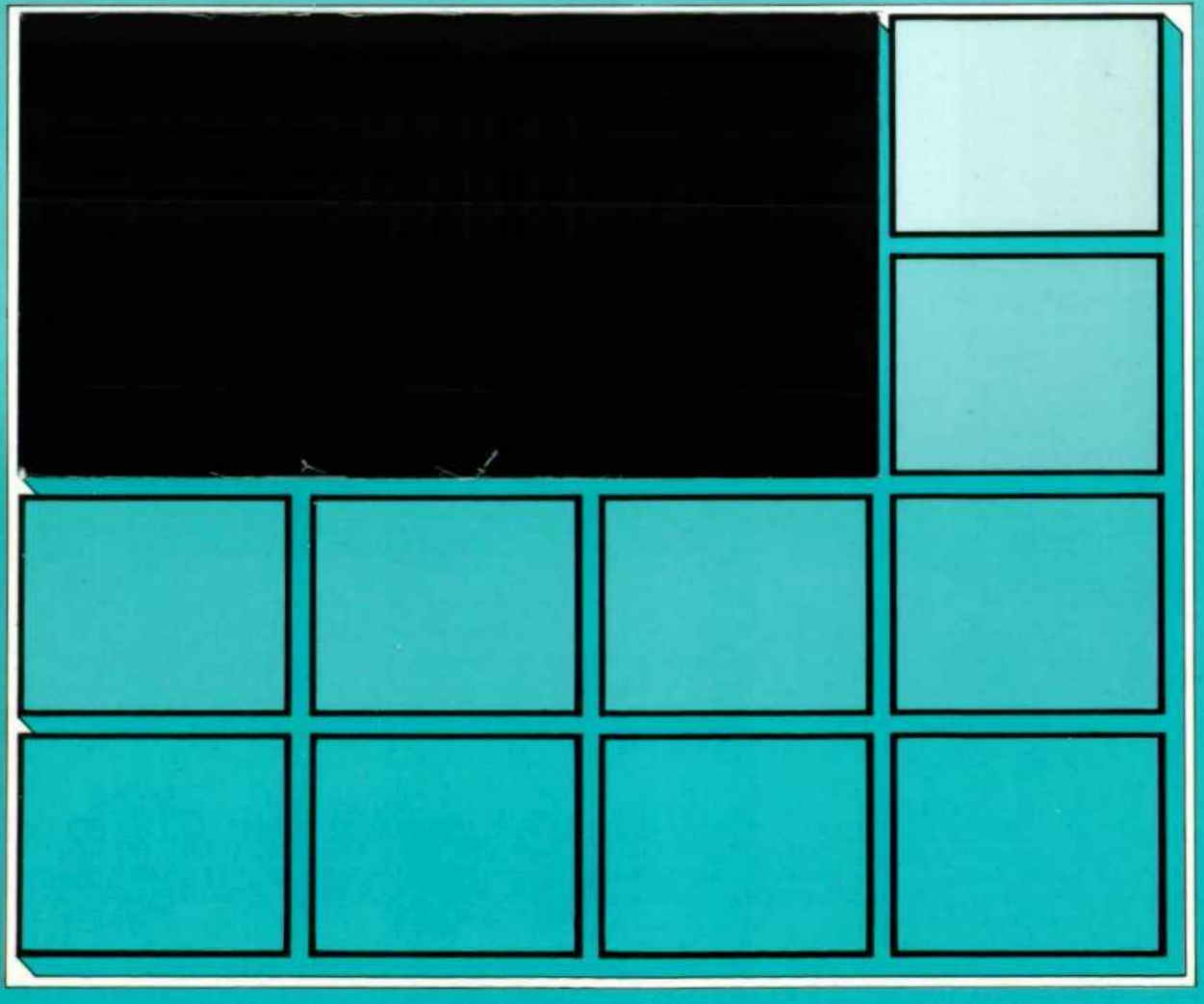

INSTITUTE of
HYDROLOGY

LIVOX QUARRY
PROPOSED EXTENSION

PRELIMINARY HYDROLOGICAL ASSESSMENT

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Date: 15 August 1990

Attention : Mr R.G. Woodbridge

Dear Sirs,

PRELIMINARY HYDROLOGICAL ASSESSMENT LIVOX QUARRY EXTENSION

In response to your enquiry of 30 May 1990, the following is a short note outlining our preliminary assessment of the potential hydrological and hydrogeological problems that may be encountered in the proposed Livox quarry extension area.

Yours faithfully,

N. Runnalls
Consulting Services.

PRELIMINARY HYDROLOGICAL ASSESSMENT LIVOX QUARRY EXTENSION

1. INTRODUCTION

1.1 Amey Roadstone Corporation is currently working Livox aggregate quarry located on the west bank of the River Wye in Gwent (NGR 3542E/19755N), 3.5 km north of Chepstow. Its location is shown on Figure 1. The existing quarry covers an area of about 12 ha. on the lower part of a ridge within a meander of the River Wye. It is proposed to extend the existing quarry by about 20 ha. in a westerly direction to within 150 m of the A466 Chepstow- Monmouth road.

1.2 The Blackcliff-Wyndcliff SSSI surrounds the proposed quarry extension to the north, south and west, while the River Wye SSSI lies to the north, south and east of the site as shown in figure 4.

1.3 This note is a preliminary assessment of the potential hydrological impact of the proposed extension to Livox Quarry on the adjacent SSSI's and on any nearby sources of water supply or springs, and also examines the likely hydraulic connection between the River Wye and the quarry workings. It has been prepared by the Institute of Hydrology at the request of ARC and is based on a site inspection, information supplied by ARC and other data held at Wallingford.

2 GEOLOGY

2.1 The geology of the general area is shown in Figure 1 [OS Sheet 250(Chepstow) 1:50000 dated 1972] and the stratigraphic sequence is given in Table 1.

Table 1 Stratigraphic Sequence

Carboniferous	Crease Limestone
	Lower Dolomite
	Lower Limestone Shale
	Limestone
Devonian	
(Upper Old Red Sandstone)	Tintern Sandstone Group
	Quartz Conglomerate
(Lower Old Red Sandstone)	Brownstones
	Sandstones

2.2 The Lower Dolomite forms the source of aggregate material. This formation dips in an easterly direction at about 5-10 degrees and is separated from the Old Red Sandstone aquifer by the Lower Limestone Shales which outcrop to the west, north and south of the quarry.

2.3 Major landslips, probably associated with the river erosion of the shales, have occurred to the north and south of the site leaving prominent cliffs. Liveoaks Brake is situated on the Lower Dolomite outcrop some 200 m. south of the proposed excavation whilst Liveoaks Grove, appears to straddle the dolomite, shales and the landslip area some 50 m. from the northern boundary, but the central and eastern portions of Liveoaks Grove are situated on dolomite.

3 HYDROLOGY

3.1 The average total annual rainfall in the Liveoaks area is approximately 950mm with the bulk of this falling in the late autumn-winter period. The relative amounts of evaporation, runoff and infiltration is unknown, although runoff is usually quite limited from the limestone sequence.

3.2 The surface water catchment of the proposed quarry extension site is less than 1.0 km2. The main surface water divide extends north-south along the high ground about 1 km. west of the extension and, with four smaller internal catchment areas, is shown in Figure 2.

3.3 A low west-north-west divide situated approximately 50 m. south of the southern boundary of the proposed quarry extension defines the northern boundary to Catchment A. This catchment supplies surface runoff to Liveoaks Brake in the southeast portions of the Blackcliff-Wyndcliff SSSI. The proposed quarry extension does not enter Catchment A and therefore will not affect runoff to the Liveoaks Brake portion of the SSSI.

3.4 Catchment B covers an area of approximately 0.25 ha. and is the principal surface drainage feature affecting the proposed quarry extension. The shallow drainage 'channel' within this area is thought to extend from near Minepit Wood, past the western side of the Liveoaks Farm buildings to a man-made pond at the southeast corner of the farm. From this pond surface water then flows through a small woodland area between Liveoak Brake and Liveoak Grove (97155390). This woodland lies outside the existing Blackcliff-Wyndcliff SSSI.

3.5 The total volume of surface flow along this drainage channel is unknown, although approximately 210,000 m3 of water falls annually within Catchment B. The extent to which surface flow is redirected by drainage works beside the A466 Chepstow-Monmouth road is also unknown.

3.6 The proposed quarry extension will capture the main drainage channel within Catchment B and reduce the volume of water passing through the woodland area. The effect of this reduction in surface water flow would probably be minimal as the total area affected is very small (approx. 150 m2).

3.7 This capture of the main drainage of Catchment B will result in an increase in the volume of surface water entering the quarry workings.

3.8 Catchment C covers a total area of approximately 0.08 ha with surface flow to the southeast passing through part of Liveoak Grove (97505400) and into the existing quarry workings. The volume of surface flow in the main drainage 'channel' in Catchment C is unknown, although on average 75,000 m3 of precipitation falls within the area each year.

3.9 Catchment C does not contribute surface flow to any part of the Blackcliff-Wyndcliff SSSI. The incorporation of this catchment into the proposed quarry will not affect surface flow into the SSSI.

3.10 The boundary between Catchments C and D lies to the north of the proposed quarry extension. The volume of surface runoff flowing northwards in Catchment D into the SSSI will therefore be unaffected by this extension.

3.11 The northwest and northeast corners of the proposed quarry development extend into Catchment D. However because of the small areas involved, 50 m x 100 m and 75 m x 100 m respectively, this is unlikely to have any significant effect upon the SSSI.

4 HYDROGEOLOGY

4.1 The porosity of the Lower Dolomite is usually low, permeabilities minimal and yields of water from the matrix minimal. However, where fissures are developed, either along faults or associated with karstic features, groundwater flow can be rapid. Such flow is localised to areas of high fissure density and issues at a limited number of springs.

4.2 Typically the Lower Dolomite has a low specific yield, with water levels responding rapidly to rainfall. Transmissivities vary widely (10-1000 m2/d) and storage coefficients range from 0.5 to 2.0%.

4.3 No wells or springs are shown on the 1:25000 OS map in the SSSI areas adjacent to the quarry extension (Figure 3). It would seem that these SSSI's are related to the steep uncultivable nature of the slopes bordering the site and are not due to any particular hydrological characteristic of the site, whether of surface water or groundwater.

4.4 According to the National Borehole Archives no major groundwater abstractions occur in the area. The distribution of wells and springs is shown in Figure 3. A strong perennial spring is reported to occur at the foot of the Ban-y-gor cliff on the river bank opposite the present quarry [Wells and Springs of Gloucestershire]. This could be associated with the nearby St Arvans faultline. The yield is reported to be about 500,000 gpd in summer and 1,500,000 gpd in winter. It was used by Tidenham and subsequently the Chepstow Water Company as a source of supply from about 1900. The present status is unknown but it is likely that the villages previously served by this supply will now be using alternative sources.

4.5 *There are no wells or springs in the proposed quarry extension area itself:* up until 1978 Liveoaks Farm drew a supply from a spring south of Moss Cottage (96955260). Numerous springs and wells serving local communities occur further west associated mainly with the Old Red Sandstone. Linen Well and springs to the north and south of the site appear to be related to local fractures at the base of the Lower Dolomite sequence and consequently none are likely to be affected by the quarry extension.

4.6 Groundwater is currently pumped intermittently from a borehole near the existing quarry plant site (97755430) for industrial and drinking purposes. This water reportedly has a high iron content and presumably is derived from the Old Red Sandstone aquifer. It is unlikely to be affected by the proposed quarry extension.

4.7 The elevation of the top of the Lower Limestone Shales based on ARC borehole information varies from about +45 m.O.D. at the western end of the quarry extension to about -25 m.O.D. at the River Wye at the east of the existing quarry. This indicates that the river bed is in contact with the dolomite in the area of the existing quarry but upstream and downstream it is in contact with the shales. Hence, any recharge of the dolomites from the River Wye would be restricted to the existing quarry area. The amount of recharge would also be reduced by the silt deposits along the river channel.

4.8 The water level of the sump within the existing quarry is usually at approximately +3.5 m.O.D. and does not vary in response to the 0.0-+6.0 m.O.D. tidal range of the River Wye. In addition, the water in the sump shows no evidence of entry of salt water from the Wye. This would indicate that there is no hydraulic connection between the river and this part of the quarry. It is therefore unlikely that the proposed quarry extension will hydrologically affect the River Wye SSSI.

4.9 Any groundwater present beneath the extension area would be derived from rainfall on the dolomite outcrop. The area of dolomites west of the Wye including the quarry, is small, about 2.5 km2, and therefore the amount of any groundwater flow in the dolomites would also be very limited. It is reported that small springs develop at approximately +25 m.O.D. along the western face of the existing quarry after prolonged periods of heavy winter rainfall. This

would also suggest that groundwater flow is very limited within the dolomites, and that in normal circumstances the water table lies below the present level of exposed quarry workings (+4.0 m.O.D.).

4.10 None of the seven investigation boreholes drilled during June-July 1989 in the existing and proposed quarry extension are reported to have encountered groundwater. Whilst each borehole was drilled into the shales, none penetrated through the shales into the underlying limestones and Old Red Sandstone, where an confined aquifer is likely to be present. The lack of groundwater in the dolomite in the extension area suggests that the upward leakage through fractures in the shales does not occur within this particular area.

4.11 Whilst occasional breccia zones (some with calcite infilling) occur and increased fissuring and joints are reported in the upper and lower part of the dolomites, there are no reports of any groundwater in these zones of secondary permeability. This would imply that the dolomites do not contain groundwater, at least in the quarry area. Any groundwater flow that does pass through any open fissure zones in the lower part of the dolomites would not be reduced by the quarrying since the quarry floor will be at least 10 m above the shales.

4.12 In view of the conditions described above it is unlikely that the proposed quarry extension will have any significant effect upon groundwater flow, or water table levels beneath the two SSSI sites.

5 CONCLUSIONS

5.1 The adjacent woodland SSSI's are not hydraulically related to the quarry extension area and are therefore unlikely to be affected by the proposed developments.

5.2 One small area of woodland to the southeast of the proposed quarry extension will be slightly affected by the diversion of surface flow but this lies outside the SSSI.

5.3 The River Wye does not contribute recharge to the Livox quarry extension area and therefore is unlikely to be affected by the proposed developments.

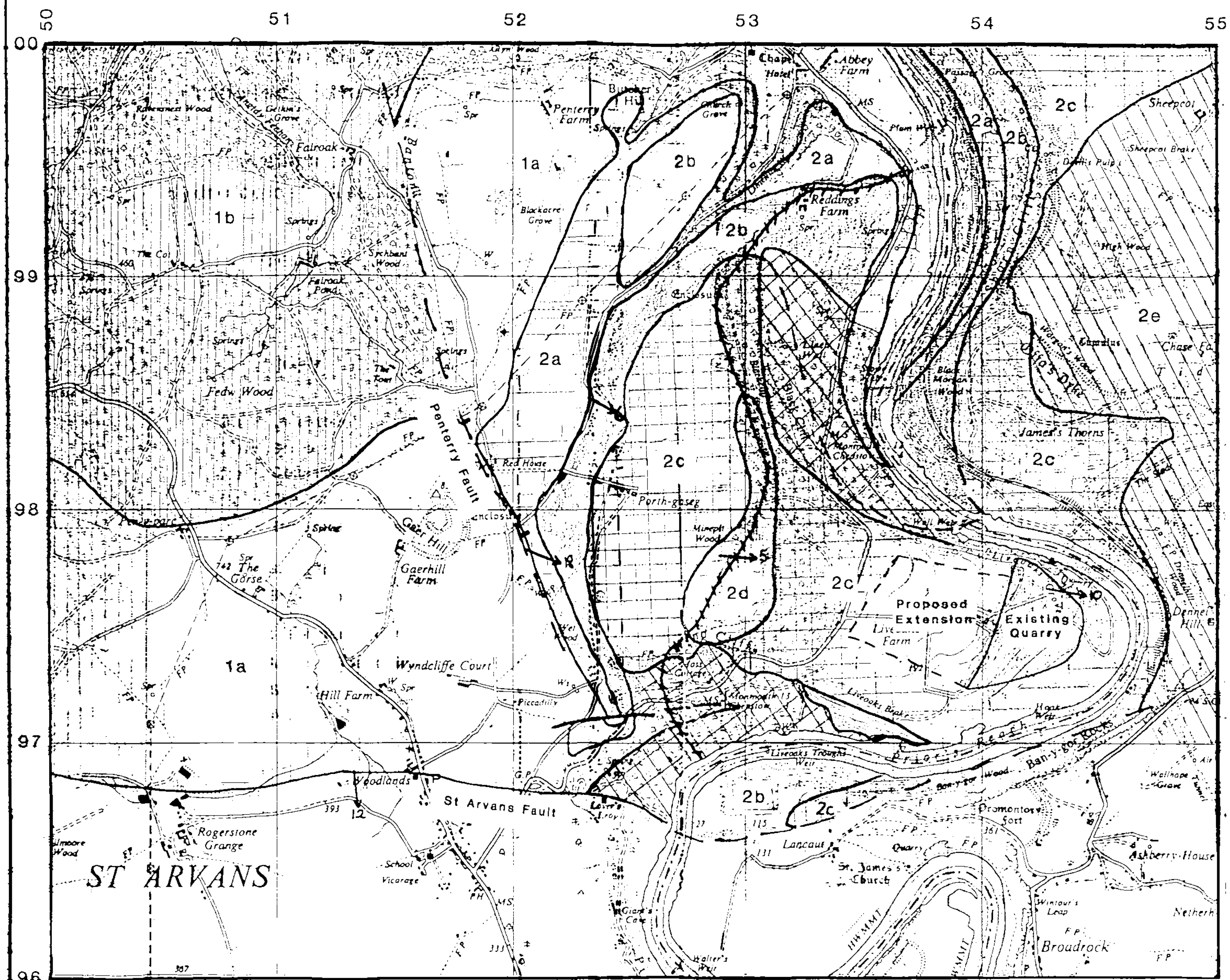
5.4 Springs and wells in the general area are associated with the Old Red Sandstone aquifer which is seperated from the dolomites by a shale sequence. The yield of any local wells and springflows is unlikely to be affected by the quarry extension.

5.5 The amount of groundwater passing through the dolomites is small and the impact of the proposed quarry extension on the groundwater regime is likely to be minimal.

Livox Quarry.
Proposed Extensions.

Preliminary
Hydrological Assessment.

Geology



KEY.

2a – Limestone
2b – Shale
2c – Dolomite
2d – Crease limestone
2e – Drybrook sequence

1a – Sandstone } O.R.S.
1b – Brownstone }

Catchment boundary
Areas of landslip
Spring
Well

Fig 1

Basemap from O.S. ST59

SCALE 1:18,200 approx.

53 54 55

98

97

Livox Quarry

Proposed Extensions

Preliminary

Hydrological Assessment.

Surface Drainage

Proposed Extension

Existing Quarry

- Drainage Divide
- Drainage Channel

B- Catchment Area

Fig 2

Basemap from O.S. ST59.

SCALE 1:10,000

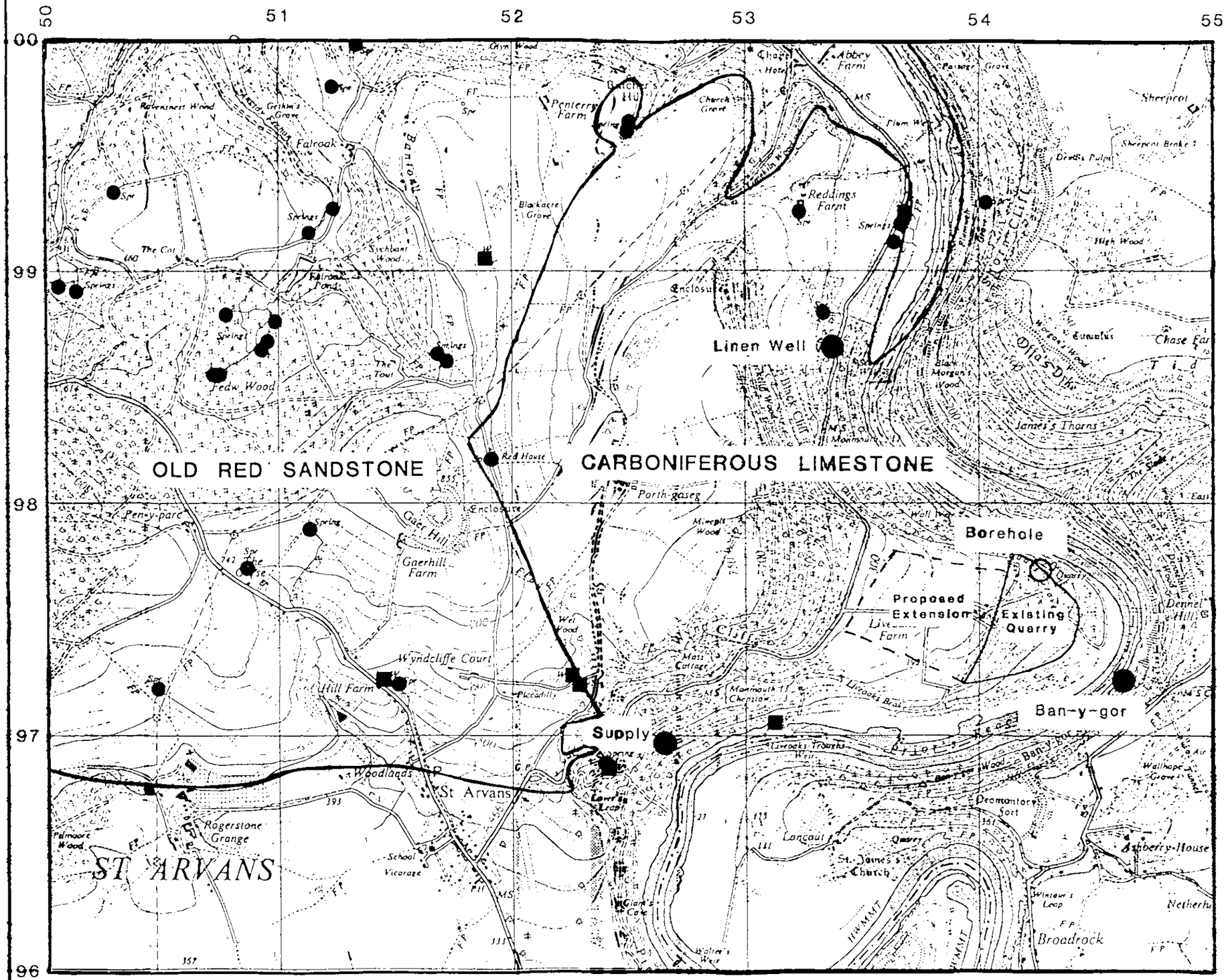


Fig 3

Basemap from O.S. ST59

SCALE 1:18,200 approx.

Livox Quarry

Proposed Extensions

Preliminary

Hydrological Assessment.

SSSI Location Plan

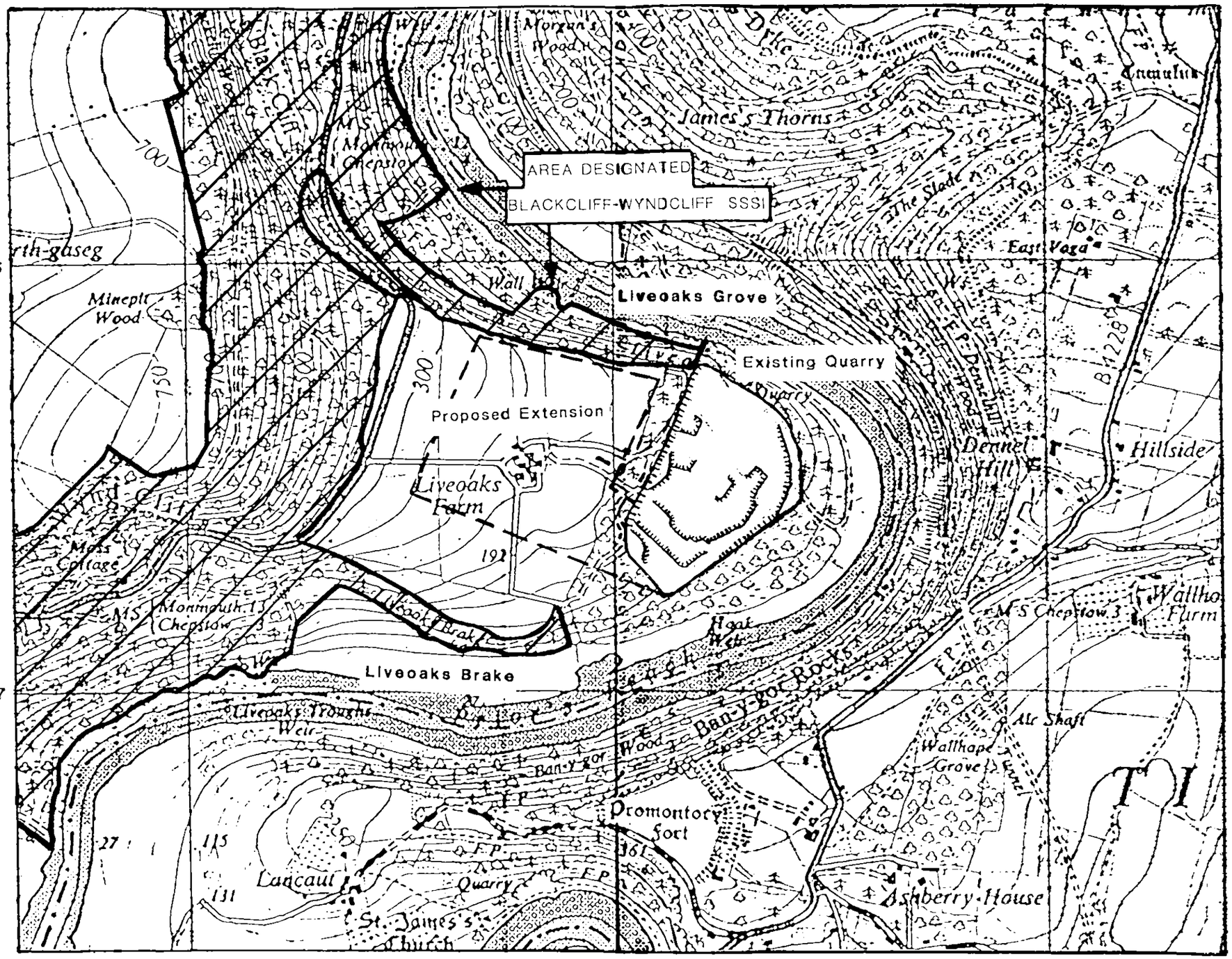
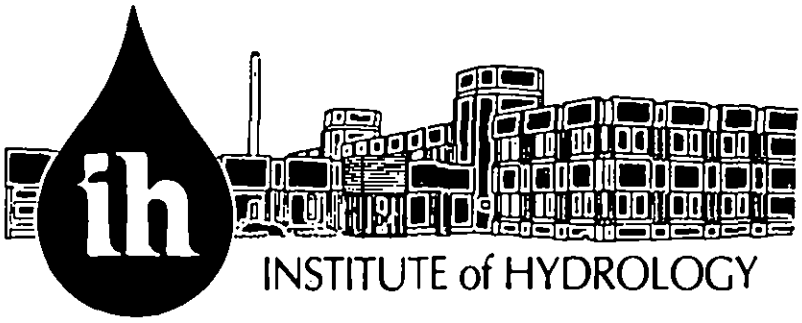


Fig 4.

Basemap from O.S. ST59.

SCALE 1:10,000



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