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Grindleton Mill

Flood Risk Assessment

Hamilton Associates

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1. INTRODUCTION

- 1.0 The proposed redevelopment site at Grindleton Mill lies to the northern extremity of the River Ribble's floodplain at Grindleton.
- 1.1 In their letter of 24 January 2001, to Ribble Valley Borough Council, the Environment Agency objected to the redevelopment of the site on the grounds of flood risk.
- 1.2 Under the Environment Agency's 'Policy and Practice for the Protection of Floodplains' the Agency seek to direct all development away from areas at risk of flooding unless the proposed development is clearly shown not to exacerbate flooding either upstream or downstream of the site.
- 1.3 Floodplain development is considered in accordance with PPG25 'Development and Flood Risk'. This Guidance directs Planning Authorities to adopt a precautionary approach to development and to undertake a risk-based analysis of flood issues.
- 1.4 The site owner, Hamilton Associates, applied for planning consent to Ribble Valley Borough Council. The planning authority has deferred its decision until such time as the Environment Agency can be satisfied regarding flood risk.
- 1.5 Hamilton Associates commissioned Parkman Ltd to undertake a flood risk assessment and provide a report to determine the extent of flooding at the site.

2. VISUAL ASSESSMENT OF THE RIVER RIBBLE.

- 2.0 A visual inspection of the River Ribble was undertaken on 15 May 2002. The inspection extended from the Sawley road bridge, approximately 3.5km upstream of the Grindleton Mill site, to the Henthorn weir approximately 4.5km downstream.
- 2.1 A photographic record of the river was taken and reference photographs of the proposed development site are included in section 3 of this report.
- 2.2 The River Ribble is fast flowing with substantial floodplains along its length. The visual inspection confirmed that there are no structures or constrictions immediately downstream of the Grindleton Mill site that could restrict flows and exacerbate localised flooding at the site.
- 2.3 The river was lined with wrack marks, located high up on the riverbanks, which are significantly higher than normal water level. Of particular interest are those wrack marks immediately downstream of the proposed development site at Grindleton Mill and those at the upstream bridge.

APPENDIX

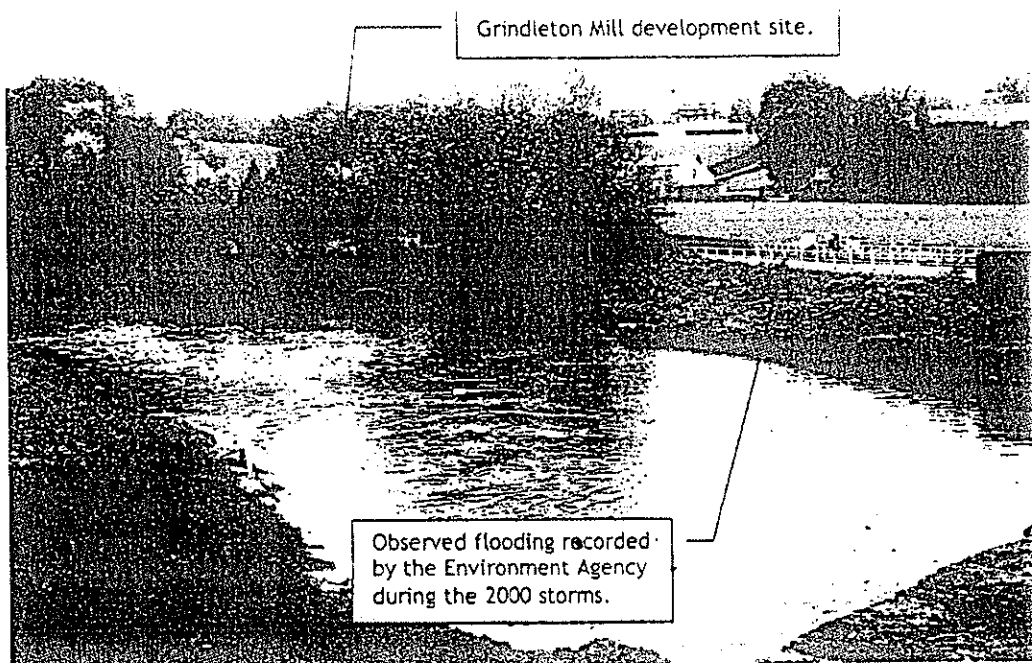


Photo 1: Overview of proposed development site.

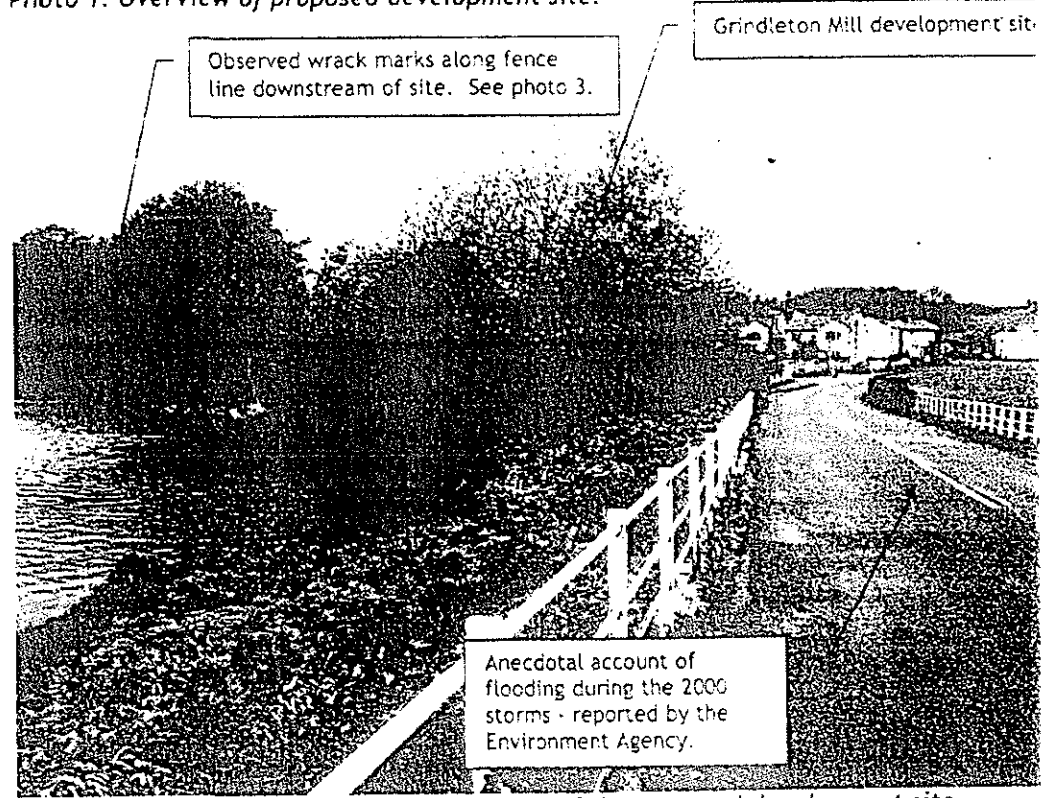


Photo 2: Observed wrack marks downstream of the proposed development site.

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4. FEH ESTIMATION OF DESIGN FLOW RATE.

- 4.0 For the purpose of this analysis the FEH annual flood maxima have been updated to include those of years 1994 to 2001 inclusively. Annual peak maxima for the period 1969 to 2001 are given in table 1 on the following page.
- 4.1 The catchment area of the River Ribble at Henthorn is 448 km². The corresponding catchment area at Grindleton Mill is 15% less at 381 km².
- 4.2 To determine the design flow rate, with a 1% annual probability of occurrence, both a pooled and single site analysis has been undertaken for the Henthorn gauge.
- 4.3 Of these, a pooled analysis estimated the design flow rate at the gauging station to be 475 m³/s. However, when compared to the historical records it is clear that this value is too low, as values near this have been reached 3 times within the past 26 years.
- 4.4 Based on a single site analysis the design flow rate at the gauge was calculated to be 600 m³/s. This value is deemed to be suitably conservative, exceeding the maximum recorded flow rate of 494 m³/s by 106 m³/s.
- 4.5 As a result, a design flow rate of 600 m³/s will be used as the basis of this assessment.

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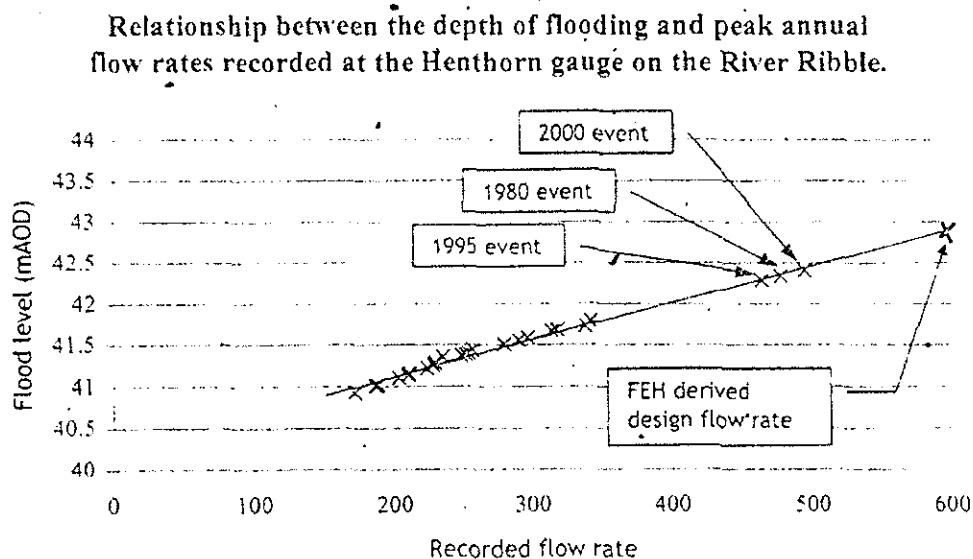
Table 1: Maximum annual flow rates recorded at the Henthorn gauge.

Rank	Year	Annual maximum flow rate (m ³ /s)	Flood level (m AOD)
1	2000	494.001	42.405
2	1980	476.978	42.341
3	1995	463.348	42.289
4	1992	341.595	41.789
5	1999	338.205	41.724
6	1991	317.973	41.683
7	1983	314.039	41.665
8	1981	296.825	41.585
9	1993	290.484	41.555
10	1979	280.056	41.505
11	1982	279.642	41.503
12	1976	257.529	41.44
13	1988	254.75	41.394
14	1978	252.378	41.38
15	1985	249.232	41.368
16	1998	235.87	41.352
17	1994	230.355	41.283
18	1997	229.026	41.254
19	2001	223.965	41.22
20	1996	211.25	41.151
21	1984	209.617	41.142
22	1977	203.141	41.106
23	1990	188.567	41.023
24	1986	187.188	41.015
25	1987	186.501	41.011
26	1989	171.999	40.925

5. HENTHORN GAUGE, ANNUAL RECORDED MAXIMA.

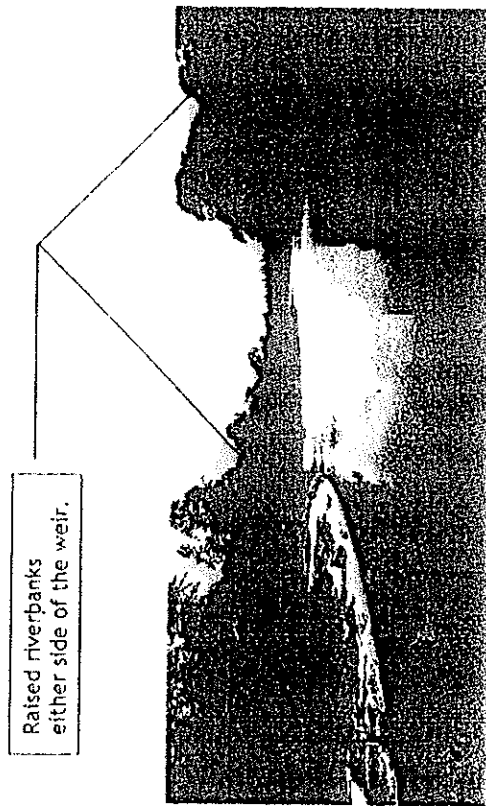
- 5.0 The Henthorn gauge is located approximately 4.5 km downstream of the Grindleton Mill site. Records of the annual peak flow rates, with corresponding depths of flow, have been made available for the period 1969 to 2001..
- 5.1 Although large floods occurred in both 1980 and 1995, with flow rates of 476 m³/s and 463 m³/s respectively, the largest recorded flood event occurred during the 2000 storm with a recorded flow rate of 494 m³/s. The recorded depth of flooding over the weir was 3.625m, giving a flood level of 42.41m AOD. The linear relationship between recorded flood levels and flow rates is given in graph 1 below.

Graph 1: Extrapolation of flood levels at the Henthorn Gauge.



- 5.2 As shown in photo 5 on the following page, the riverbanks either side of the river at the Henthorn gauge confine the width of flooding at the weir. As a result, it is reasonable to assume that the linear relationship between flow rate and flood level remains valid for storm events of greater intensity.
- 5.3 By extrapolation of the historical records of graph 1 above, the FEH design flow rate of 600 m³/s will have a corresponding increase in water level of 0.5m. The associated flood level at the weir during the design event is therefore 42.91m AOD.

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Raised riverbanks
either side of the weir.

6. YEAR 2000 FLOOD LEVELS AT GRINDLETON MILL.

6.0 Wrack marks are clearly visible along the banks of the River Ribble for several kilometres either side of the proposed development site. They are significantly higher than normal water level and coincide with the anecdotal accounts of flood levels, given by both the Environment Agency and local residents, observed at Grindleton during the year 2000 flood event.

6.1 These wrack marks provide an accurate record of the maximum flood level of the river during the year 2000 event. They cannot be attributed to any other recent storm, as they are the worst on record. They demonstrate the river's actual hydraulic regime, including the localised effects that bridges, and variations in the extent of the floodplain, have on flood levels.

6.2 Wrack marks at the upstream face of the bridge (see photo 4) indicate a maximum water level of 65.47m AOD.

At this flood level the bridge is acting as a restriction to flow, elevating flood levels at the upstream face. The effects of localised turbulence caused by the bridge abutments should also be considered when assessing the actual peak flood level of the river.

6.3 The flood level at the upstream face of the bridge supports the anecdotal accounts of flooding across the road 'East View'. The road level in this location is 64.87m AOD (see photo 1).

During the 2000 flood it was reported that the depth of flooding over the road was "about 12 inches and only passable by Land Rover". This gives an approximate flood level over the road of 65.2m AOD.

6.4 Located downstream of the site, the fence line along the top of the riverbank (see photo 3) indicates a maximum water level of 64.47m AOD.

This drop in water level, when compared to that immediately upstream of the bridge, can be attributed to the river re-establishing the full width of the floodplain downstream of the constrictive East View Bridge.

The extent of the active floodplain downstream of the bridge is approximately twice that immediately upstream of the bridge. Downstream of the bridge, the floodplain is principally to the south of the river, on the opposite side to the proposed development site. Water levels in this location are unaffected by the constriction caused by the East View bridge.

7. ESTIMATION OF DESIGN FLOOD LEVEL AT GRINDLETON MILL.

- 7.0 The observed wrack marks are a visual confirmation of the river's hydraulic regime during an extreme flood event. They therefore form a suitable basis for undertaking a hydraulic analysis of the river and for defining the probable flood level at the site during the design event.
- 7.1 The relationship between flood level at the weir and the associated flood levels at Grindleton have been determined by comparing the level of the observed wrack marks with the depth of flow at the weir, recorded during the year 2000 storm event.
- 7.2 As discussed in section 5, the peak annual flow rates and corresponding depths of flow recorded at the Henthorn weir can be extrapolated for other storm events of greater intensity. Hence, it has been determined that the design flow rate of 600 m³/s will increase the depth of flow over the weir by 0.5m above that recorded during the year 2000 storm event, ie 42.91m AOD.
- 7.3 The River Ribble is fast flowing and is typically bordered by large floodplains. There are no structures downstream of the development site that could restrict flows and exacerbate flood levels at the site. The closest crossing point downstream of the site is the Bradford Bridge, which is approximately 2.2 km away.
- 7.4 When in flood the River Ribble will tend to have a uniform hydraulic gradient. The predicted increase in flood level at the weir is likely to result in a similar increase in flood levels at Grindleton. The predicted flood levels would therefore be 66m AOD at the upstream face of the bridge and 65m AOD just downstream of the site.
- 7.5 The discrepancy between levels can, in part, be attributed to the turbulence caused by the river striking the abutment walls, elevating upstream water levels in the immediate vicinity of the bridge. Downstream of the bridge the river is free to re-establish the full extent of its floodplain causing levels to drop.
- 7.6 It should be noted that the width of the floodplain adjacent to the proposed development site exceeds that available at the Henthorn weir. As a result it is unlikely that actual flood levels at the site will increase by the same degree as that predicted for the weir. This provides additional confidence in our approach to determining flood levels.

8. THE REDEVELOPMENT OF THE GRINDLETON MILL SITE.

- 8.0 A schematic giving the location of the proposed office development is given in Appendix 1.
- 8.1 The office space has a plan area of 345m². The average ground level of the site is currently 65.75m AOD.
- 8.2 In keeping the slab levels of the adjacent housing development, Hamilton Associates have specified a minimum slab level of 66.5m AOD.
- 8.3 In accordance with the requirements of PPG 25 proposals for redevelopment of the site must take account of the risks of flooding and avoid interference with floodplain flows. The risk of flooding can be determined by undertaking a flood risk assessment that is appropriate to the scale and nature of the development.
- 8.4 The existing ground level exceeds that of the predicted design flood level, immediately downstream of the site, by 0.75m. Hence, the development site is not liable to flood during the design event. When compared to the minimum slab level the office development will exceed the design flood level by 1.5m.
- 8.5 To ensure a conservative approach to flood risk at the site, comparison is also made to the flood level at the upstream face of the bridge. As discussed in section 7.5, this flood level is exaggerated by the localised turbulence caused by the bridge abutments. The proposed slab level for the development exceeds the predicted flood level by 0.5m.
- 8.6 As a result, the redevelopment of the former Grindleton Mill site will not exacerbate flooding either upstream or downstream of the site. The site is not at risk of flooding and no compensation for loss of flood storage is required.

9. SURFACE WATER ATTENUATION.

- 9.0 Planning guidance on housing (PPG 3) emphasises the need for urban regeneration and the redevelopment of previously developed land to minimise the need for development of green-field land. The land at Grindleton Mill is classed as 'brown field' and hence, is potentially suitable for redevelopment.
- 9.1 Although the tarmac parking and concrete paved areas still exist, the mill itself has been demolished to its foundations. To improve the aesthetic appearance of the site for the adjacent housing development, the entire area has been grassed over with approximately 150mm of seeded topsoil (see drawing 1).
- 9.2 Despite its appearance as a natural meadow, the development site remains highly impermeable. The existing surface water drainage systems for the site can still be seen protruding along the riverbank.
- 9.3 The impermeability of the site will not significantly alter as a result of redevelopment. As the volume of surface water runoff will not be exacerbated no additional surface water attenuation is required.

10. DISCUSSION AND CONCLUSIONS.

- 10.1 Floodplain development was considered in accordance with PPG 25 'Development and Flood Risk' and the proposed development has been assessed for a catchment design storm event with a 1% annual probability of occurrence.
- 10.2 The methodology was based on the extrapolation of the actual flood records for the River Ribble, during the year 2000 flood event, as outlined in section 7. The observed wrack marks, which form the basis of this assessment, are a visual confirmation of the river's actual hydraulic regime during an extreme flood event. They provided an accurate record of the maximum flood levels of the river during the year 2000 event.
- 10.3 To ensure a conservative approach to flood risk at the site, our assessment provides for a corresponding increase in predicted flood levels at both the Henthorn weir and Grindleton.
- 10.4 Extrapolation of water levels for the site is based on the more onerous depth of flooding at the Henthorn weir. The contributing catchment area at Grindleton Mill is 15% less than that at Henthorn and hence, the corresponding increase in the depth of flooding is likely to be less.
- 10.5 The width of the active floodplain at Grindleton significantly exceeds that at the Henthorn weir. This provides additional confidence in our approach to determining flood levels at the site, as this will tend to reduce further the actual depth of flooding at Grindleton.
- 10.6 Analysis demonstrates that the proposed development site is not located within the River Ribble's floodplain and hence, will not exacerbate flooding during the design storm event.
- 10.7 A proposed slab level of 66.5m AOD significant exceeds the predicted water level at the site by 1.5m.
- 10.8 The site, having been previously developed, remains effectively impermeable. As a result, the proposed redevelopment will not increase the volume of surface water runoff and no additional attenuation is therefore required.