3201607 11P

# Land at 9 Downham Road
# Chatburn

# Flood risk and drainage assessment for 2 houses

## Postcode BB7 4AU

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INDEX

## 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.

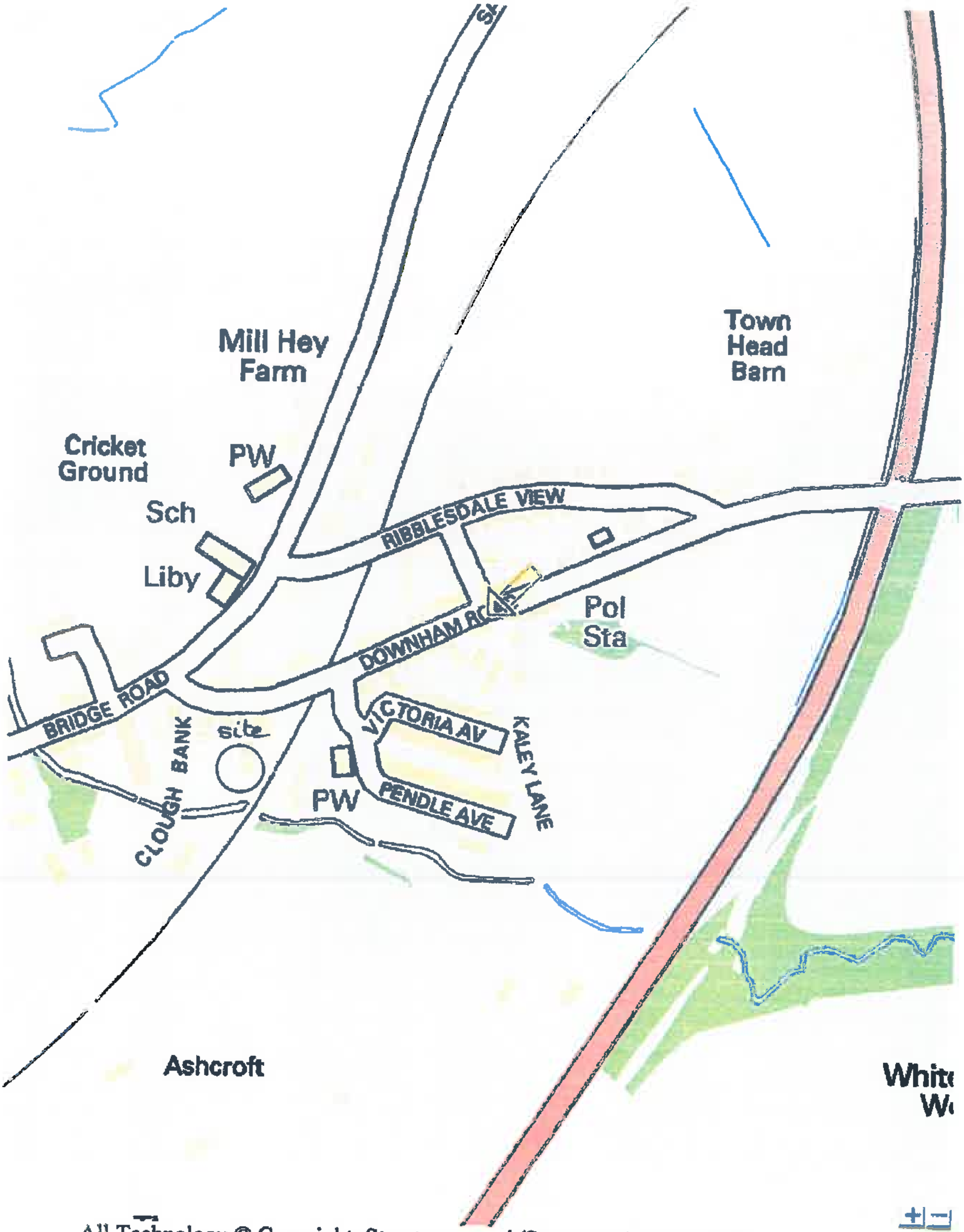
## 7.0 Attachments

| 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


Mill Hey
Farm
Town
Head
Barn
Cricket
Ground
PW
Sch
Liby
RIBBLESDALE VIEW
DOWNHAM RD
Pol
Sta
BRIDGE ROAD
CLOUGH BANK
site
VICTORIA AV
KALEY LANE
PENDLE AVE
PW
Ashcroft
Whit
W
+ −

Print

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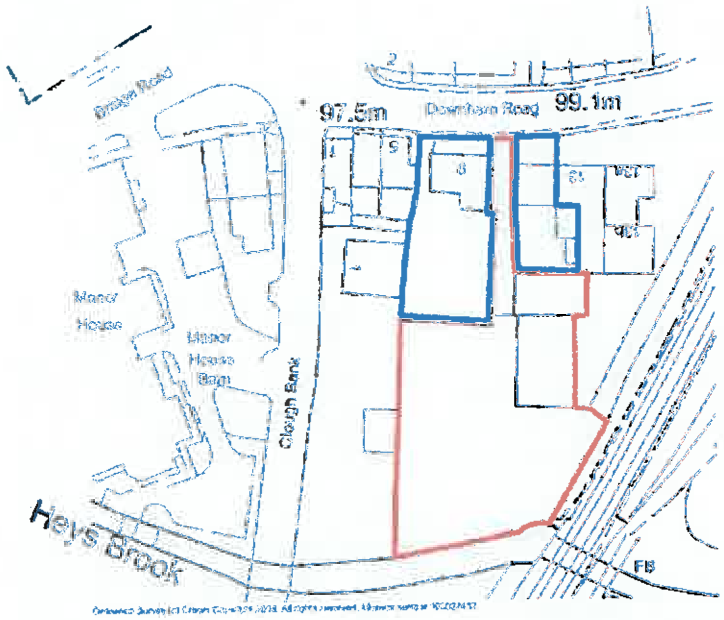

## Location PLAN

**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.
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Town Planning - Architectural Design - Building Regulations - Surveying

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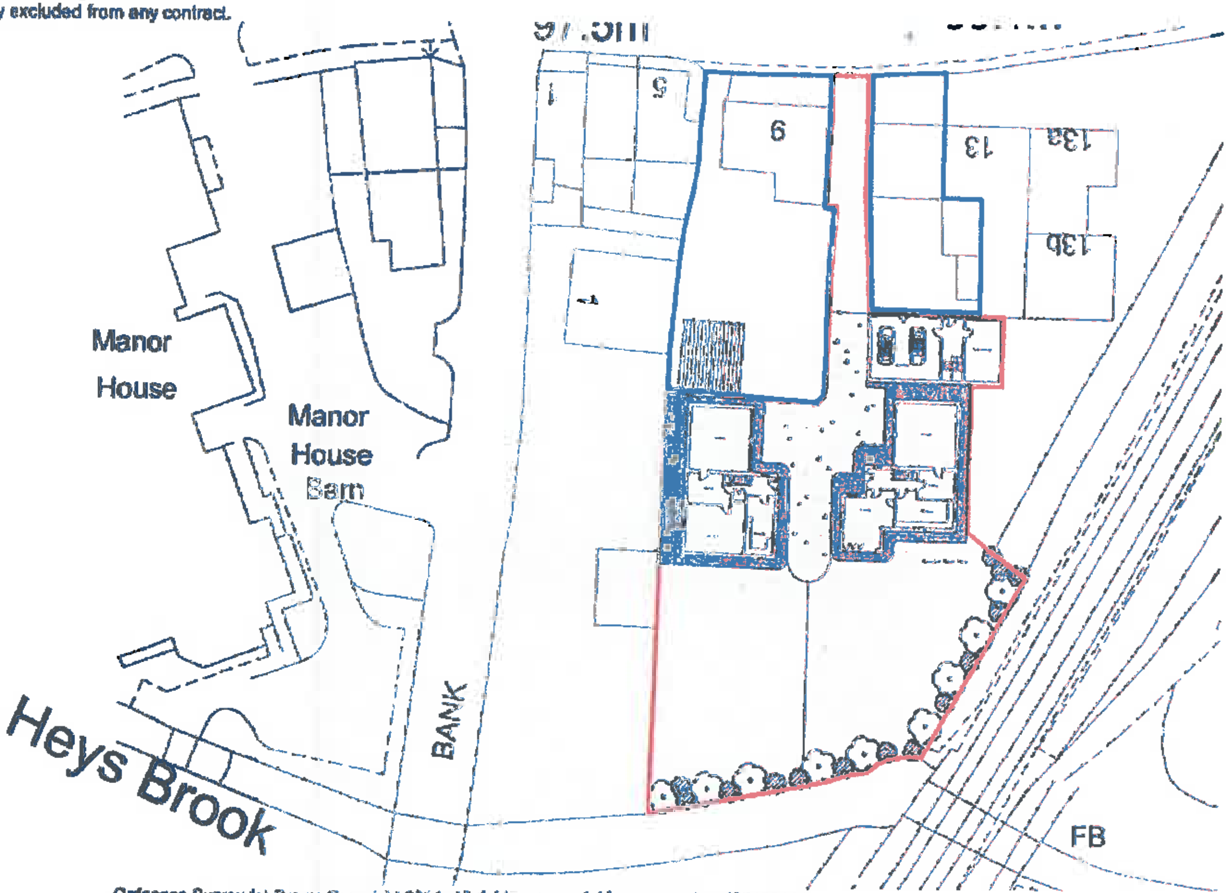

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## SITE PLAN

**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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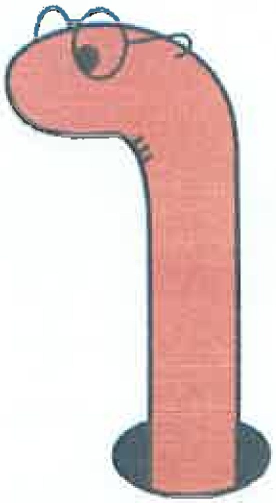
# Electronic Report



## WORMS EYE

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BB11 1TS
Phone
01282 414649 / 458410

Our Ref: Downham Road/BB7 4AV/2015

Date: 20/7/2015

Leanne Flynn
Avalon Chartered Town Planning
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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.

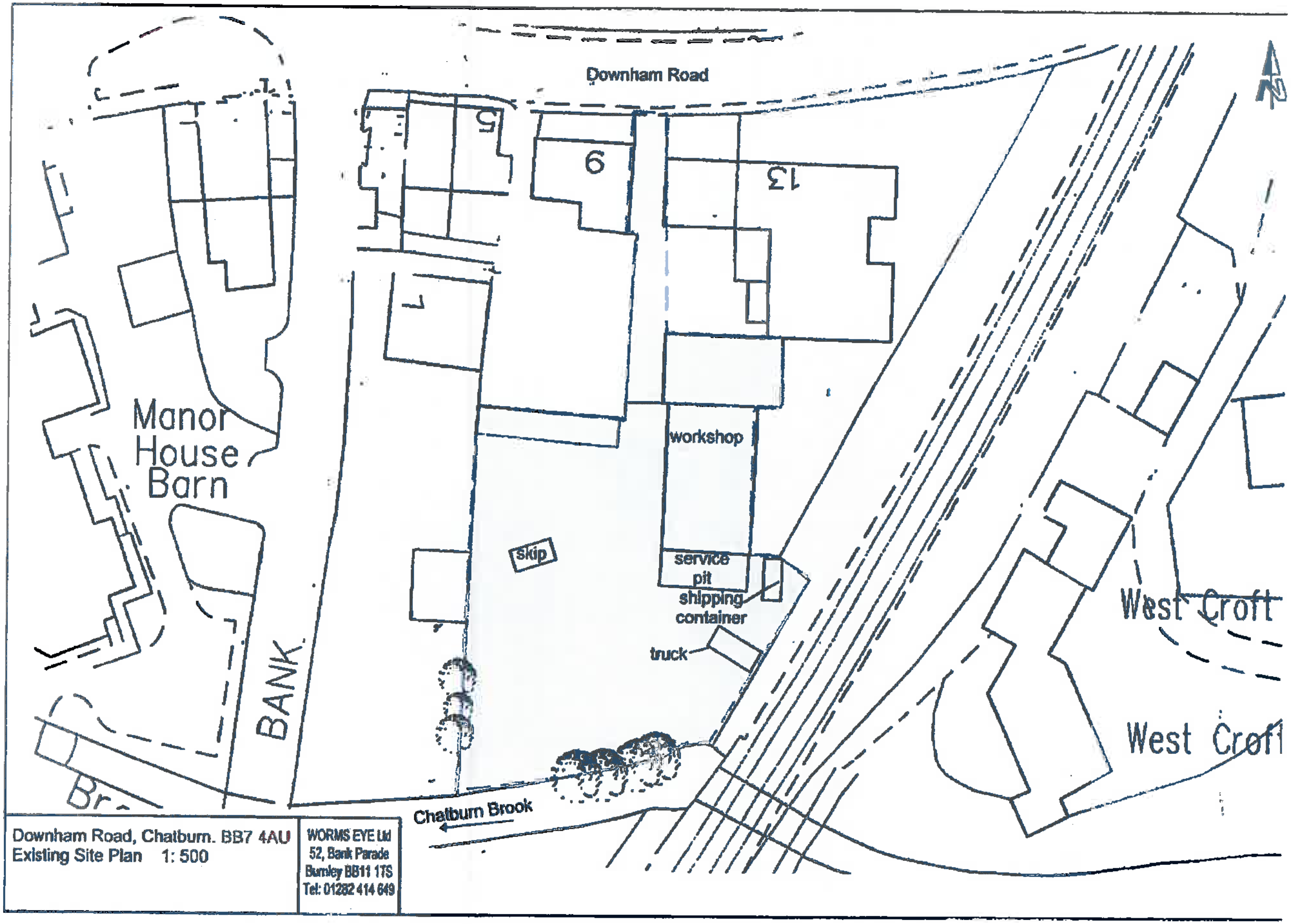
## PROPOSED DEVELOPMENT

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, Chatburn. BB7 4AU
Existing Site Plan 1: 500

WORMS EYE Ltd
52, Bank Parade
Burnley BB11 1TS
Tel: 01282 414 649

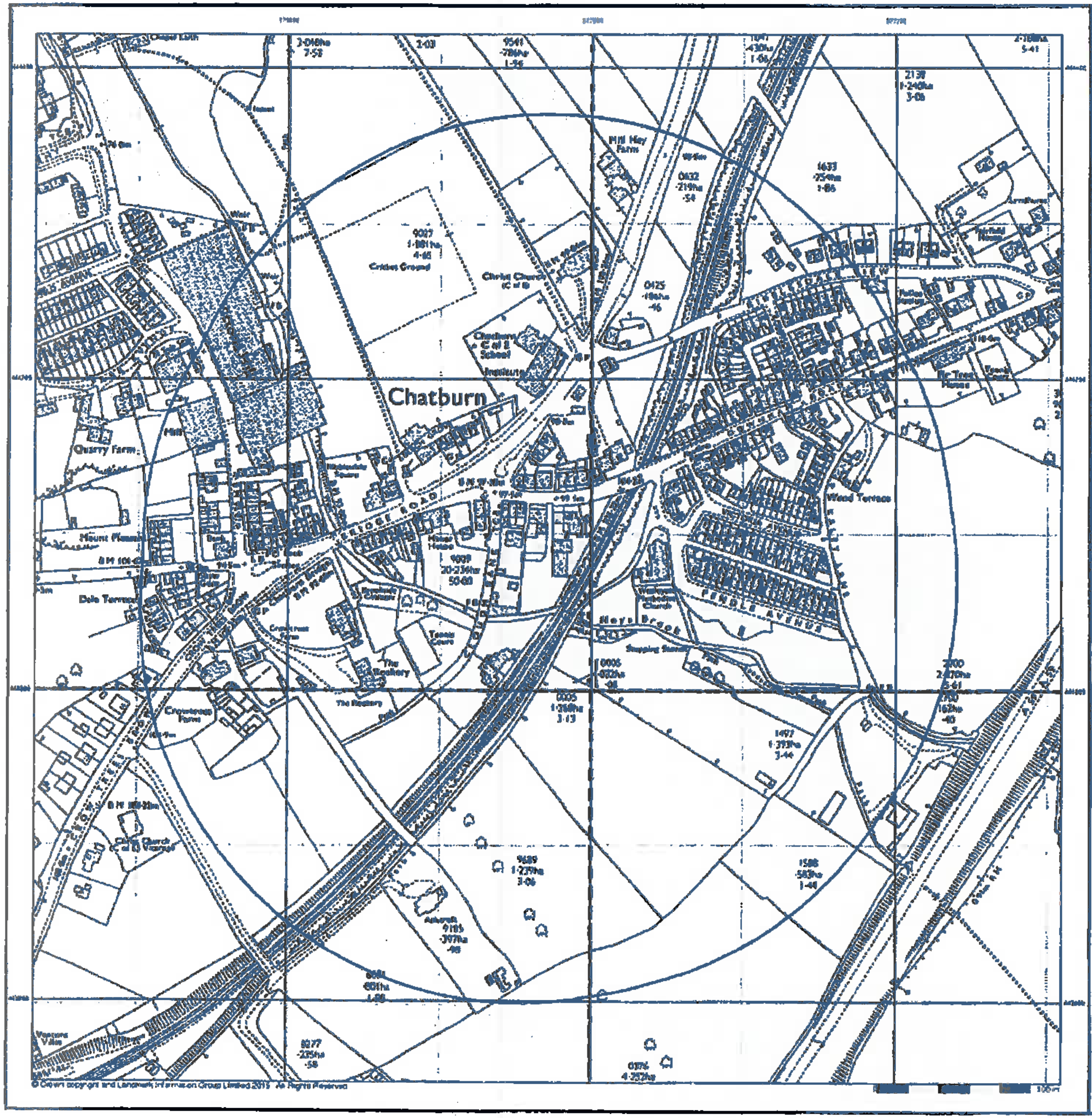
# Downham Road, Chatburn, BB7 4AU

view of site looking northeast

bonfire remains and asbestos fragments in southwest corner

view of site looking southwest

service pit



# Envirocheck

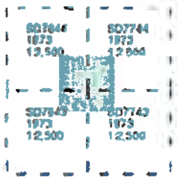
## Ordnance Survey Plan

## Published 1973

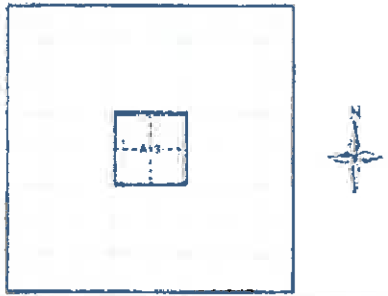
## Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held 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 1896 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 1938, 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 outlying areas.

## Map Name(s) and Date(s)



## Historical Map - Segment A13



## Order Details

| | |
|---|---|
| Order Number: | 69227055_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

Landmark

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

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

**PSA Design Limited**
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6 Berry Lane
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mail@psadesign.co.uk

## 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 determinands by the statistical analysis within the made ground material:

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

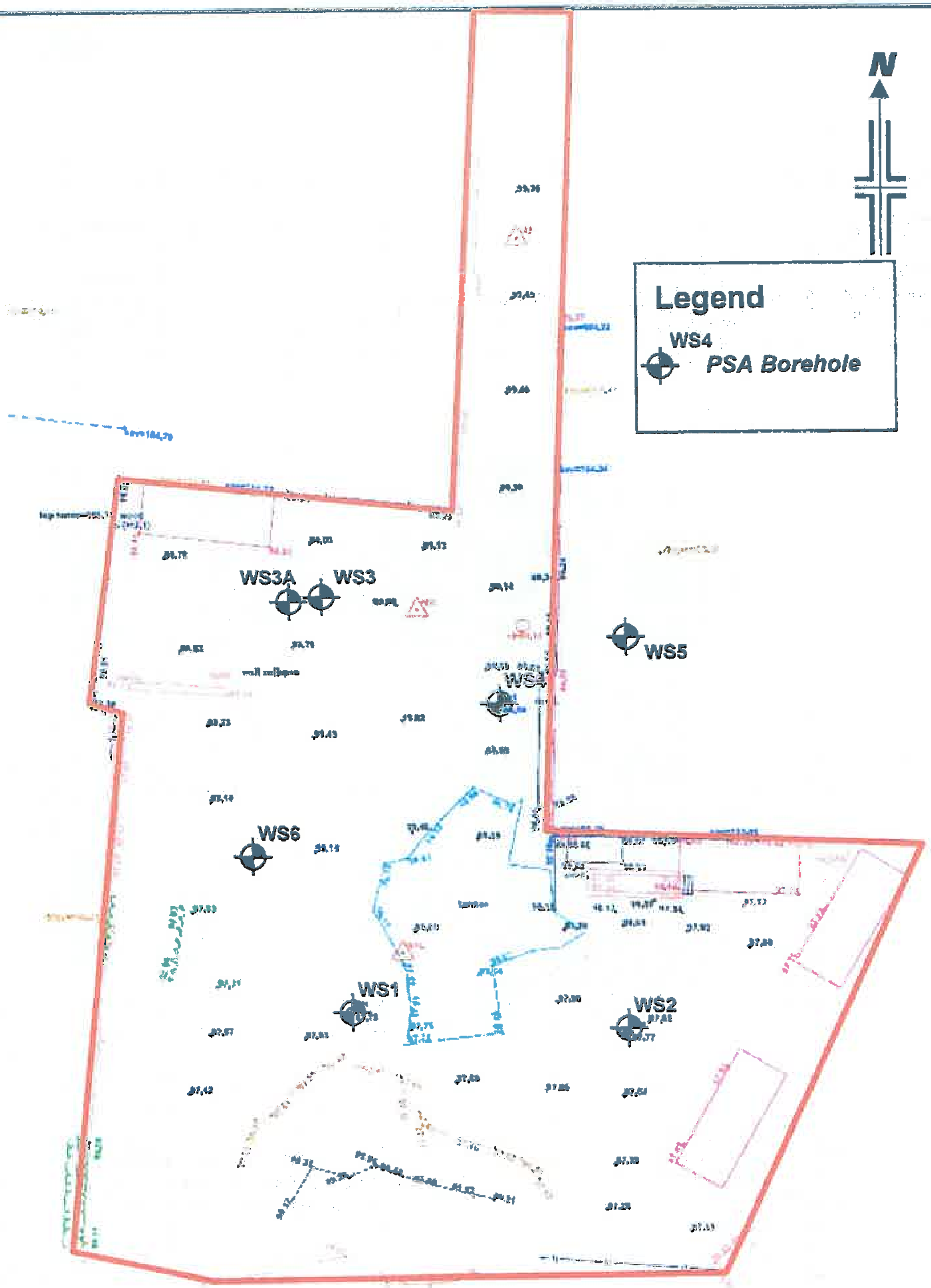
Raised levels of contamination were found within the various types of made ground across the site and at various depths. Slightly elevated levels of PAH were also found in the leachate test. The main contamination risk from hydrocarbons leaking from the tank appears not to have occurred, with testing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

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PSA Design
The Old Bank House
6 Berry Lane, Longridge
Preston, PR3 3JA
Tel. 01772 786066

| | |
|---|---|
| Client | A Jackson |
| Job | Downham Road, Chatburn |
| Title | Ground Investigation Plan |

| Scale | NTS | |
|---|---|---|
| Drawn | Check | Appr |
| JSB | JSB | JSB |

| | |
|---|---|
| Dwg No. | G2235-06 |
| Date | 03-06-2016 |
| Rev | |

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email: mail@psadesign.co.uk

| | | | |
|---|---|---|---|
| Project Name<br>Downham Road | Project No.<br>G2235 | Co-ords: - | Borehole No<br>**WS1**<br>Sheet 1 of 1 |
| | | | Hole Type<br>WS |
| Location: Chatburn | | Level: - | Scale<br>1:50 |
| Client: Alan Jackson | | Dates: 11/02/2016 | Logged By<br>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 | | 1.00 | | ▨ | 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).<br>(MADE GROUND) |
| | | | | | 2.10 | | ▨ | 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).<br>(MADE GROUND) |
| | | | | | 3.20 | | ▨ | 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).<br>(MADE GROUND) |
| | | | | | 3.40 | | ▨ | 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).<br>(MADE GROUND) |
| | | | | | 3.45 | | | Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragements. (possible weathered bedrock - Chatburn Limestone)<br>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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| | | | |
|---|---|---|---|
| Project Name<br>Downham Road | Project No.<br>G2235 | Co-ords: - | Borehole No<br>**WS2**<br>Sheet 1 of 1 |
| | | | Hole Type<br>WS |
| Location: Chatburn | | Level: - | Scale<br>1:50 |
| Client: Alan Jackson | | Dates: 11/02/2016 | Logged By<br>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).<br>(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).<br>(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).<br>(MADE GROUND) |
| | | | | | 3.30 | | | Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragements. (possible weathered bedrock - Chatburn Limestone)<br>Refusal of drilling (possible bedrock) |
| | | | | | 3.35 | | | End of Borehole at 3.35 m |

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: 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) | Level (m AOD) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | 0.30 | IVN 1 | 125 | 0.05 | | | TOPSOIL:Turf over grey brown slightly organic CLAY with common fine rootlets.<br>(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).<br>(GLACIAL TILL) |
| | | | | | 0.80 | | | Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragements. (possible weathered bedrock - Chatburn Limestone).<br>Refusal of drilling (possible bedrock). |

End of Borehole at 0.80 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.

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Borehole No
**WS03A**
Sheet 1 of 1

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

| Well | Water Strikes | Samples & In Situ Testing | | | Depth (m) | Level (m AOD) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | | | | 0.05 | | | TOPSOIL:Turf over grey brown slightly organic CLAY with common fine rootlets. (TOPSOIL) |
| | | 0.30 | IVN 1 | 128 | | | | |
| | | | | | 0.55 | | | 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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| | | | |
|---|---|---|---|
| Project Name<br>Downham Road | Project No.<br>G2235 | Co-ords: - | Borehole No<br>**WS4**<br>Sheet 1 of 1 |
| | | | Hole Type<br>WS |
| Location: Chatburn | | Level: - | Scale<br>1:50 |
| Client: Alan Jackson | | Dates: 11/02/2016 | Logged By<br>JSB |

| Well | Water Strikes | Samples & In Situ Testing Depth (m) | Type | Results | Depth (m) | Level (m AOD) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | | | | 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).<br>(MADE GROUND) |
| | | 0.50-0.90 | ES | | 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).<br>(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).<br>(MADE GROUND) |
| | | | | | 1.80 | | | Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragements. (possible weathered bedrock - Chatburn Limestone).<br>Refusal of drilling (possible bedrock) |

End of Borehole at 1.80 m

1
2
3
4
5
6
7
8
9

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

| Well | Water Strikes | Samples & In Situ Testing | | | Depth (m) | Level (m AOD) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| ▨ | | | | | 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, slightly 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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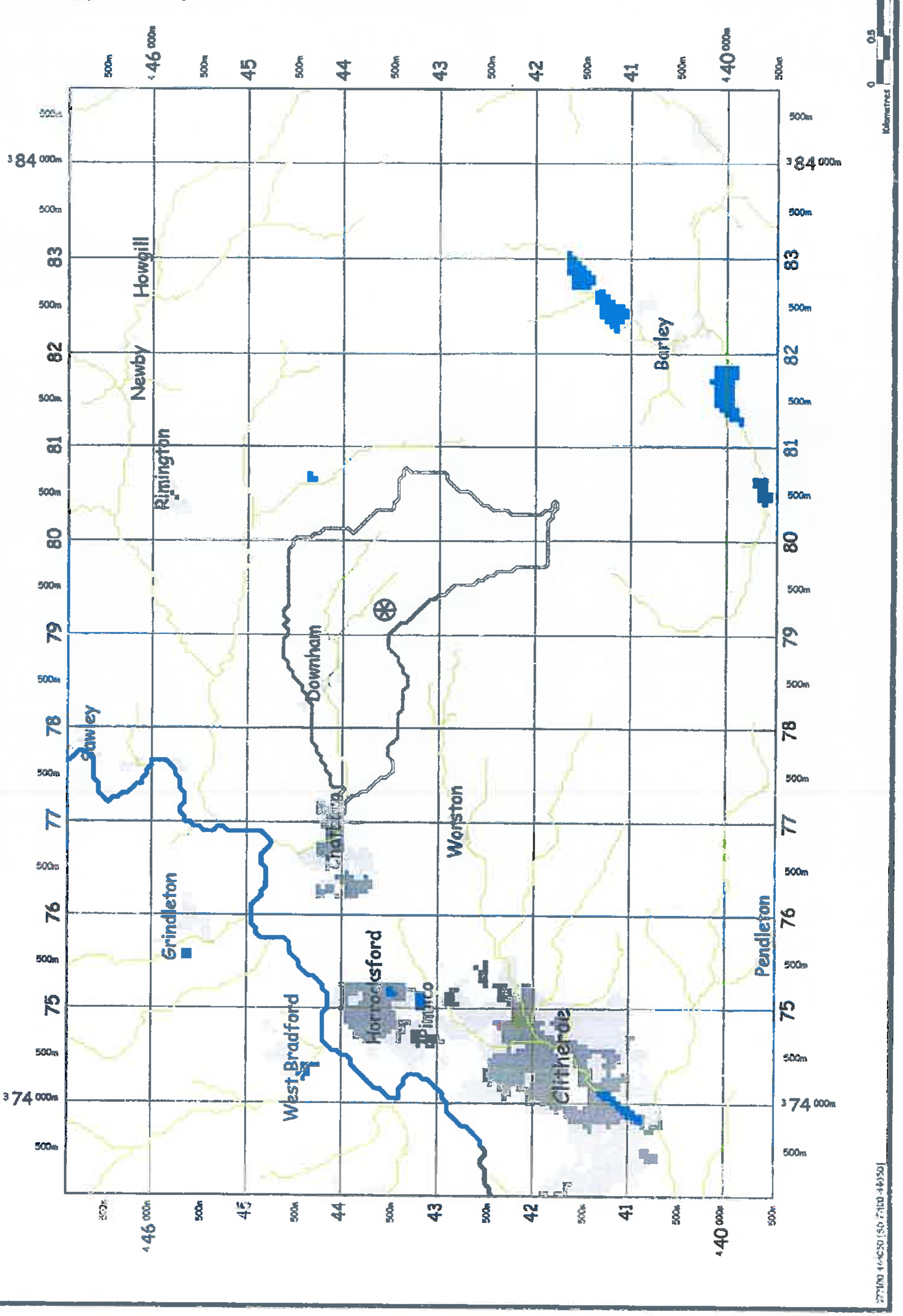
| | | | |
|---|---|---|---|
| Project Name<br>Downham Road | Project No.<br>G2235 | Co-ords: - | Borehole No<br>**WS6**<br>Sheet 1 of 1 |
| Location: Chatburn | | Level: | Hole Type<br>WS |
| | | | Scale<br>1:50 |
| Client: Alan Jackson | | Dates: 11/02/2016 | Logged By<br>JSB |

| Well | Water Strikes | Samples & In Situ Testing | | | Depth (m) | Level (m AOD) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | | | | 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).<br>(MADE GROUND) |
| | | 0.30-0.60 | ES | | | | | |
| | | | | | 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).<br>(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).<br>(MADE GROUND) |
| | | | | | 2.40 | | | Very dense (driller's description) dark grey, strong, medium-coarse LIMESTONE gravel fragements. (possible weathered bedrock - Chatburn Limestone).<br>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.

Printed from FEH CD-ROM 3 at 09:09 on 12-Feb-2016.



| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 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 | 1287 | | | | | | | |
| 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 | 0.38255 | | | | | | | |
| D3 | 0.4197 | | | | | | | |
| E | 0.30324 | | | | | | | |
| F | 2.47865 | | | | | | | |
| C(1 km) | -0.026 | | | | | | | |
| D1(1 km) | 0.429 | | | | | | | |
| D2(1 km) | 0.388 | | | | | | | |
| D3(1 km) | 0.439 | | | | | | | |
| E(1 km) | 0.302 | | | | | | | |
| F(1 km) | 2.463 | | | | | | | |

**Michael Lambert Associates**

Catchment descriptors

Heys Brook, Chatburn

12/02/2016 mel

B1839

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| VERSION | FEH CD-R | Version | 3 | exported a | 09:10:08 | GMT | Fri | 12-Feb-16 | | | B1852 |
| Parameters | | | | Chatburn area | | | | mel | | | |
| Calculation | Design rainfall | | | Point rainfall depths unadjusted | | | | | | | |
| Calculatior | For a point | | | | | | | | | | |
| Calculatior | 1 km point | GB | 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 | 0.388 | 0.439 | 0.302 | 2.463 | | | | | | |

A design rainfall of 82.0 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.

| | | | 10 | 20 | 50 | 100 | 200 | 500 |
|---|---|---|---|---|---|---|---|---|
| Duration | Duration | Duration | year rainfa | year rainfa | year rainfa | year rainfa | year rainfa | year rainfall |
| minutes | hours | days | mm | mm | mm | mm | mm | mm |
| 15 | 0.25 | 0.010417 | 13.86 | 17.68 | 24.22 | 30.67 | 38.8 | 52.92 |
| 30 | 0.5 | 0.020833 | 17.92 | 22.56 | 30.4 | 38.01 | 47.49 | 63.7 |
| 45 | 0.75 | 0.03125 | 20.82 | 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 | 81.38 |
| 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 | 107.18 |
| 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 | 65.66 | 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 | 54.85 | 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 | 49.46 | 59.16 | 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 | 111.96 | 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 | 116.85 | 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 | 67.98 | 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 | 58.56 | 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 | 153.69 |
| 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** | mis | **Catchment easting** | 377100 | **Version** | 1.4 |
| **Project name** | chatburn brook | **Catchment northing** | 444050 | | |
| | | **Catchment area** | 4.39 | | |

## 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

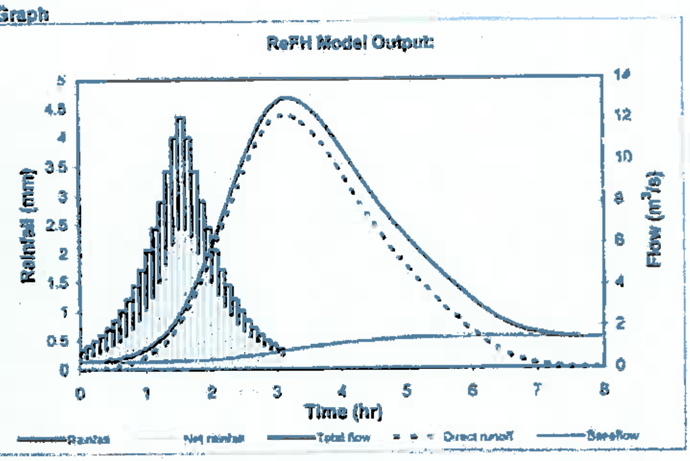
| | | | |
|---|---|---|---|
| **FEH DDF rainfall (mm)** | 68.1 | **Peak rainfall (mm)** | 4.3 |
| **Design rainfall (mm)** | 51.1 | **Peak flow ($m^3/s$)** | 13.1 |

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 | 0.6 |
| 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 | 0.5 | 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 | 11.6 | 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 | 6.5 | 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 |

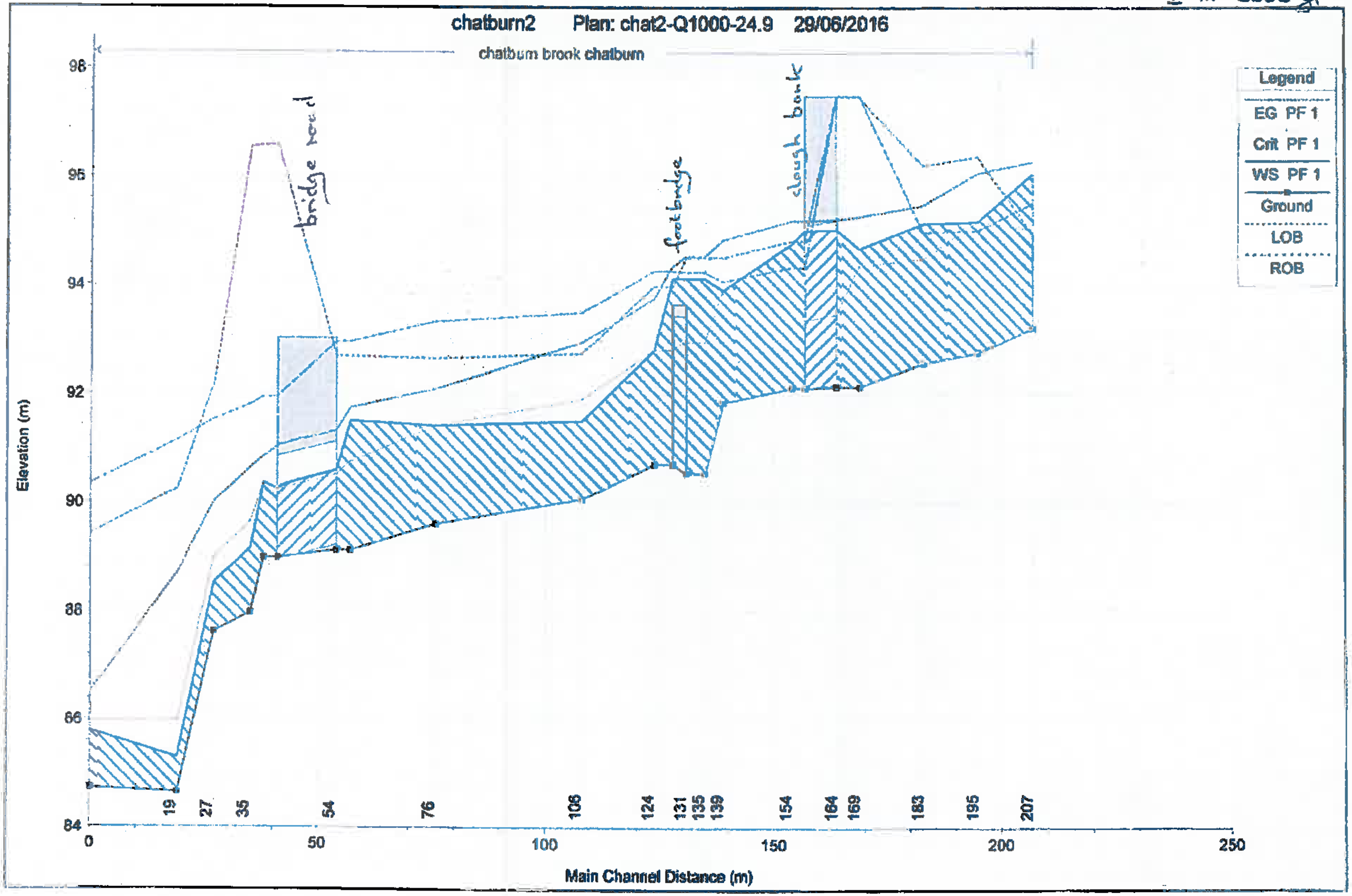
**Graph**



Q1000 24.9

Growth factor 1.9

1 in 1000 yr


chatburn2 Plan: chat2-Q1000-24.9 29/06/2016
chatburn brook chatburn
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
LOB
ROB
bridge road
footbridge
clough bank
Elevation (m)
98
96
94
92
90
88
86
84
0
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)

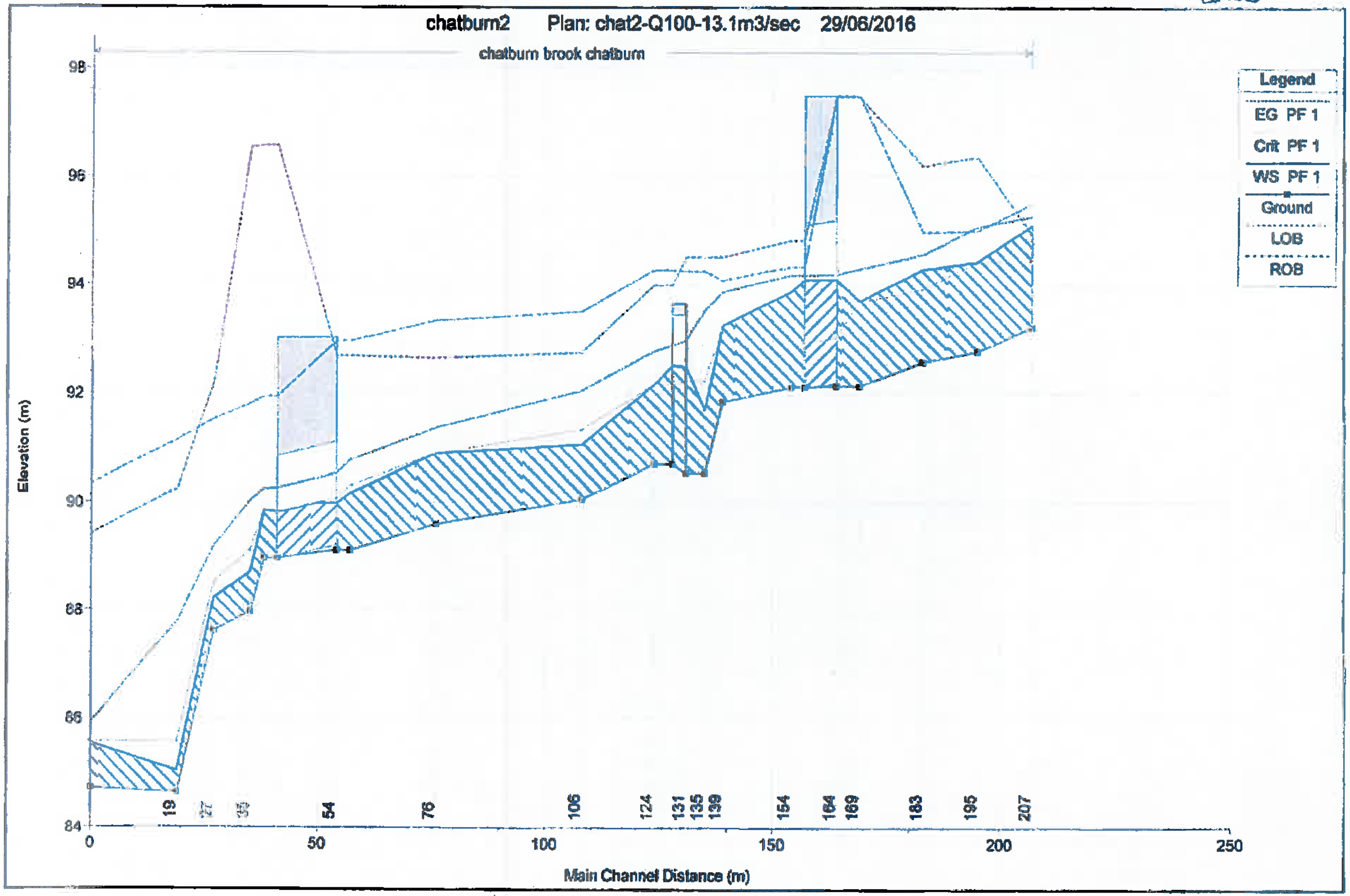
1 in 1000 year

HEC-RAS Plan: p02 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 | 24.900 | 93.210 | 96.040 | 95.03 | 96.26 | 0.005 | 2.08 | 11.98 | 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 | 92.96 | 0.066 | 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 | 90.63 | 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 | 0.082 | 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 | 85.788 | 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
0
50
100
150
200
250
Main Channel Distance (m)
19
27
35
54
76
106
124
131
135
139
154
164
169
183
195
207

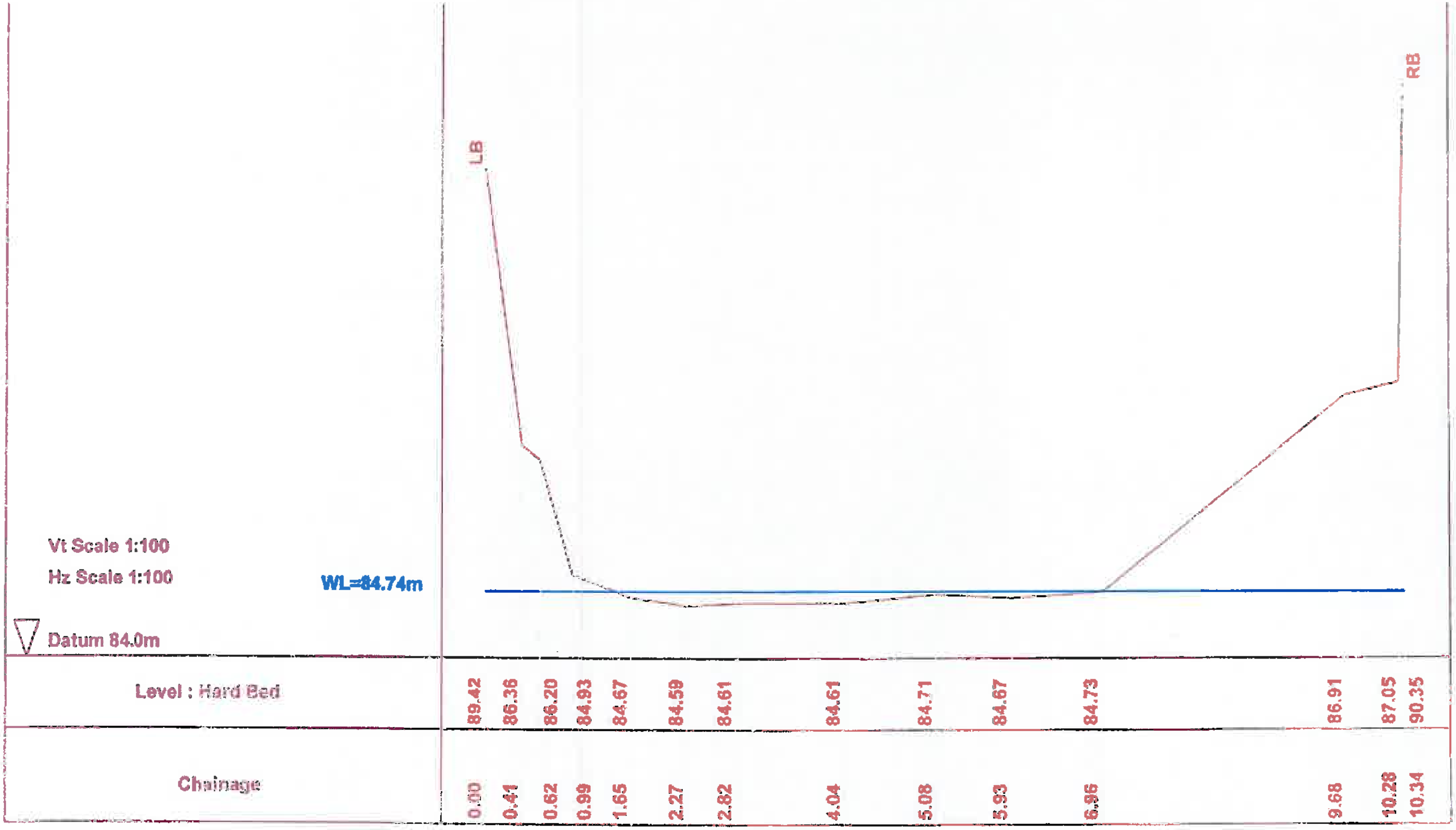
water levels ↓

1 in 100 year

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

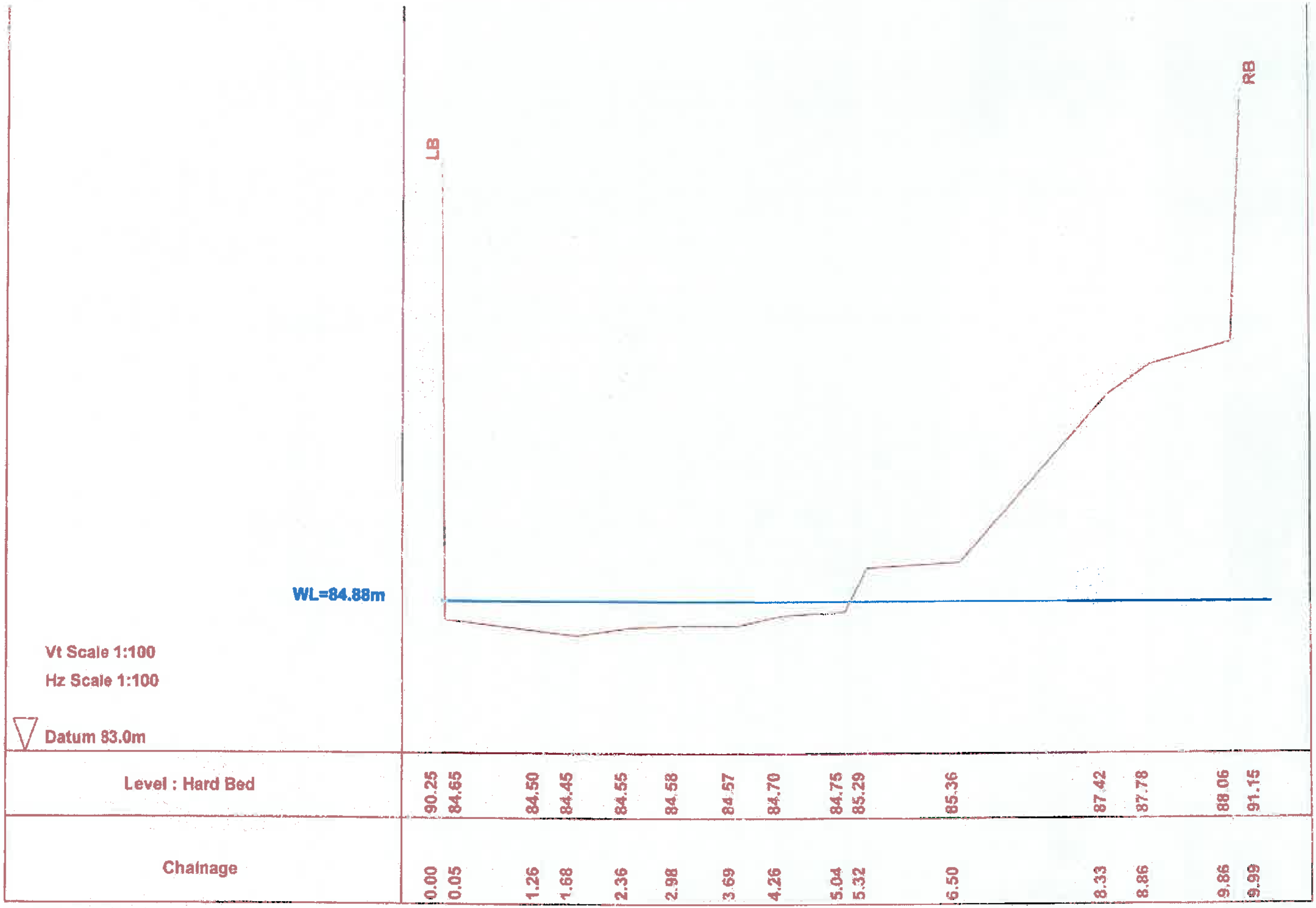
| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (m3/s) | (m) | (m) | (m) | (m) | (m/m) | (m/s) | (m2) | (m) | |
| chatburn | 207 | PF 1 13 | 13.100 | 93.210 | 95.096 | 94.45 | 95.27 | 0.006 | 1.83 | 7.15 | 5.07 | 0.49 |
| chatburn | 195 | PF 1 12 | 13.100 | 92.770 | 94.422 | 94.42 | 95.07 | 0.033 | 3.58 | 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 | 93.86 | 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 | 88.980 | 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 | 2.08 |
| chatburn | 27 | PF 1 3 | 13.100 | 87.620 | 88.234 | 88.53 | 89.21 | 0.081 | 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 | 4.82 | 7.28 | 1.07 |

} site 97 S



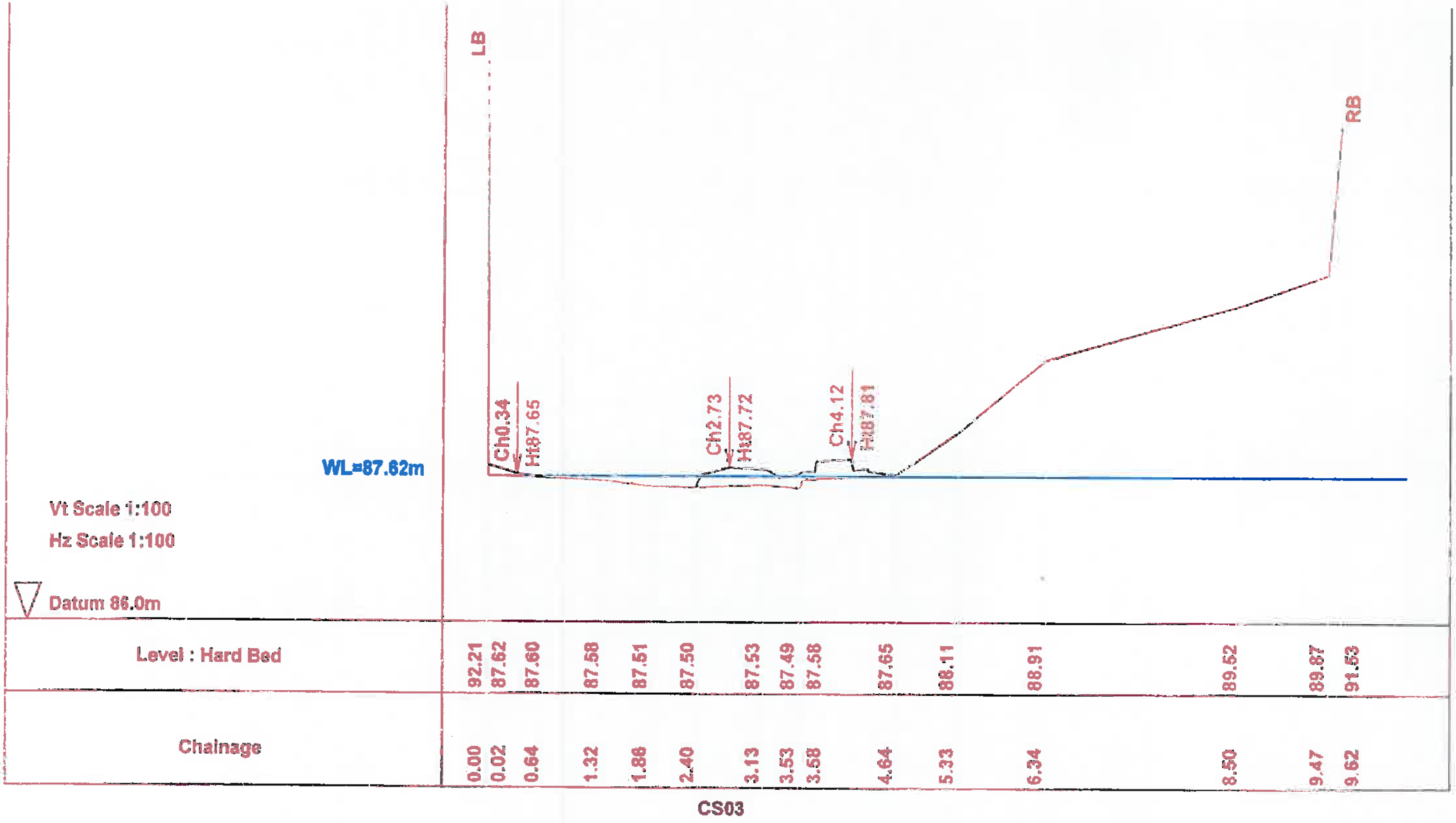
| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Level : Hard Bed | 89.42 | 86.36 | 86.20 | 84.93 | 84.67 | 84.59 | 84.61 | 84.61 | 84.71 | 84.67 | 84.73 | 86.91 | 87.05 | 90.35 |
| Chainage | 0.00 | 0.41 | 0.62 | 0.99 | 1.65 | 2.27 | 2.82 | 4.04 | 5.08 | 5.93 | 6.96 | 9.68 | 10.28 | 10.34 |

CS01



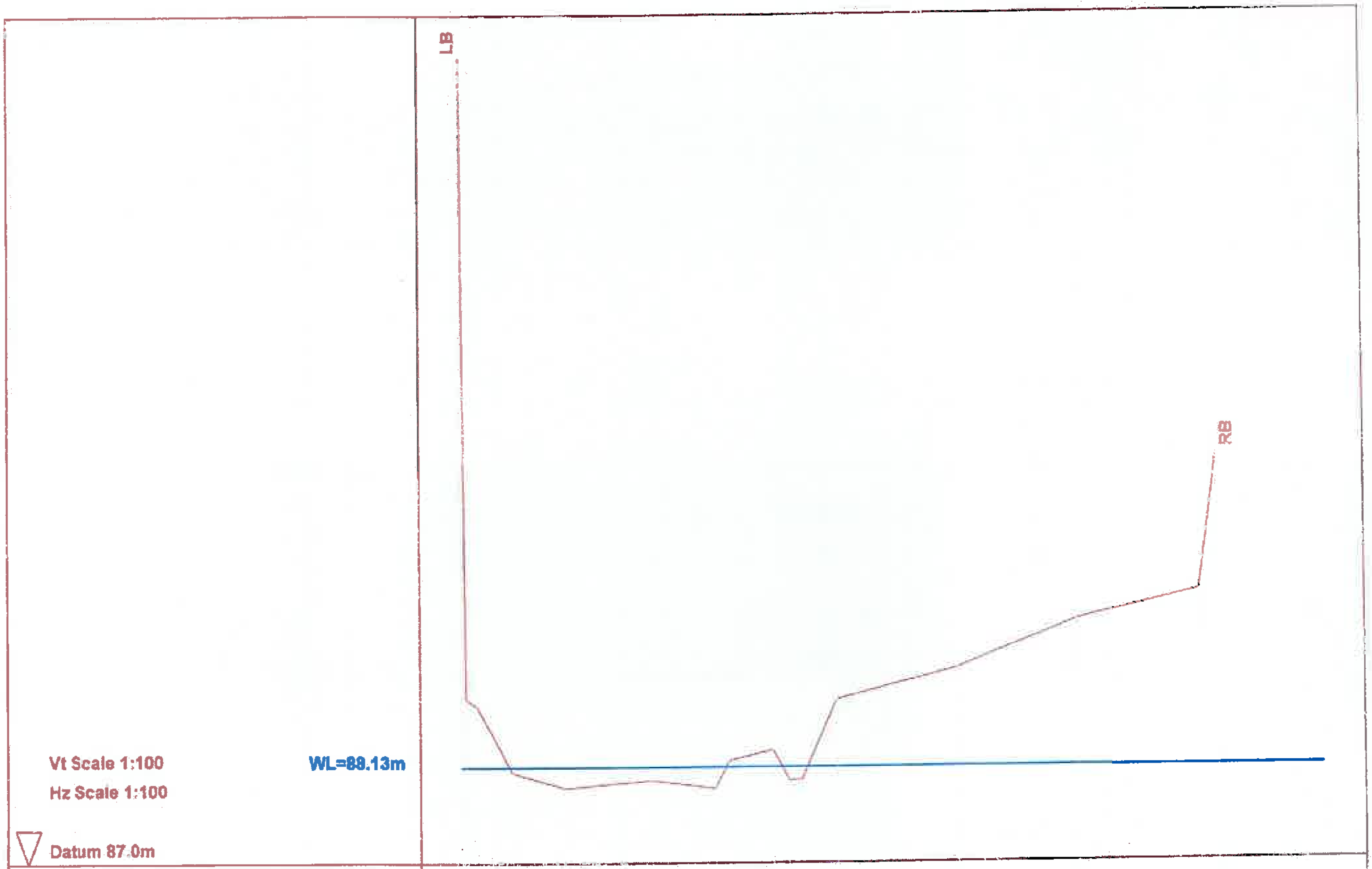
| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Level : Hard Bed | 90.25 | 84.65 | 84.50 | 84.45 | 84.55 | 84.58 | 84.57 | 84.70 | 84.75 | 85.29 | 85.36 | 87.42 | 87.78 | 88.06 | 91.15 |
| Chainage | 0.00 | 0.05 | 1.26 | 1.68 | 2.36 | 2.98 | 3.69 | 4.26 | 5.04 | 5.32 | 6.50 | 8.33 | 8.86 | 9.86 | 9.99 |

CS02



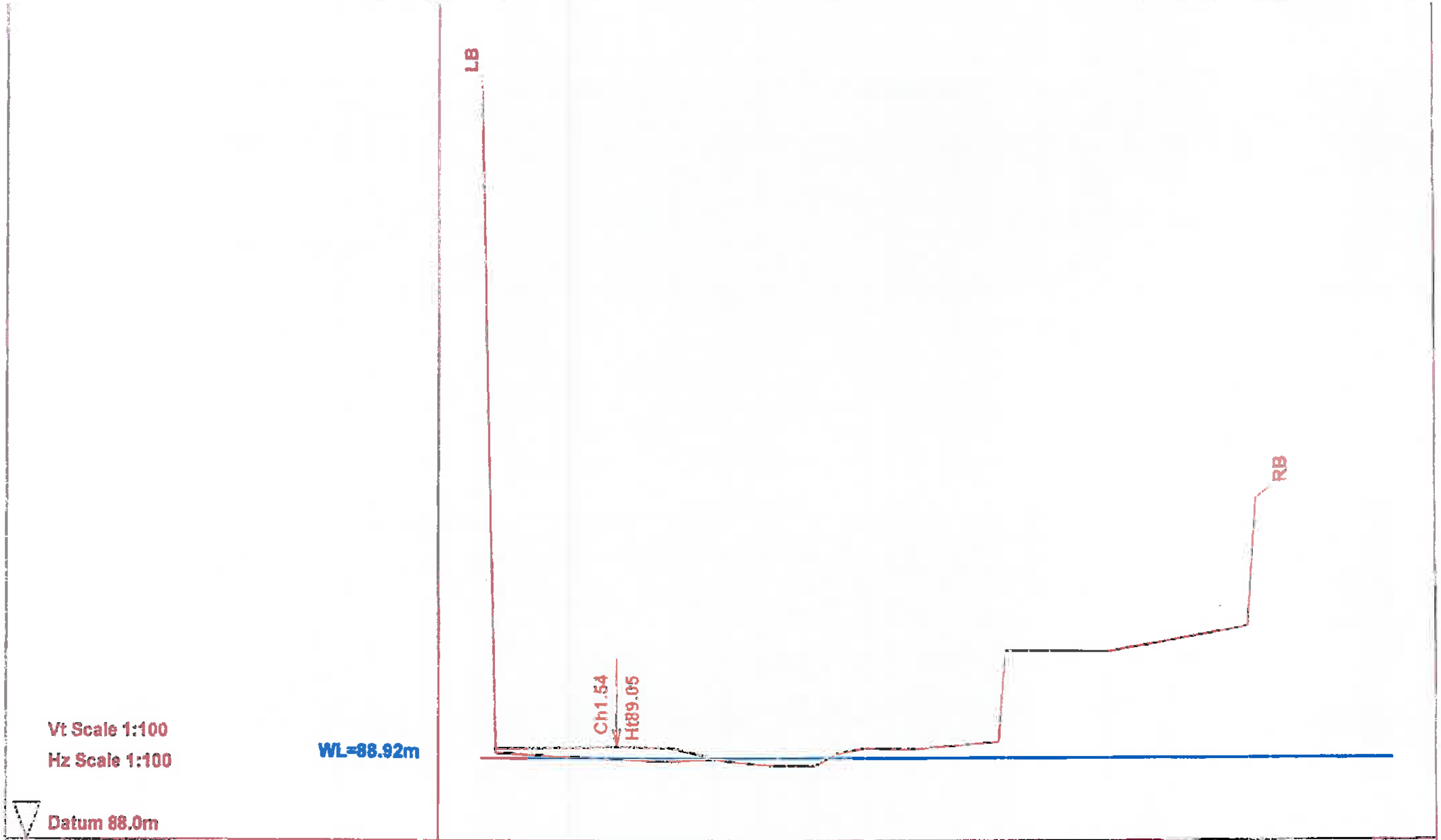
| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Level : Hard Bed | 92.21 | 87.62 | 87.60 | 87.58 | 87.51 | 87.50 | 87.53 | 87.49 | 87.58 | 87.65 | 88.11 | 88.91 | 89.52 | 89.87 | 91.53 |
| Chainage | 0.00 | 0.02 | 0.64 | 1.32 | 1.88 | 2.40 | 3.13 | 3.53 | 3.58 | 4.64 | 5.33 | 6.34 | 8.50 | 9.47 | 9.62 |

CS03



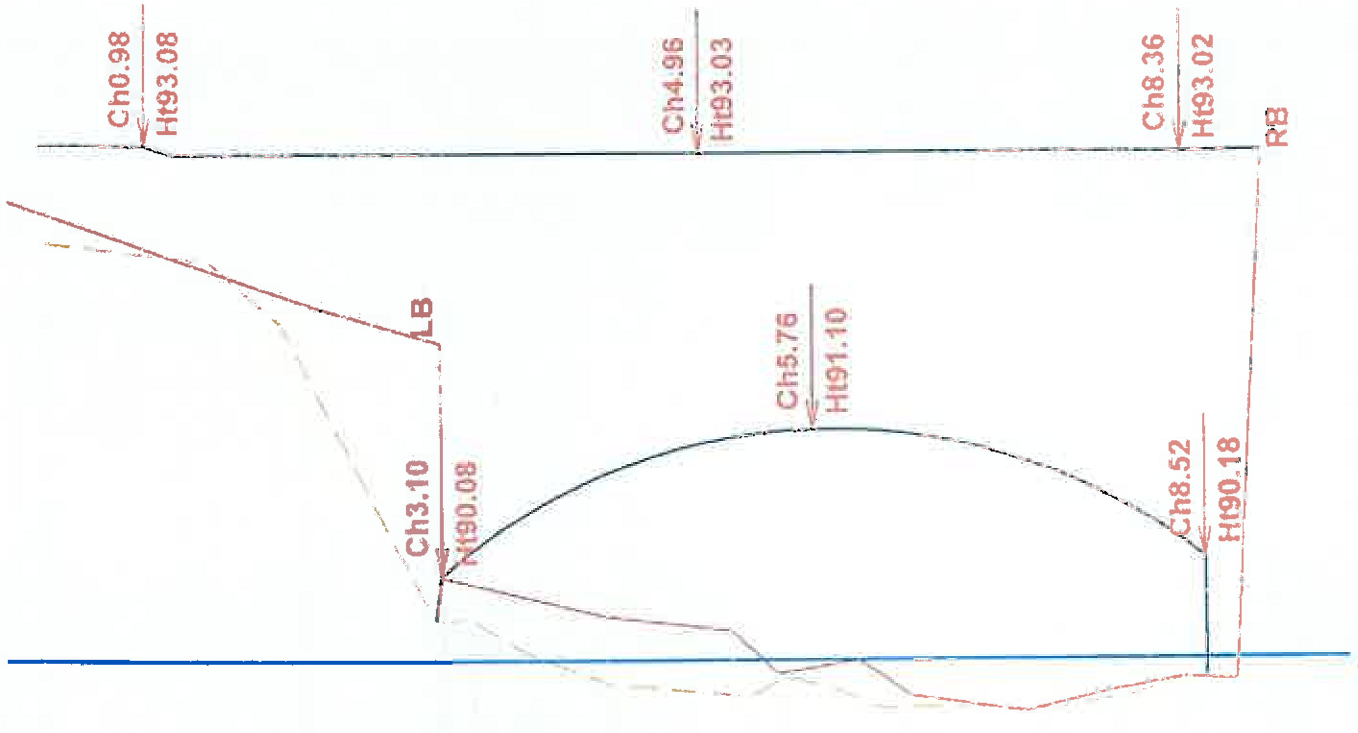
| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Level : Hard Bed | 96.54 | 88.94 | 88.07 | 87.88 | 87.97 | 87.87 | 88.20 | 88.33 | 87.97 | 88.92 | 89.29 | 89.85 | 90.19 | 91.81 |
| Chainage | 0.00 | 0.05 | 0.60 | 1.24 | 2.27 | 3.04 | 3.20 | 3.73 | 3.93 | 4.51 | 5.97 | 7.41 | 8.88 | 9.09 |

CS03A



| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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



Vt Scale 1:100

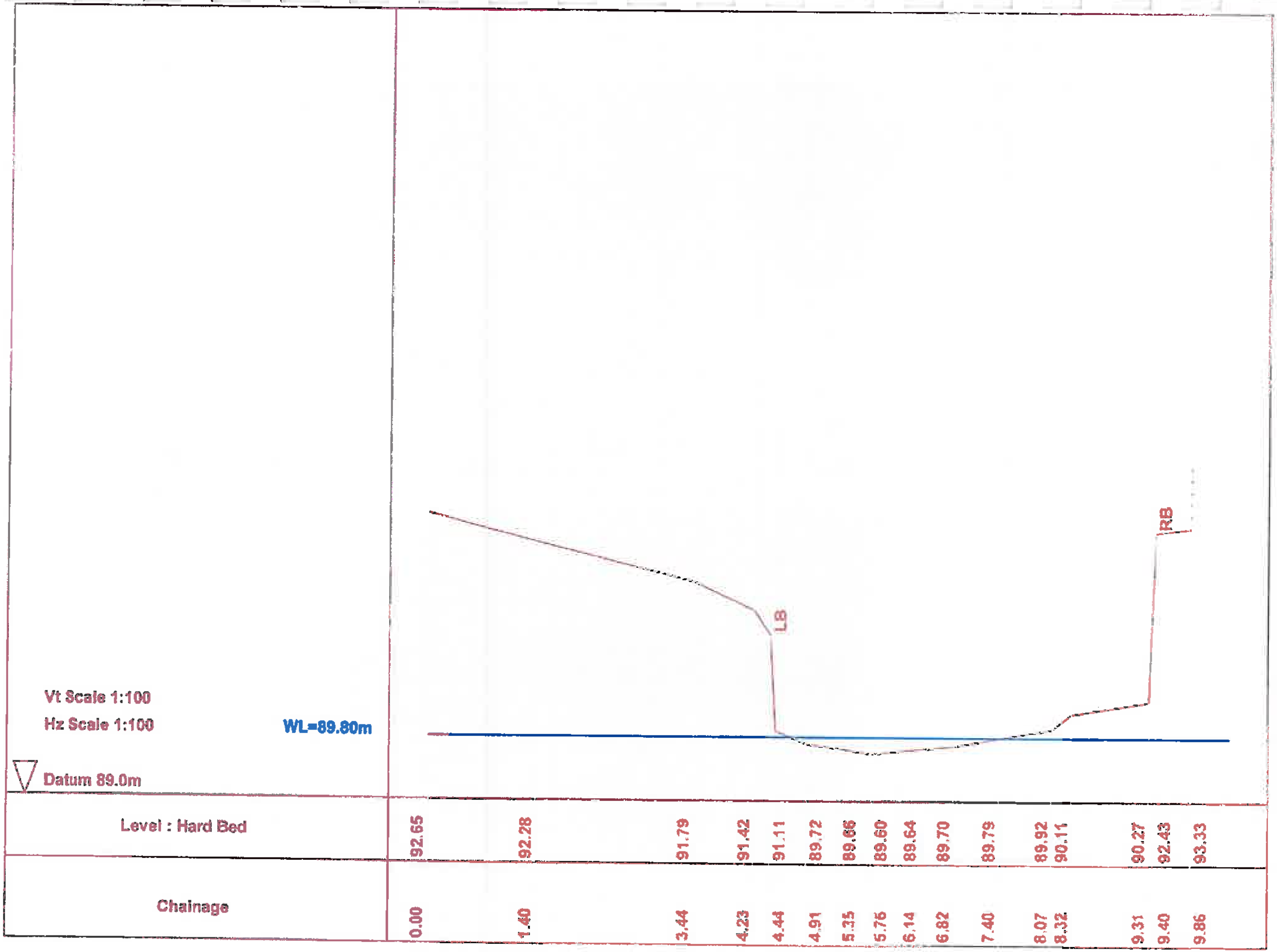
Hz Scale 1:100

▽ 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) | | 92.41 | 92.27 | 91.83 | | | | 89.76 | 89.58 | | 89.31 | | 89.22 | | 89.35 | | 89.25 | | 89.14 | | 89.12 | | 89.21 | | 89.35 | | | |
| Chainage | 0.00 | 0.26 | 1.45 | 1.96 | 2.12 | 3.09 | 3.11 | 3.32 | 3.70 | 4.28 | 4.31 | 5.18 | 5.32 | 5.51 | 5.57 | 6.07 | 5.90 | 6.44 | 6.68 | 7.25 | 7.42 | 7.86 | 7.96 | 8.36 | 8.42 | 8.74 | 8.53 | 8.93 |

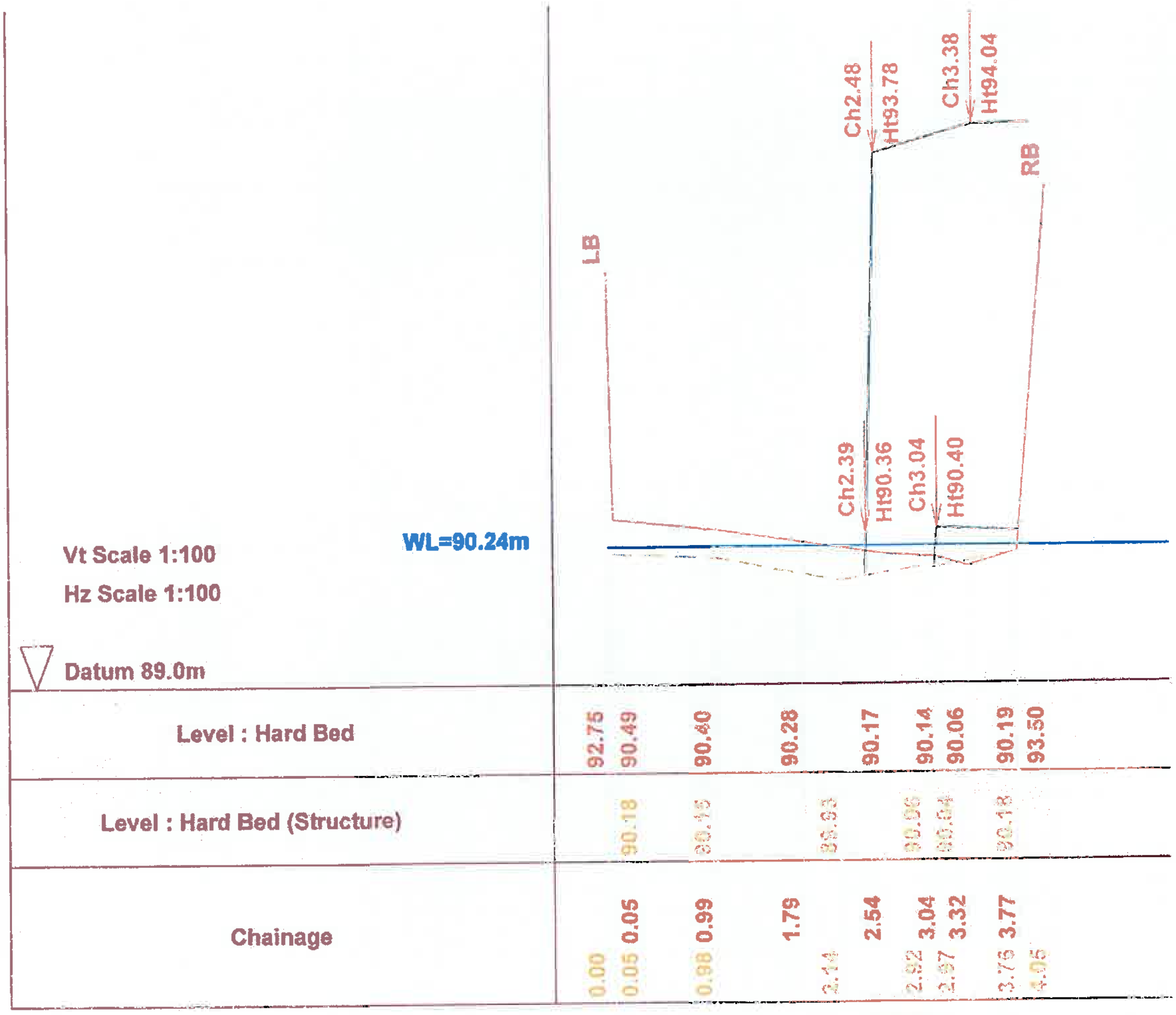
CS05

48

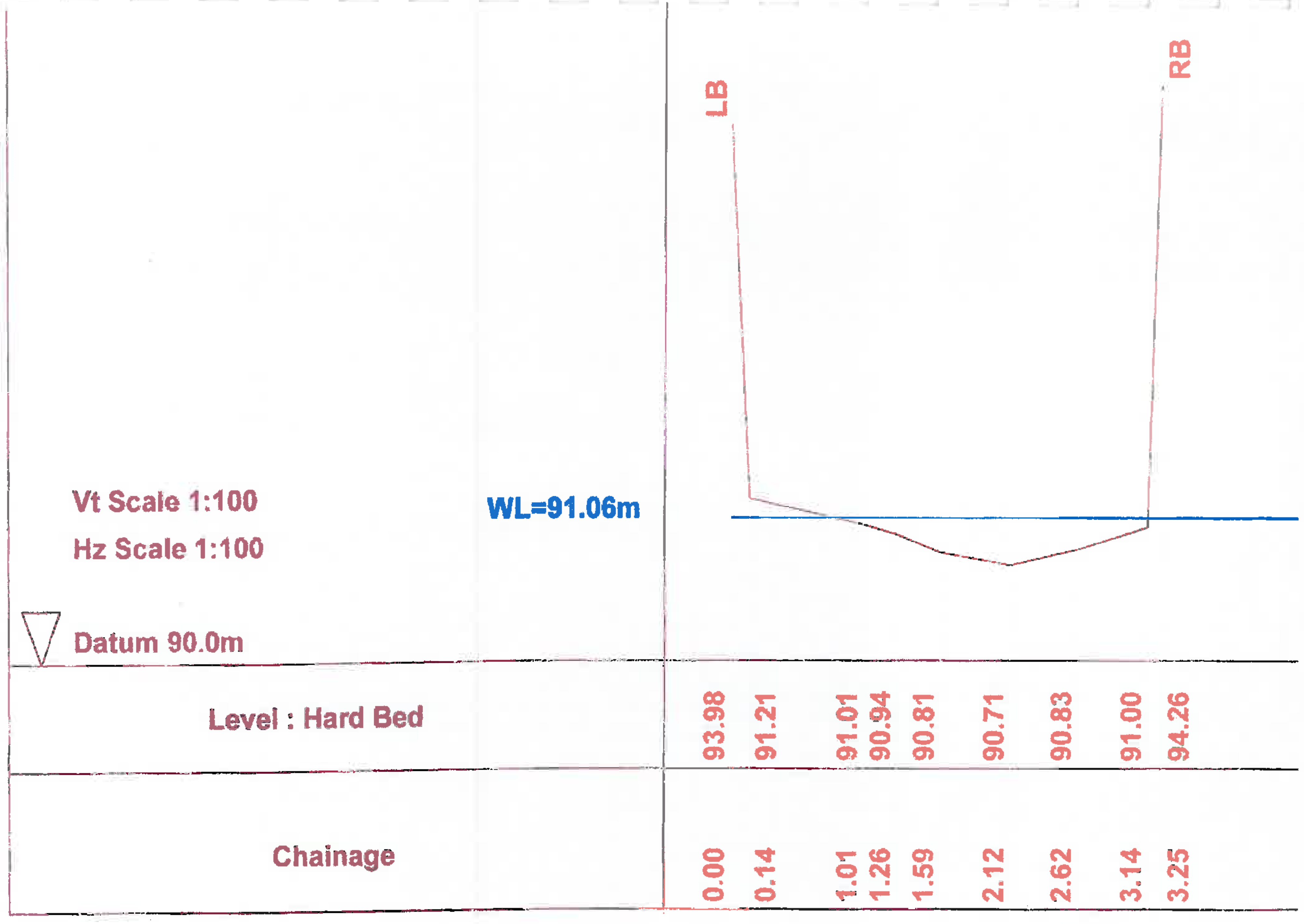


| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Level : Hard Bed | 92.65 | 92.28 | 91.79 | 91.42 | 91.11 | 89.72 | 89.66 | 89.60 | 89.64 | 89.70 | 89.79 | 89.92 | 90.11 | 90.27 | 92.43 | 93.33 |
| Chainage | 0.00 | 1.40 | 3.44 | 4.23 |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

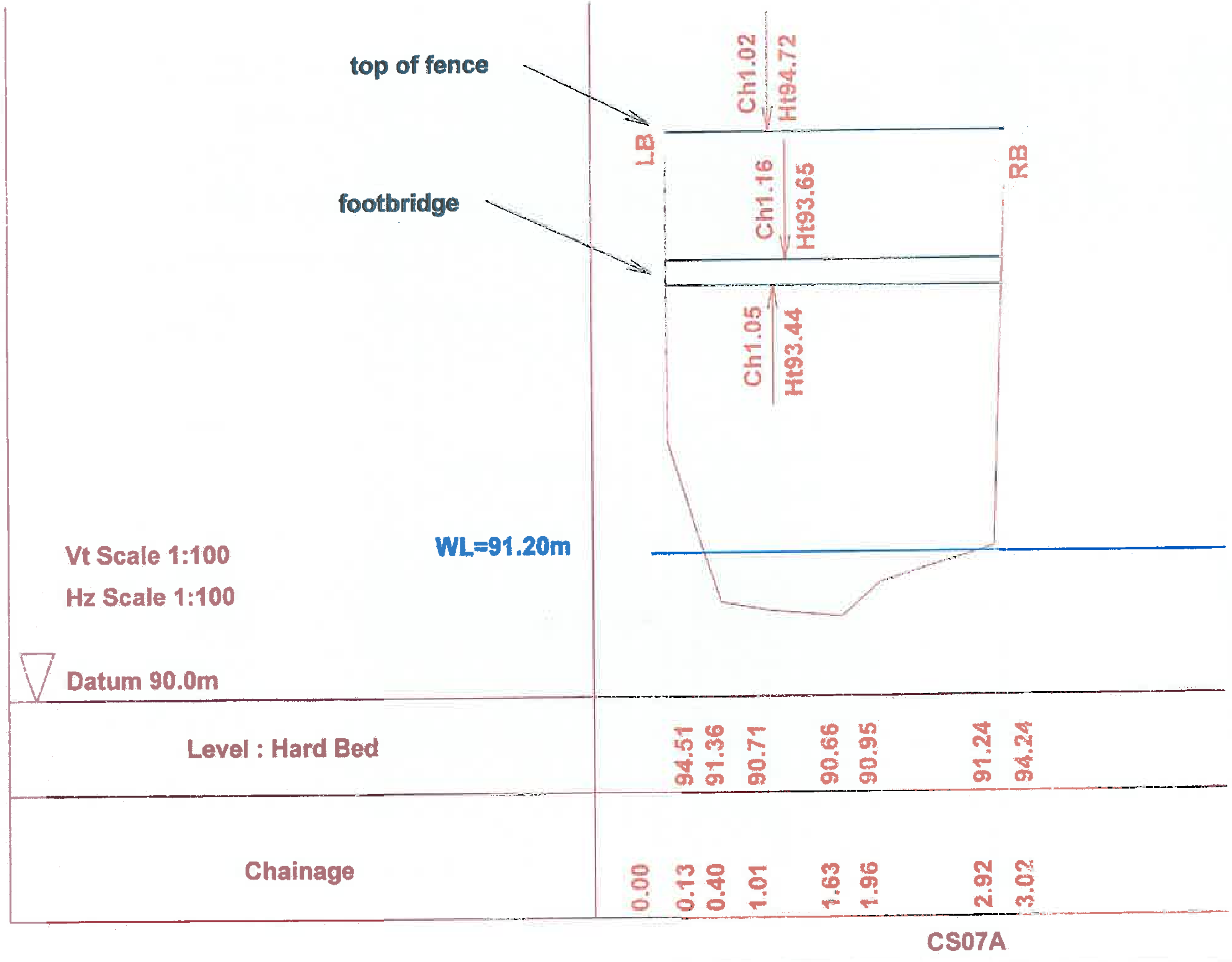
CS06

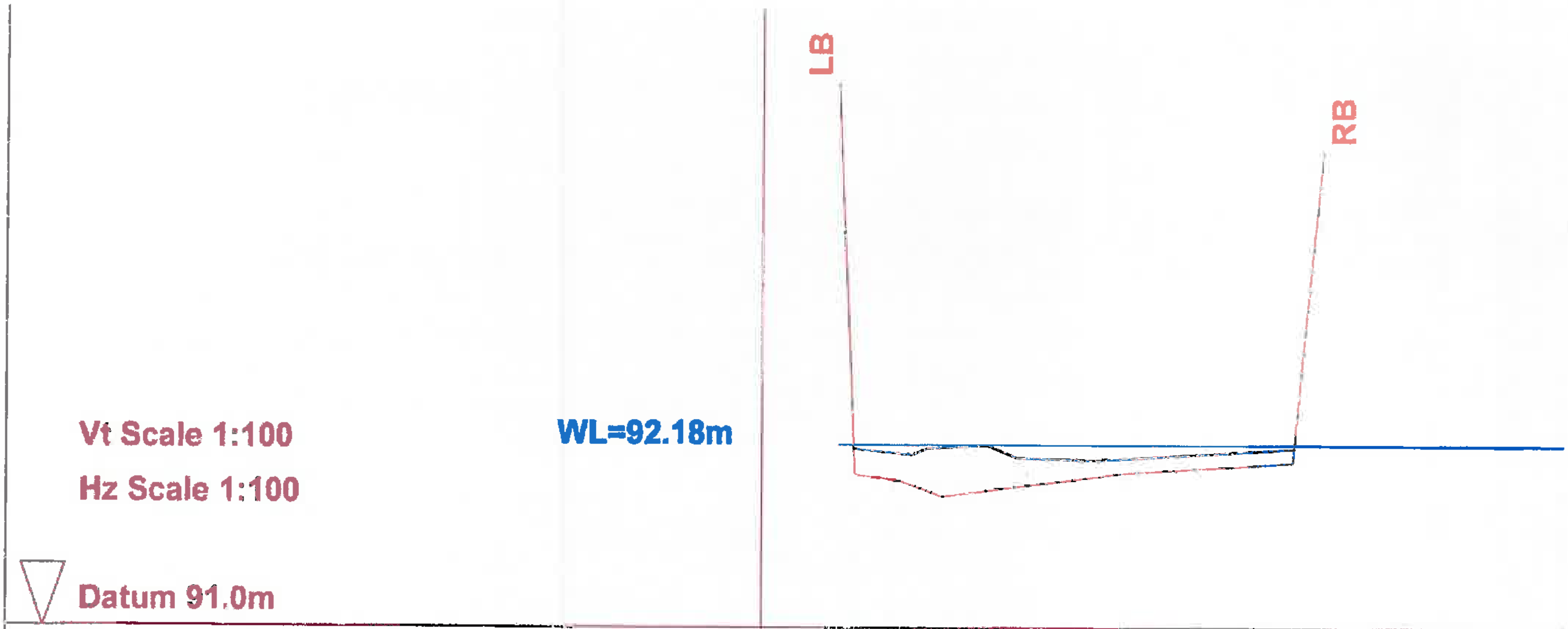

Ch2.48
Ht93.78
Ch3.38
Ht94.04
RB
LB
Ch2.39
Ht90.36
Ch3.04
Ht90.40
WL=90.24m
Vt Scale 1:100
Hz Scale 1:100
Datum 89.0m
Level : Hard Bed
92.75
90.49
90.40
90.28
90.17
90.14
90.06
90.19
93.50
Level : Hard Bed (Structure)
90.18
90.15
89.93
90.06
90.04
90.18
Chainage
0.05
0.99
1.79
2.54
3.04
3.32
3.77
0.00
0.05
0.98
2.14
2.92
2.97
3.76
4.05

CS06A


LB
RB
WL=91.06m
Vt Scale 1:100
Hz Scale 1:100
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

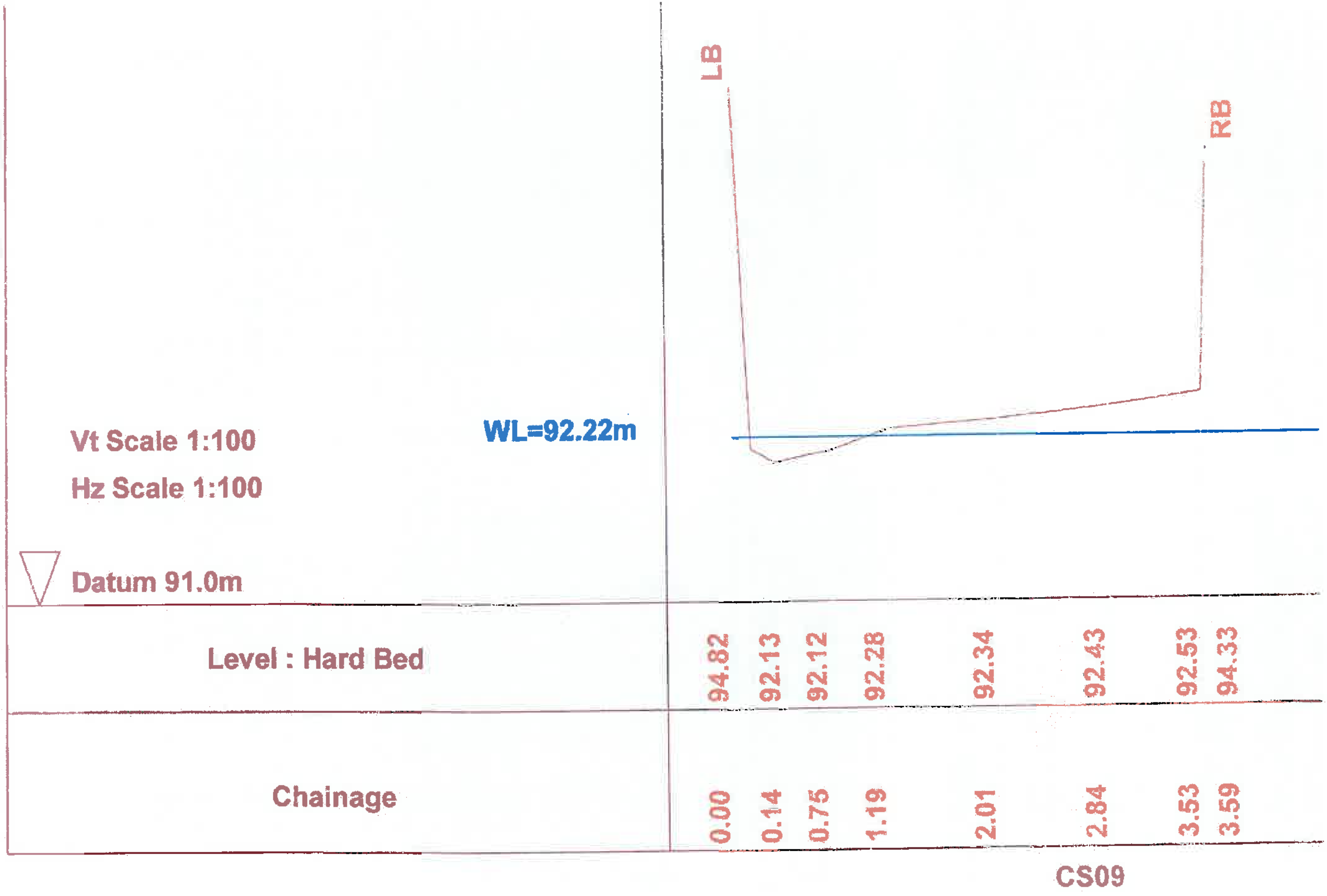
CS07


top of fence
footbridge
Ch1.02
Ht94.72
Ch1.16
Ht93.65
Ch1.05
Ht93.44
LB
RB
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

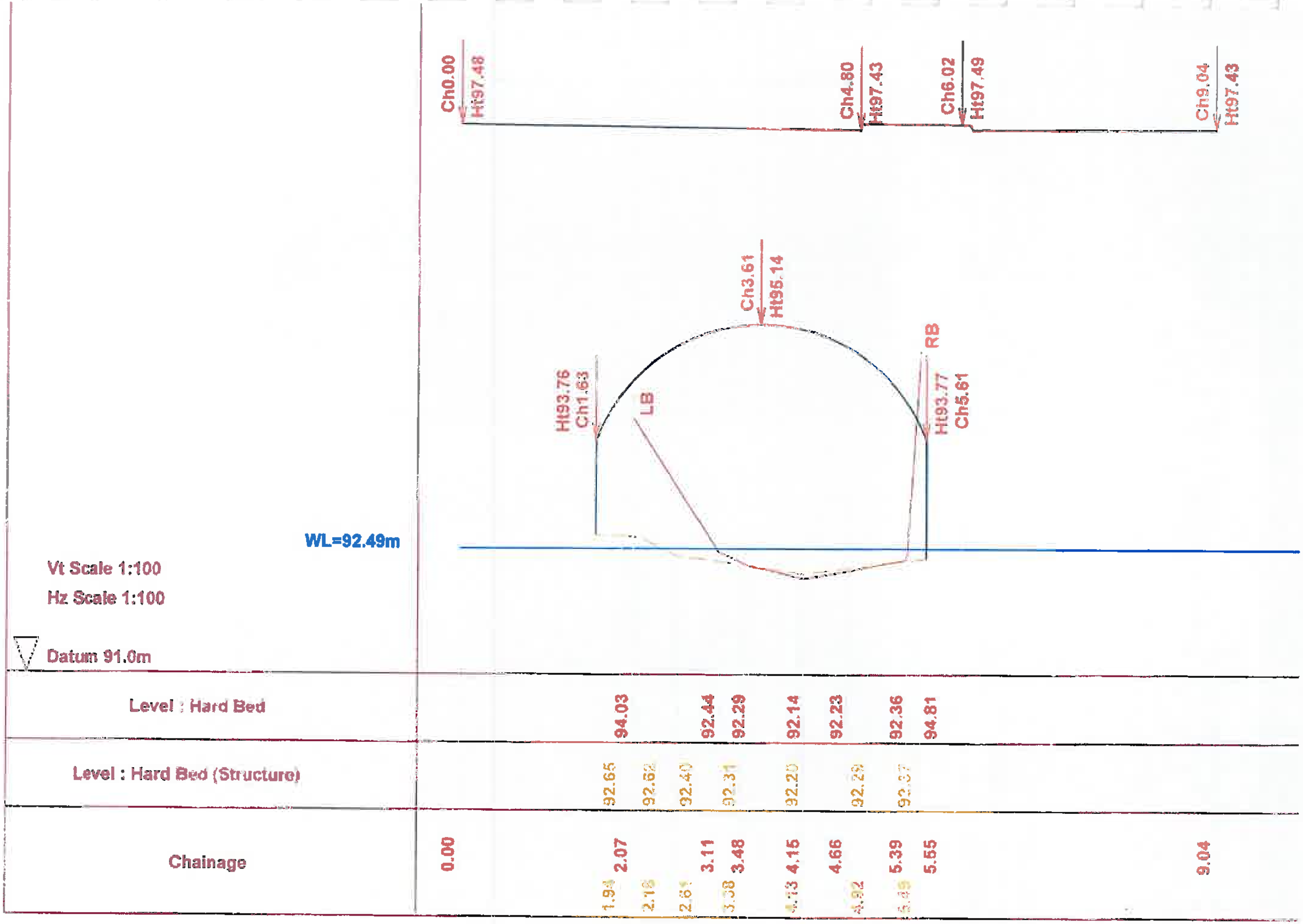


| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Level : Hard Bed | 94.51 | 91.99 | 91.95 | 91.85 | 92.00 | 92.07 | 94.07 |
| Chainage | 0.00 | 0.11 | 0.41 | 0.69 | 1.88 | 2.99 | 3.18 |

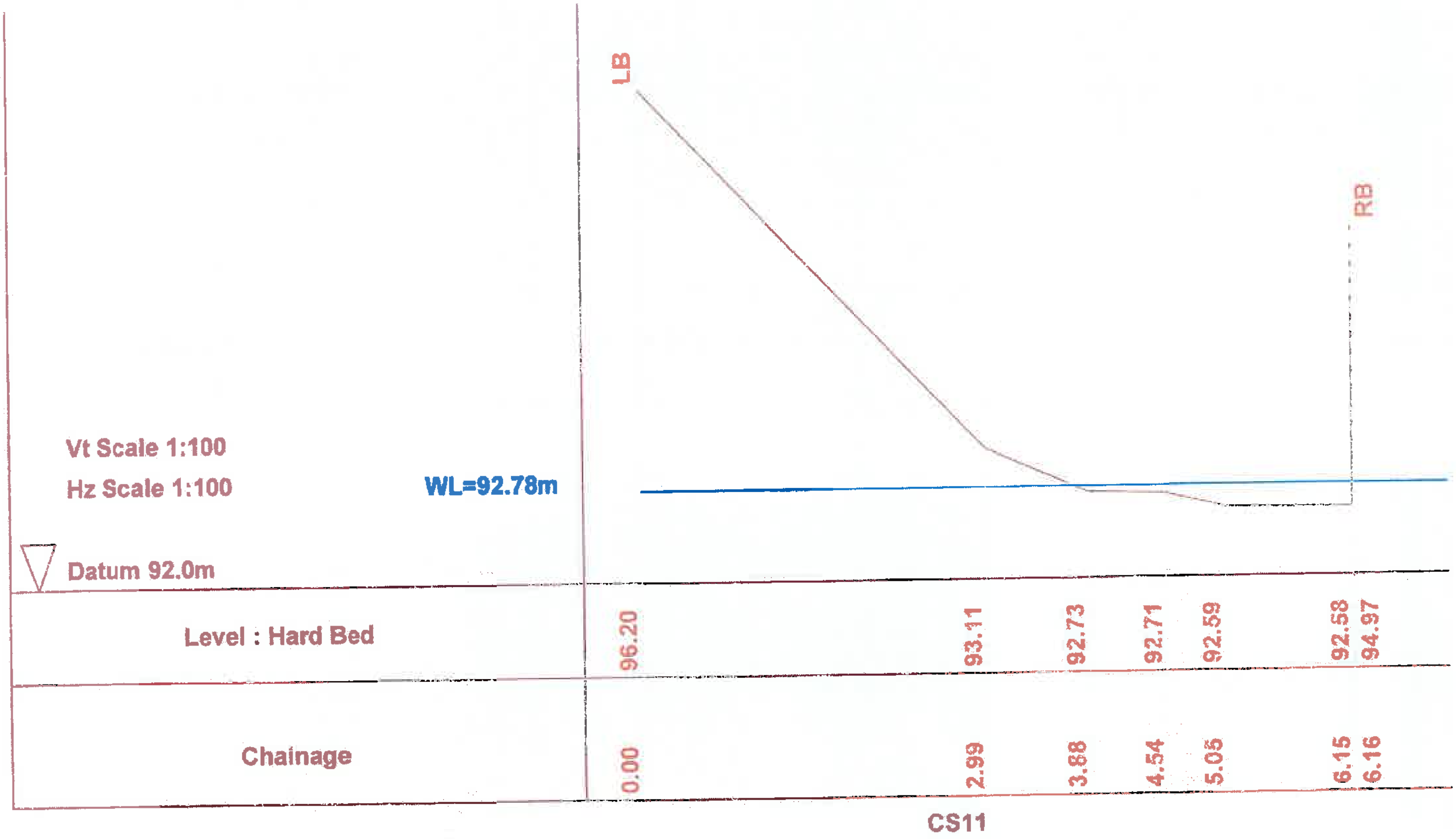
CS08



| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 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 |

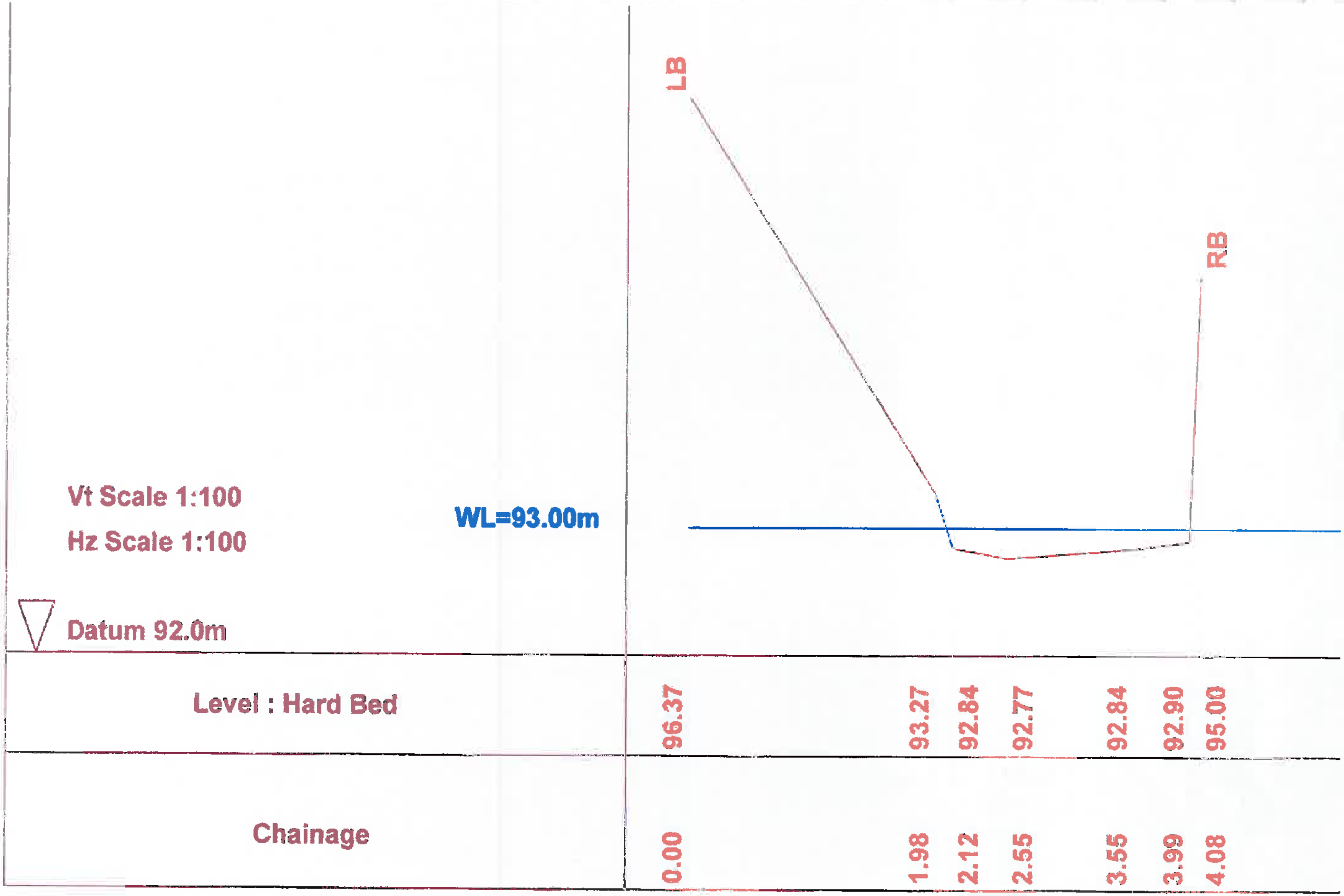

Ch0.00
Ht97.48
Ch4.80
Ht97.43
Ch6.02
Ht97.49
Ch9.04
Ht97.43
Ch3.61
Ht95.14
RB
Ht93.76
Ch1.63
LB
Ht93.77
Ch5.61
WL=92.49m
Vt Scale 1:100
Hz Scale 1:100
Datum 91.0m
Level : Hard Bed
94.03
92.44
92.29
92.14
92.23
92.36
94.81
Level : Hard Bed (Structure)
92.65
92.62
92.40
92.31
92.20
92.29
92.37
Chainage
0.00
2.07
3.11
3.48
4.15
4.66
5.39
5.55
9.04
1.94
2.16
2.61
3.38
4.13
4.92
5.49

CS10

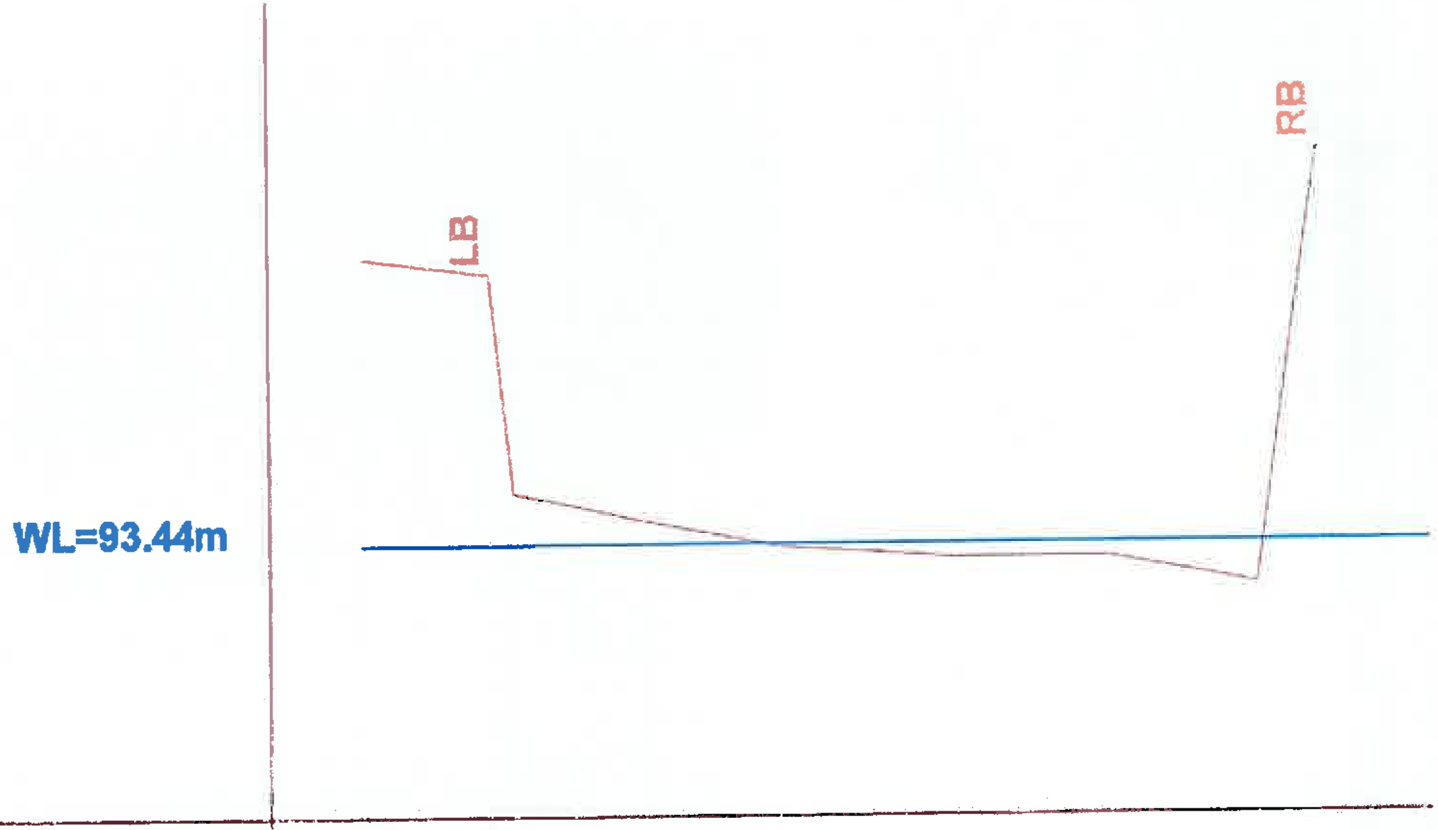


| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Level : Hard Bed | 96.20 | 93.11 | 92.73 | 92.71 | 92.59 | 92.58 | 94.97 |
| Chainage | 0.00 | 2.99 | 3.88 | 4.54 | 5.05 | 6.15 | 6.16 |

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



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



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
```

```
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      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      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      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      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       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
  .3

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
  .3

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
  .3

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", 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:** | 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 Ltd, the Environment Agency and any local authority are not liable for the performance of a drainage scheme which is based upon the output of this report*

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:** 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 | 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 | $m^3$ |

*HR Wallingford Ltd, the Environment Agency and any local authority are not liable for the performance of a drainage scheme which is based upon the output of this report*

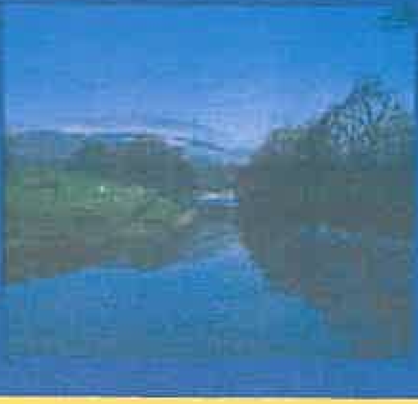
Ribble Valley Borough
Council

# 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.

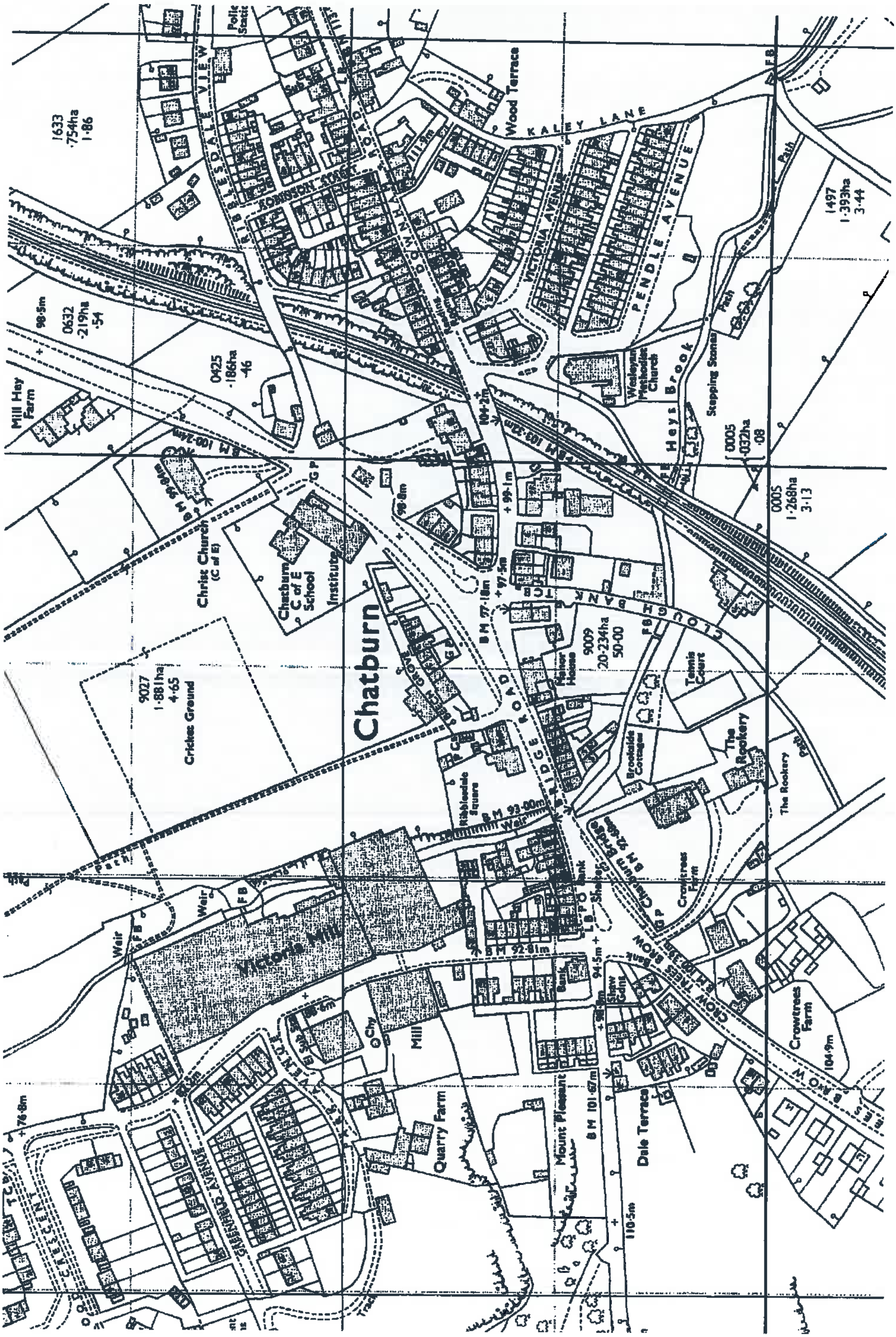
## Clitheroe Policy Option P5 –

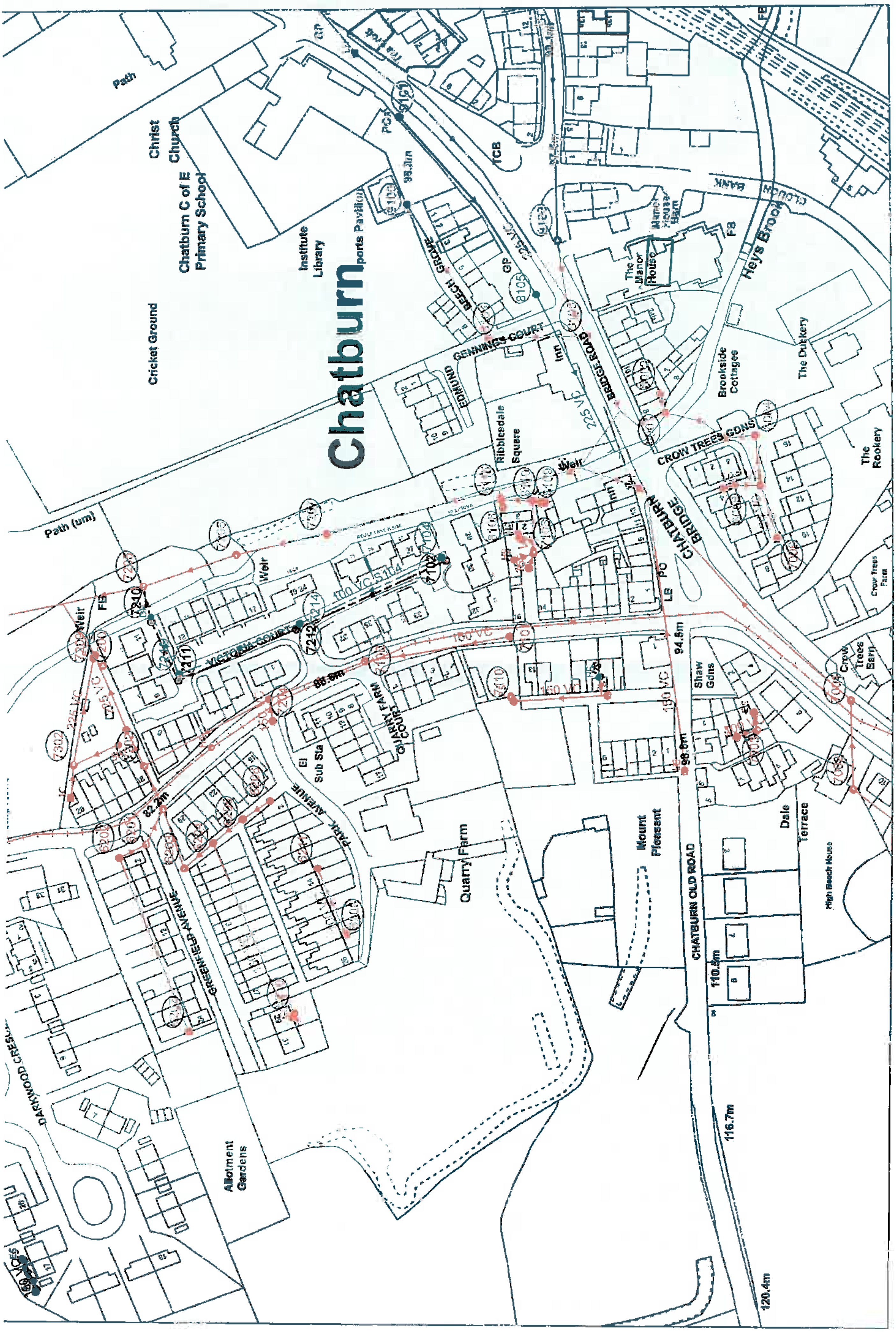
**Preferred Policy –**

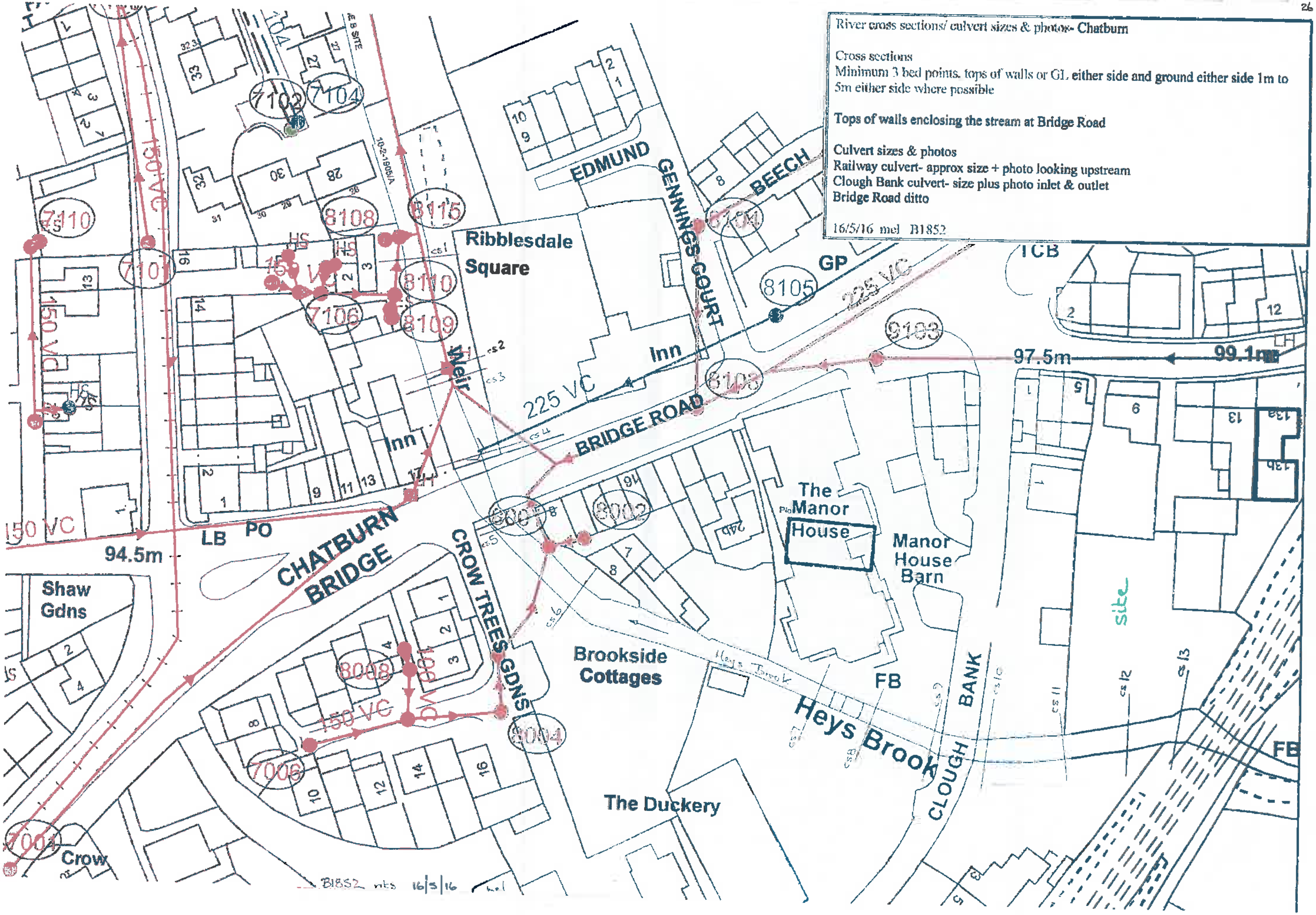
Take further action to reduce flood risk

**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
Victoria Mill
Christ Church (C of E)
Chatburn C of E School
Institute
Cricket Ground
Mill Hey Farm
Quarry Farm
Mount Pleasant
Dale Terrace
Crowtrees Farm
The Rookery
Brookside Cottages
Tennis Court
Heys Brook
Stepping Stones
Wesleyan Methodist Church
Wood Terrace
KALEY LANE
PENDLE AVENUE
VICTORIA AVENUE
RIBBLESDALE VIEW
ROBINSON STREET
DOWNHAM ROAD
BRIDGE ROAD
CLOUGH BANK
CROW TREES BROW
GREENFIELD AVENUE
CRESCENT
Ribblesdale Square
Malcar House
Shaw Gdns
Weir
FB
GP
PO
LB
TCB
Path
Mill
Chy
El Sub Sta
BM 100·24m
BM 98·84m
BM 97·18m
BM 93·00m
BM 92·81m
BM 101·67m
BM 103·22m
BM 96·06m
98·5m
98·8m
99·1m
97·5m
104·2m
111·9m
94·5m
98·6m
78·8m
110·5m
104·9m
1633 ·754ha 1·86
0632 ·219ha ·54
0425 ·186ha ·46
9027 1·881ha 4·65
9009 20·234ha 50·00
0005 ·032ha ·08
0005 1·268ha 3·13
1497 1·393ha 3·44


Chatburn
Christ Church
Chatburn C of E Primary School
Cricket Ground
Institute
Library
Sports Pavilion
Path
Path (um)
Weir
FB
GP
PCB
TCB
98.3m
BEECH GROVE
GENNINGS COURT
EDMUND
Ribblesdale Square
Inn
BRIDGE ROAD
225 VC
The Manor House
Manor House Barn
Heys Brook
CLOUGH BANK
Brookside Cottages
The Duckery
CROW TREES GDNS
The Rookery
CHATBURN BRIDGE
Crow Trees Farm
Crow Trees Barn
LB
PO
94.5m
150 VC
100 VC
VICTORIA COURT
88.6m
82.2m
QUARRY FARM COURT
El
Sub Sta
PARK AVENUE
GREENFIELD AVENUE
DARNWOOD CRESCENT
Allotment Gardens
Quarry Farm
Mount Pleasant
Shaw Gdns
Dale Terrace
High Beech House
98.8m
CHATBURN OLD ROAD
110.5m
116.7m
120.4m
150 VCS



River cross sections/ culvert sizes & photos- Chatburn

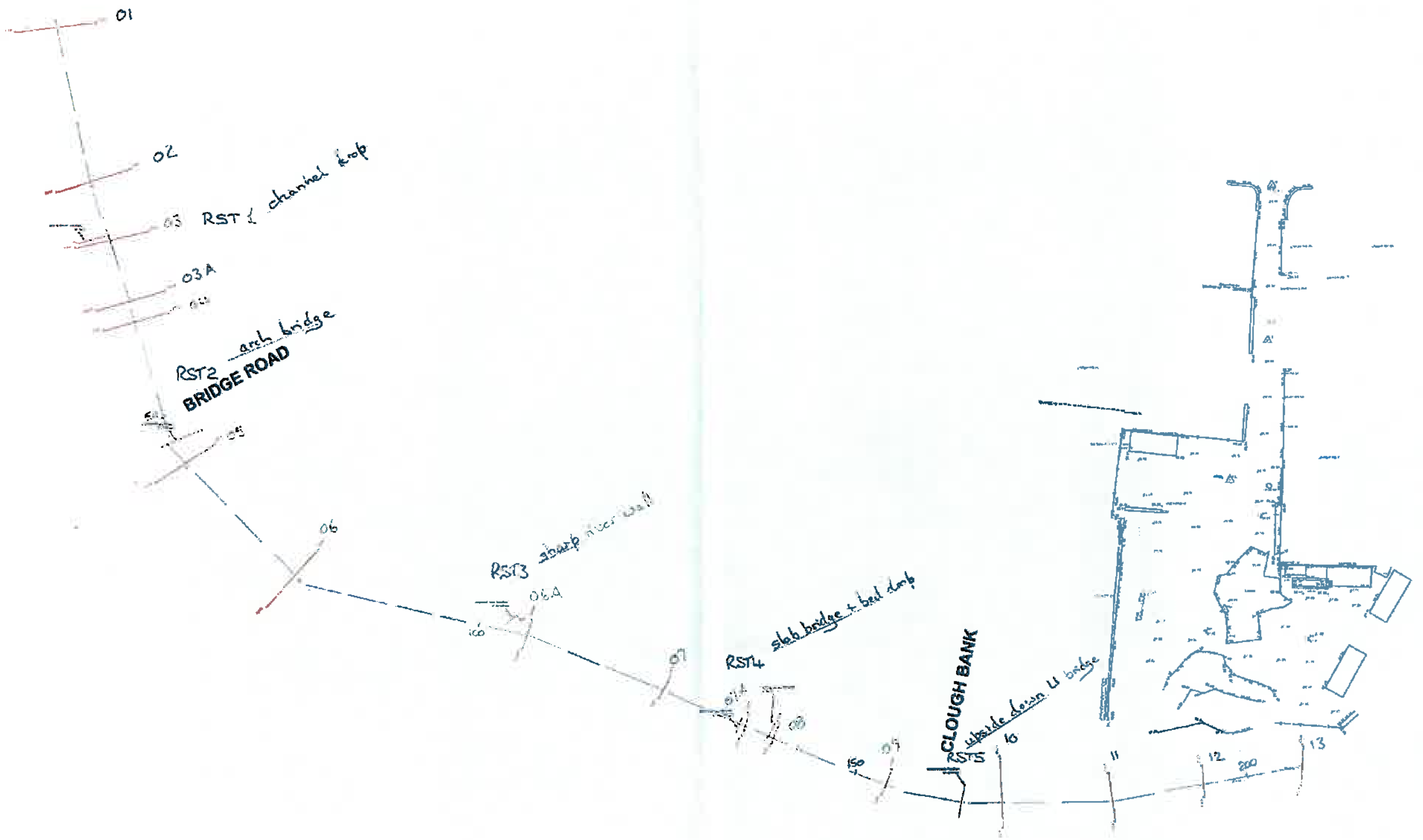
Cross sections
Minimum 3 bed points, tops of walls or GL either side and ground either side 1m to 5m either side where possible

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 mel B1852

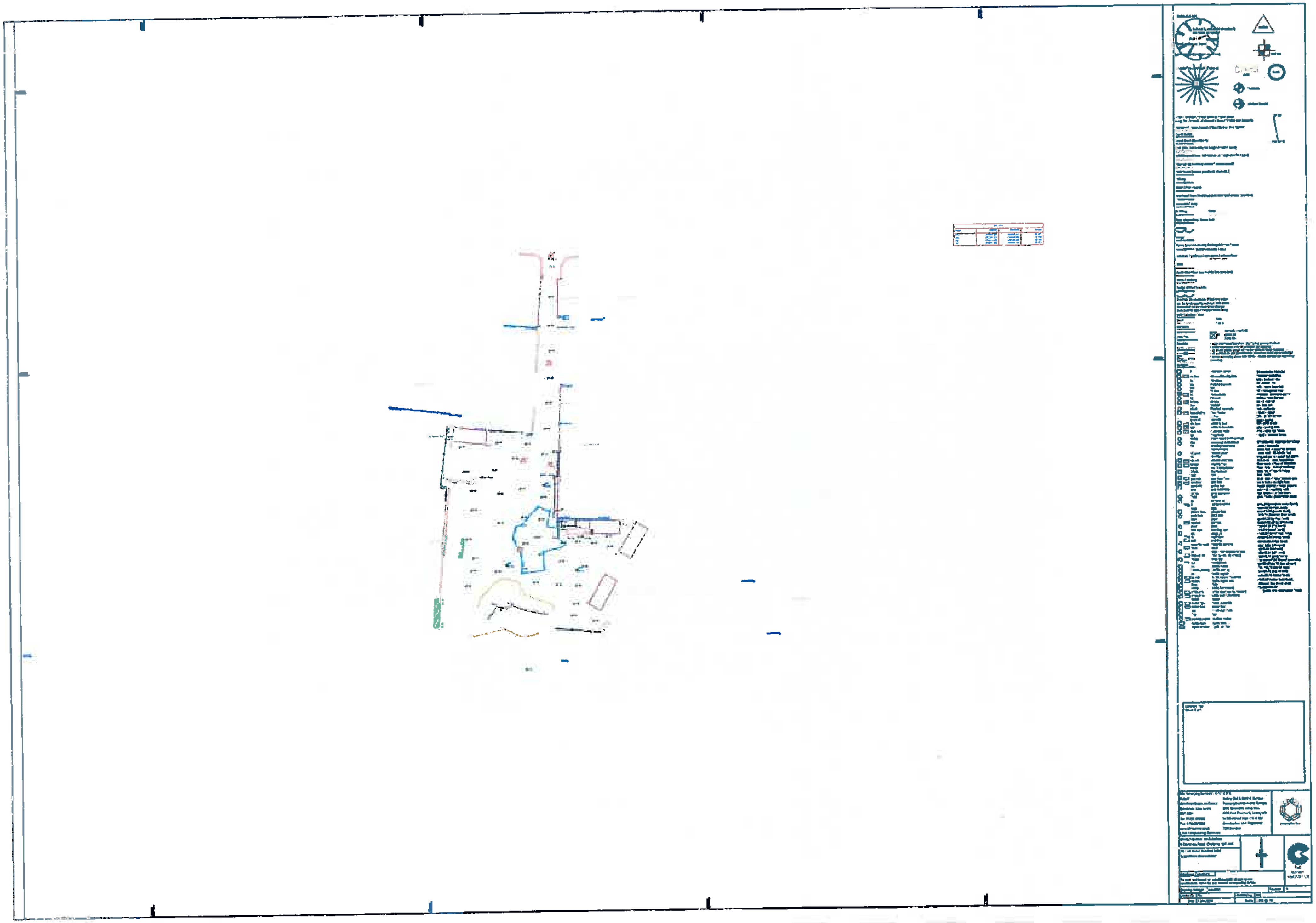
B1852 nts 16/5/16



29/6/15 mel B1852

1/500
1mm = 0 S


GRINDLETON CP
GISBURN CP
RIMINGTON CP
MIDDOP CP
SAWLEY CP
DOWNHAM CP
TWISTON CP
WORSTON CP
CHATBURN CP
CAMPING BARN
NATURE RESERVE
GEOLOGY TRAIL
Quarries
Downham
Chatburn
Grindleton
Sawley
Worston
Rimington
West Bradford
Downham Moor
Twiston Moor
Worsaw Hill
Ings Beck
Martin Top Lane




U6
99.95 w.
99.04
ds
99.21
eav=103.21
99.17
eav=105.08
99.32
unknown cover
ds
99.36
U5
99.46
99.33
eav=104.22
99.46
eav=104.79
eav=104.34
99.39
eav=101.22
99.04
99.25
top fence=109.77 wood
(M21)
98.78
98.93
99.00
99.13
99.24
99.14
98.98
N2L
98.63
98.76
wall collapse
98.36
99.01
BH
98.98
98.73
98.43
98.62
98.60
98.18
98.19
97.45
98.59
eav=102.75
eav=102.85
98.82
96.17
95.53
97.94
97.72
terrace
98.09
98.05
97.80
97.69
97.83
97.42
97.71
98.34
BH
97.78
97.75
97.90
BH
97.68
97.77
97.57
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97.29
97.23
98.31
93.31
93.14

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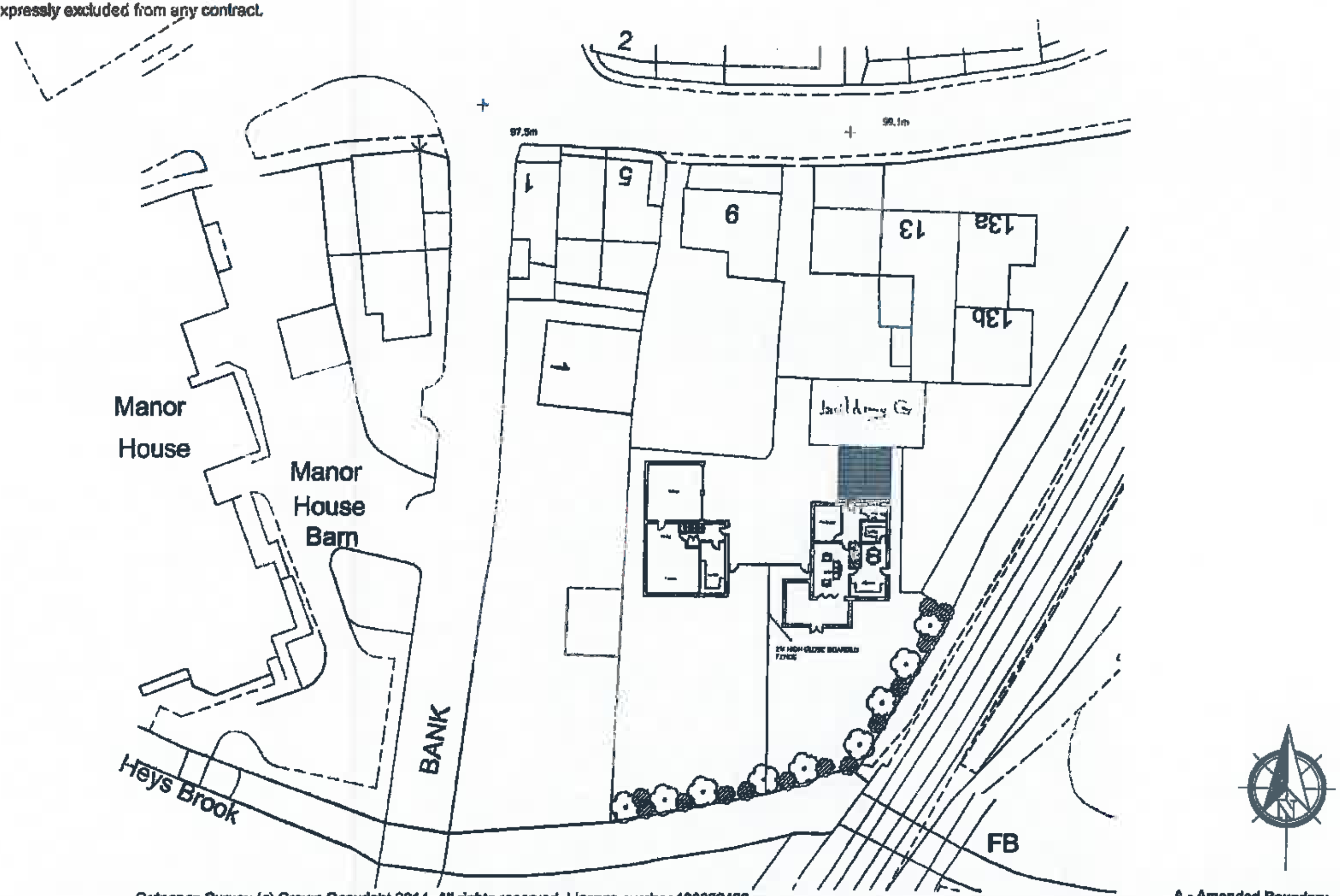

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A - Amended Boundary

## 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

Avalon
Chartered Town Planning
Town Planning - Architectural Design - Building Regulations - Surveying

**Phone:** 01282 834834 **Fax:** 01282 451666
Web: www.avalontp.co.uk Email: planning@avalontp.co.uk
2 Reedley Business Centre, Redman Road, Burnley, Lancashire, BB10 2TY

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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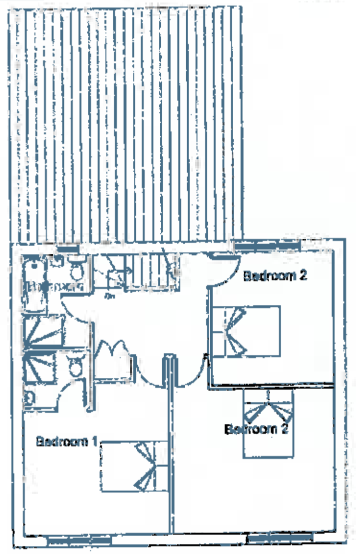
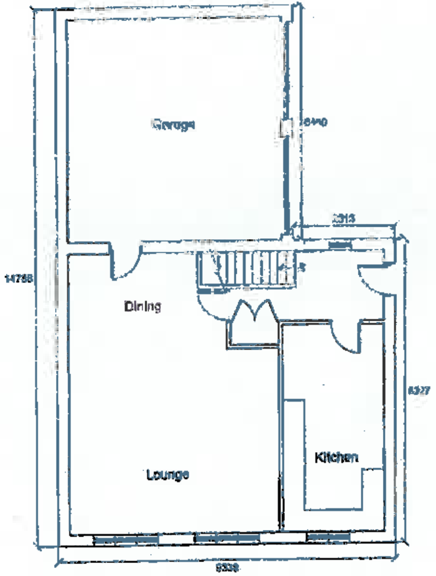
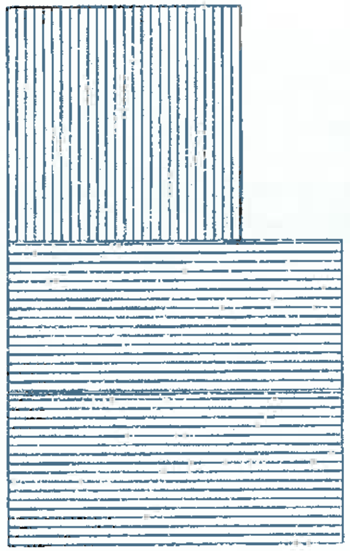


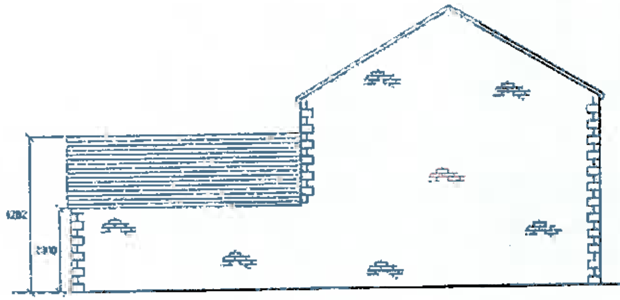
Ground Floor Plan



First Floor Plan



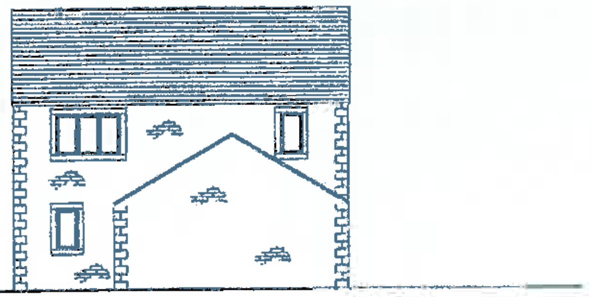
Roof Plan



REAR ELEVATION

FRONT ELEVATION

SIDE ELEVATION



SIDE ELEVATION

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**Avalon** RTPI
Chartered Town Planning
Town Planning - Architectural Design - Building Regulations - Surveying
Phone: 01282 834834 Fax: 01282 451668
[illegible]
[illegible]

PROPOSED ELEVATIONS

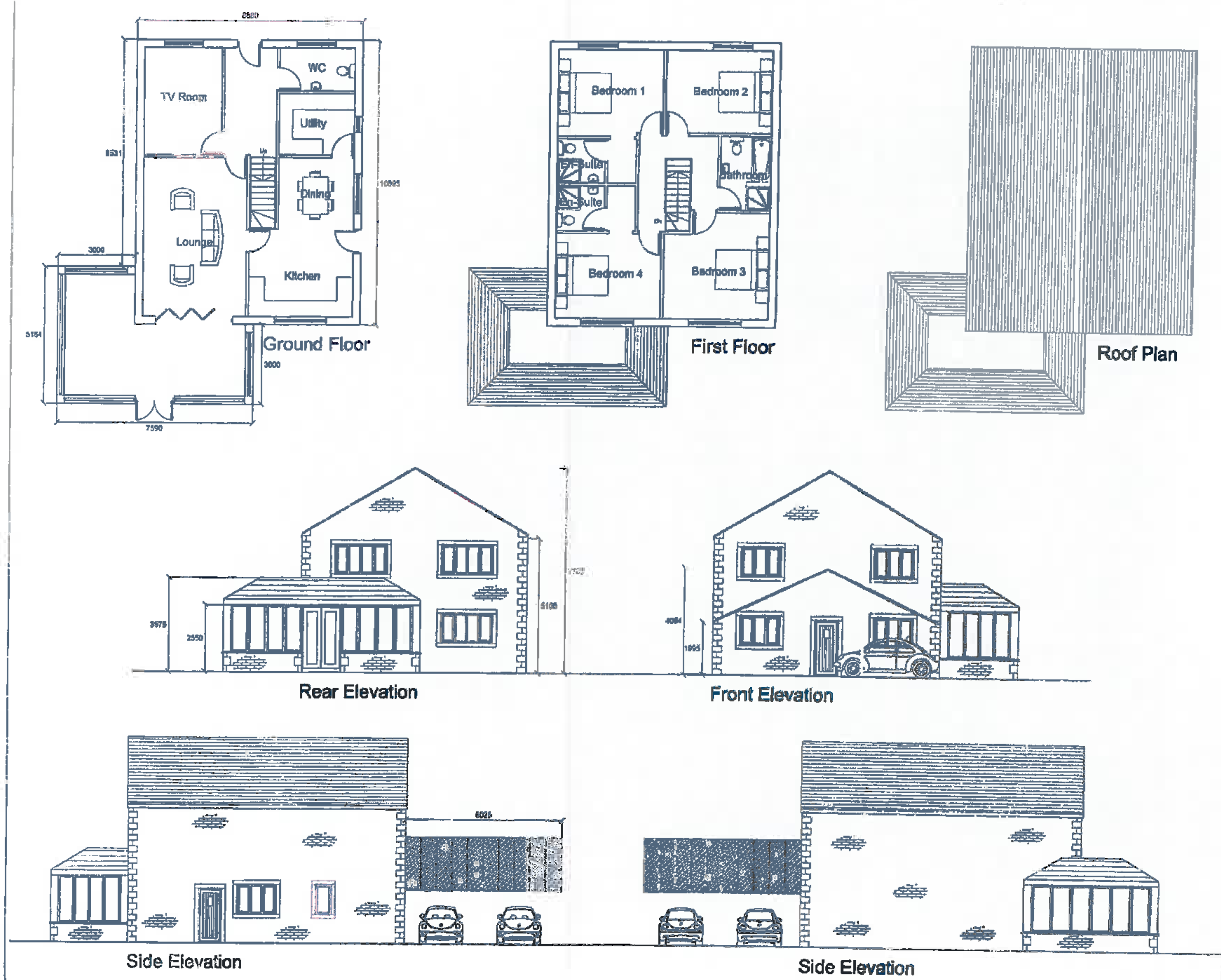
Site: 3 Downham Road
Chatburn
BB7 4AU

Client: Alan Jackson

Date: 13.08.15
Scale: 1:100 @ A2

Project No: JACKS - 04 / Dwg C6
Drawn: HA

Amendments:



**Notes:**

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Chartered Town Planning
Town Planning - Architectural Design - Building Regulations - Surveying
Phone: 01282 834834 Fax: 01282 451666

**PROPOSED ELEVATIONS**

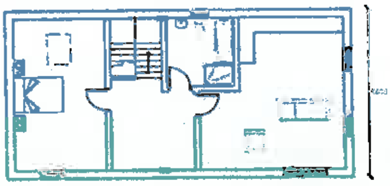
Site: 9 Downham Road
Chatburn
BB7 4AU

Client: Alan Jackson

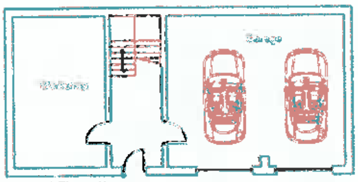
Date: 18.08.15 | Scale: 1:100 @ A2

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

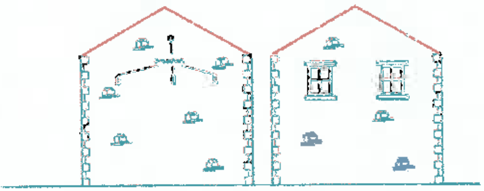
Amendments:


First Floor Plan

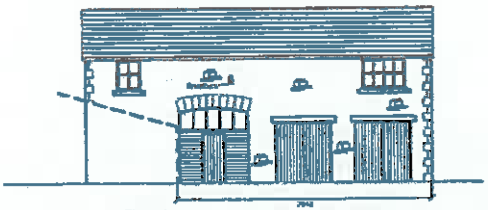

Roof Plan

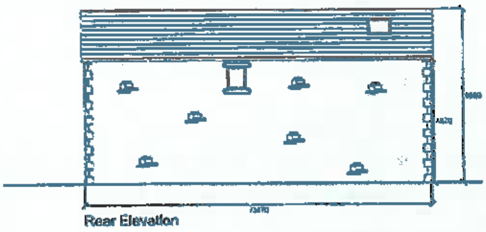


Ground Floor Plan


Side Elevation

Side Elevation


Front Elevation


Rear Elevation

building G

## Plans and Elevations

**Site:** 9 Downham Road
Chatburn
BB7 4AU

**Client:** Alan Jakson
**Drawn:** HA
**Date:** 19.08.15
**Scale:** 1:150 @ A3
**Project No:** JACKS-05 / Dwg 04
**Amendments:** ☐ ☐ ☐ ☐ ☐ ☐ ☐

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Web: www.avalontp.co.uk Email: planning@avalontp.co.uk
2 Rossway Business Centre, Rodman Road, Burnley, Lancashire, BB10 2TY

**Environment Agency**

**Enter a postcode or place name:**

BB7 4AU

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**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)

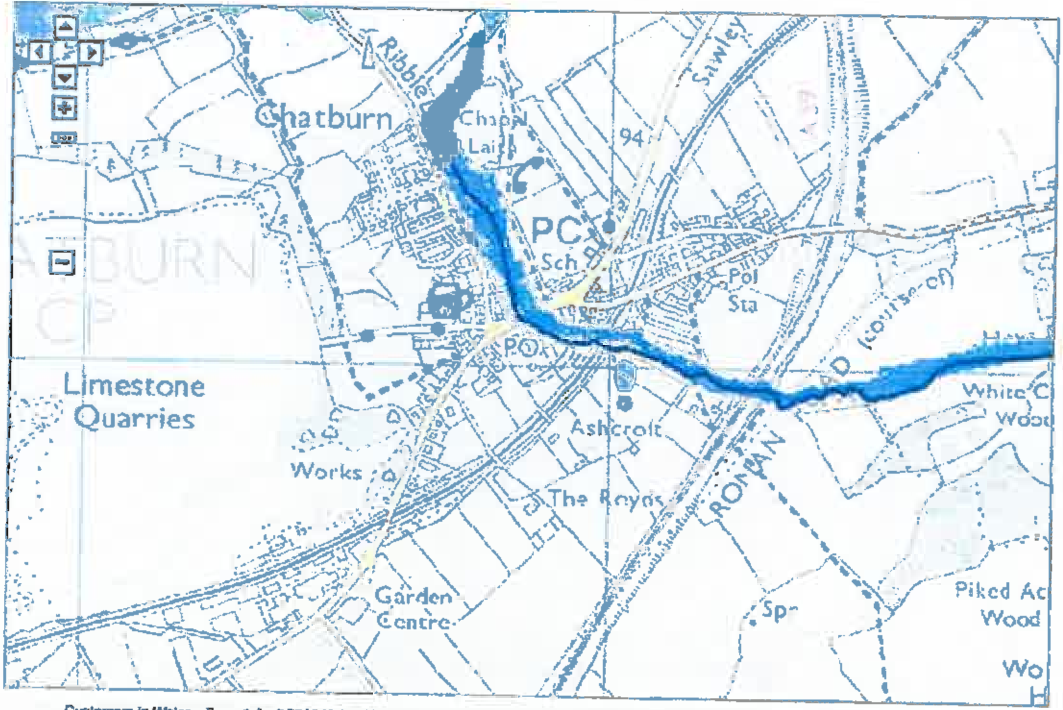
- 🟦 Flood Zone 3
- 🟦 Flood Zone 2
- Flood defences (Not all may be shown*)
- ▨ Areas benefiting from flood defences (Not all may be shown*)

☑ Main River Line

- Main River Line

☑ Other national environmental organisations

- ☐ Natural Resources Wales Area of responsibility
- Scottish Environment Protection Agency Area of responsibility



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**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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Environment Agency

**Enter a postcode or place name:** Go

**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

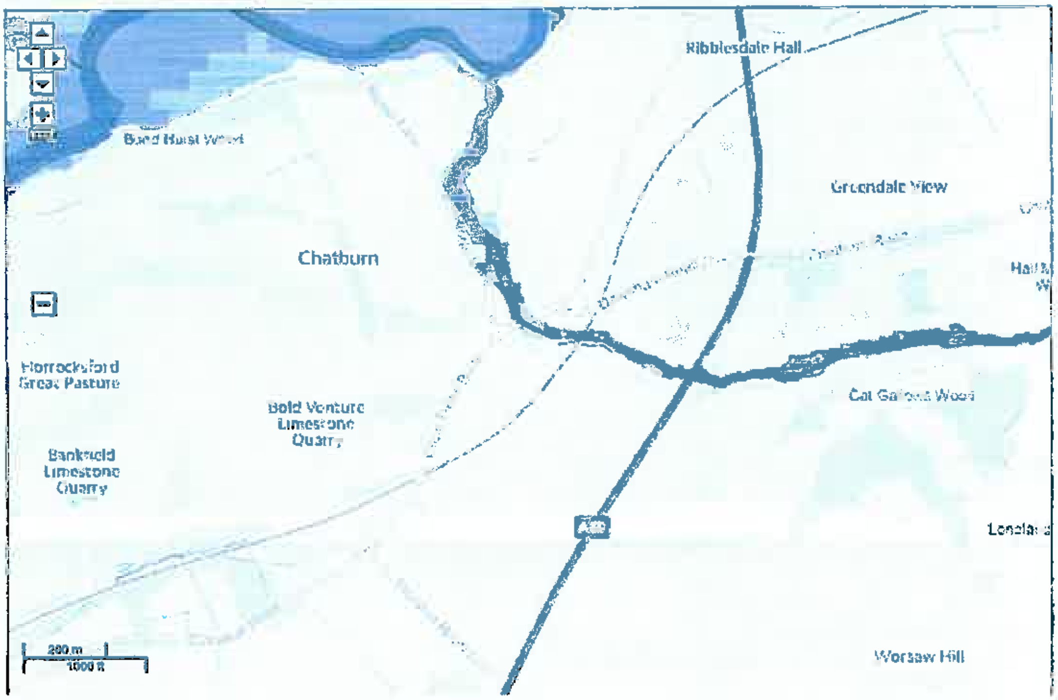
▨ Low

■ Very Low

☑ Other national environmental organisations

☐ Natural Resources Wales Area of responsibility

▨ Scottish Environment Protection Agency Area of responsibility



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Environment Agency

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Go

**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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