Officer.
All dimensions are in millimetres unless where explicitly shown otherwise. The contractor should check and clarify all dimensions at work process and notify the design team of any discrepancies. Do not scale off the drawings, if in doubt ask.
Avalon Chartered Town Planning are not liable for work undertaken prior to Full Planning Consent and/or Building Regulations Approval

Avalon RTPI
Chartered Town Planning
Town Planning - Architectural Design - Building Regulations - Surveying
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2 Rawdon Business Centre Rawdon Road, Burnley, Lancashire, BB10 2TY

Environment Agency

Enter a postcode or place name: BB7 4AU Go

Other topics for this area... Flood Map for Planning (Rivers and Sea)

Flood Map for Planning (Rivers and Sea)

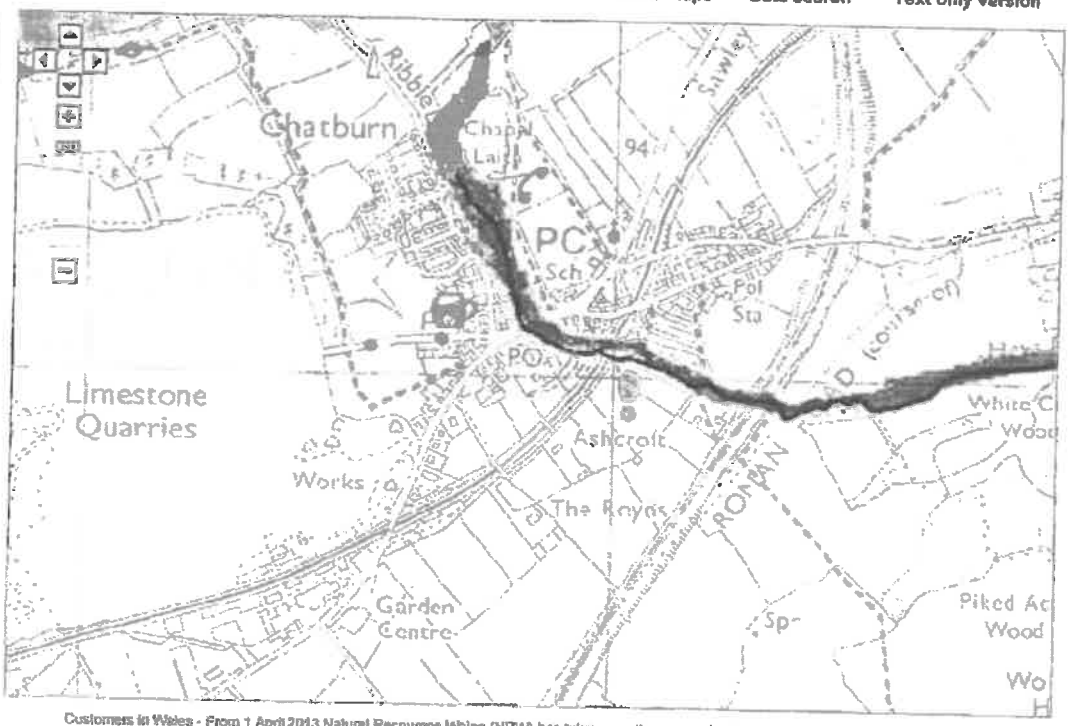
Map legend

BB7 4AU at scale 1:10,000

Other maps | Data search | Text only version

Click on the map to see what Flood Zone (National Planning Policy Guidance definitions) the proposed development is in.

- Flood Map for Planning (Rivers and Sea)
  - Flood Zone 3
  - Flood Zone 2
  - Flood defences (Not all may be shown*)
  - Areas benefiting from flood defences (Not all may be shown*)
- Main River Line
  - Main River Line
- Other national environmental organisations
  - Natural Resources Wales Area of responsibility
  - Scottish Environment Protection Agency Area of responsibility



More about flooding:

Understanding the Flood Map for Planning (Rivers and Sea)

A more detailed explanation to help you understand the flood map shown above.

Current flood warnings

We provide flood warnings online 24 hours a day. Find out the current flood warning status in your local area.

* **Legend information:** Flood defences and the areas benefiting from them are gradually being added through updates. Please contact your local environment agency office for further details.

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Author: Environment Agency | wiybysupport@environment-agency.gov.uk
Last updated: 16th March 2016

Environment Agency

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Other topics for this area... Risk of Flooding from Rivers and Sea

View other Interactive Maps

Risk of Flooding from Rivers and Sea

River flooding happens when a river cannot cope with the amount of water draining into it from the surrounding land. Sea flooding happens when there are high tides and stormy conditions.

The shading on the map shows the risk of flooding from rivers and the sea in this particular area

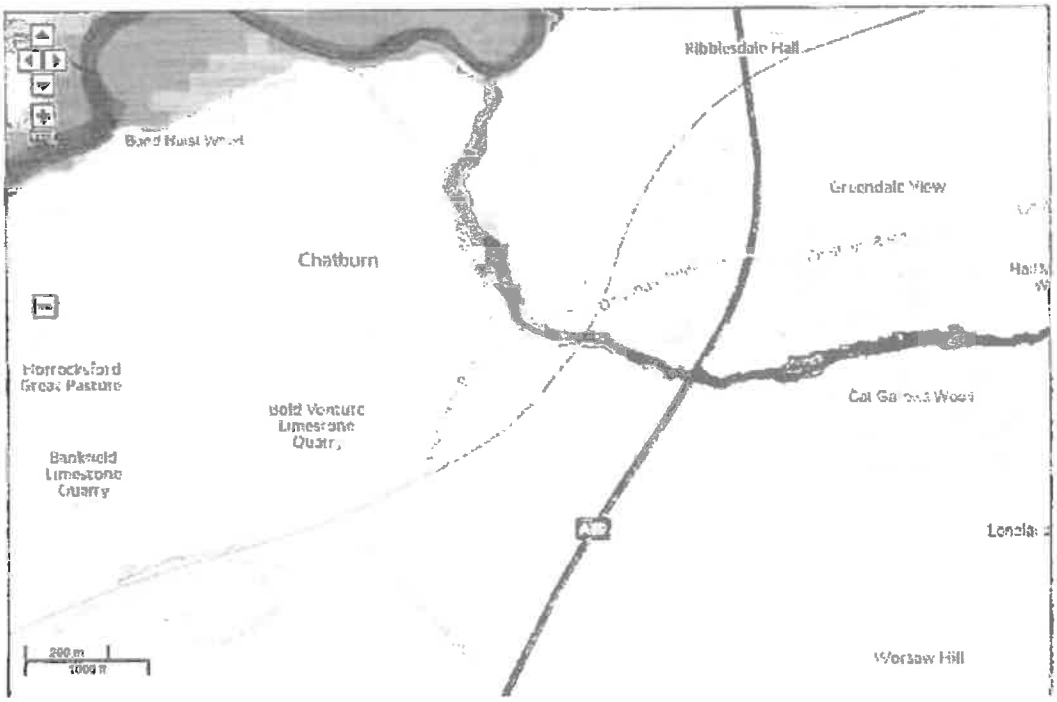
Click on the map for a more detailed explanation

Map of X: 376,856; Y: 444,026 at scale 1:10,000

Data search

Map legend

- Risk of Flooding from Rivers and Sea
  - High
  - Medium
  - Low
  - Very Low
- Other national environmental organisations
  - Natural Resources Wales Area of responsibility
  - Scottish Environment Protection Agency Area of responsibility



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Last updated: 06 May 2016

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Other topics for this area... Risk of Flooding from Surface Water

View other interactive Maps

Risk of Flooding from Surface Water

Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

The shading on the map shows the risk of flooding from surface water in this particular area.

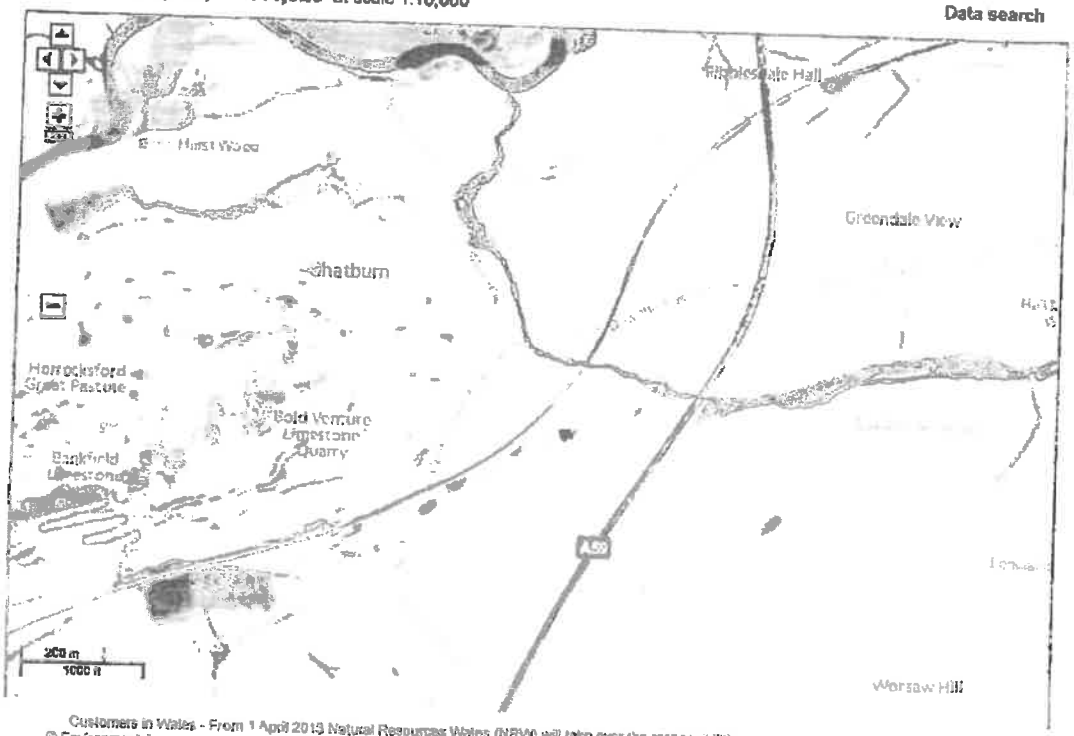
Click on the map for a more detailed explanation.

Map legend

- Risk of Flooding from Surface Water
  - High
  - Medium
  - Low
  - Very Low
- Other national environmental organisations
  - Natural Resources Wales Area of responsibility
  - Scottish Environment Protection Agency Area of responsibility

Map of X: 376,855; Y: 444,026 at scale 1:10,000

Data search



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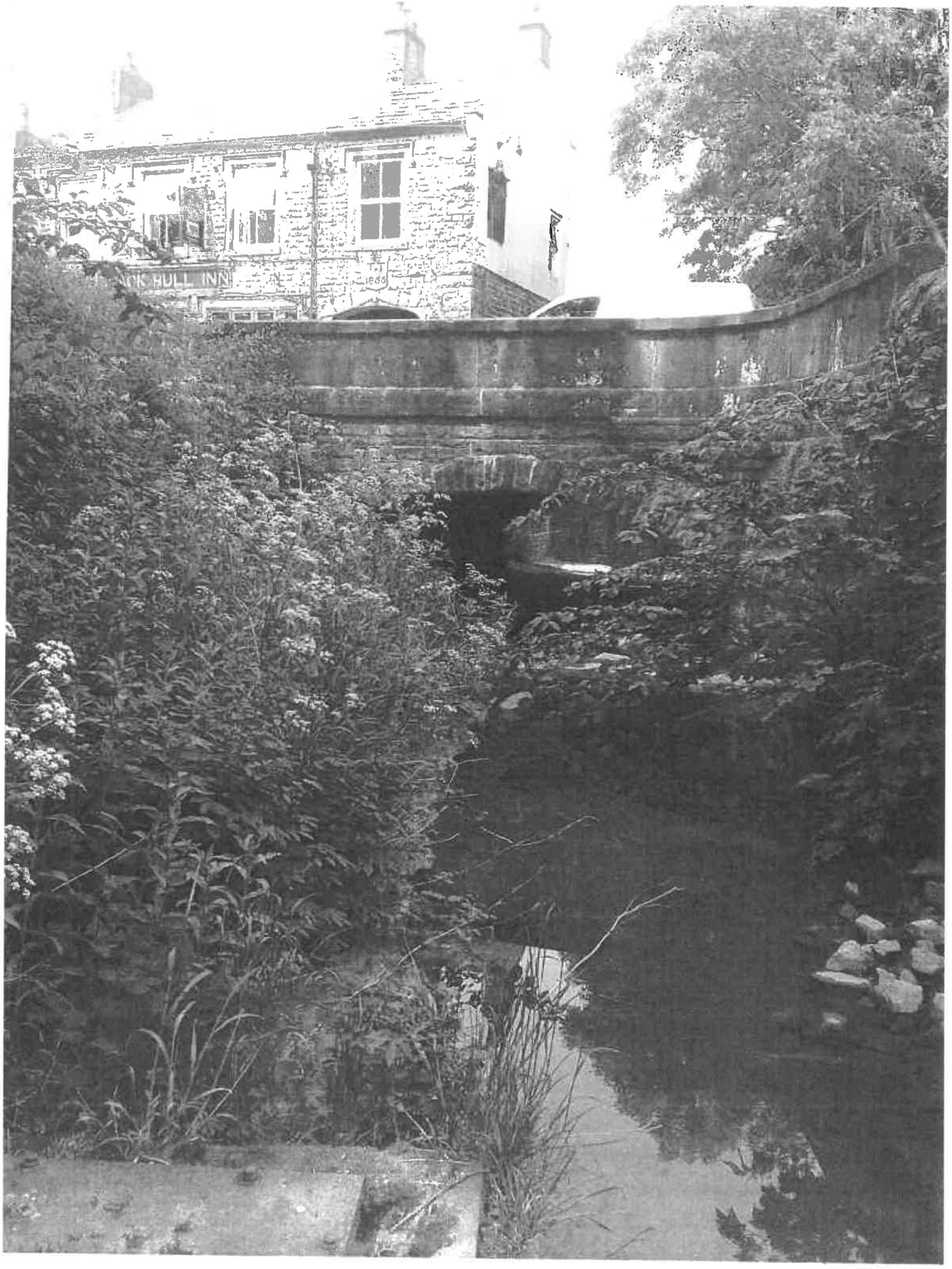
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