West Lothian Geodiversity

Volume 2 – Figures

H F Barron, M A E Browne and A Finlayson

Contributors
S L B Arkley, S M Clarke, A Matthewson, A Pickering and K I G Lawrie and E K Hyslop

Editor
D J D Lawrence

The National Grid and other Ordnance Survey data are used with the permission of the Controller of Her Majesty’s Stationery Office. Licence No: 100017897/2006.

Keywords
Geodiversity; West Lothian.

Front cover
Five Sisters Bing, West Calder

Bibliographical reference

Copyright in materials derived from the British Geological Survey’s work is owned by the Natural Environment Research Council (NERC) and/or the authority that commissioned the work. You may not copy or adapt this publication without first obtaining permission. Contact the BGS Intellectual Property Rights Section, British Geological Survey, Keyworth, e-mail ipr@bgs.ac.uk. You may quote extracts of a reasonable length without prior permission, provided a full acknowledgement is given of the source of the extract.

Maps and diagrams in this book use topography based on Ordnance Survey mapping.

© NERC 2006. All rights reserved

Keyworth, Nottingham  British Geological Survey  2006
The full range of Survey publications is available from the BGS Sales Desks at Nottingham, Edinburgh and London; see contact details below or shop online at www.geologyshop.com.

The London Information Office also maintains a reference collection of BGS publications including maps for consultation.

The Survey publishes an annual catalogue of its maps and other publications; this catalogue is available from any of the BGS Sales Desks.

The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as its basic research projects. It also undertakes programmes of British technical aid in geology in developing countries as arranged by the Department for International Development and other agencies.

The British Geological Survey is a component body of the Natural Environment Research Council.

British Geological Survey offices

Keyworth, Nottingham NG12 5GG
☎ 0115-936 3241  Fax 0115-936 3488
 e-mail: sales@bgs.ac.uk
 www.bgs.ac.uk
 Shop online at: www.geologyshop.com

Murchison House, West Mains Road, Edinburgh EH9 3LA
☎ 0131-667 1000  Fax 0131-668 2683
 e-mail: scotsales@bgs.ac.uk

London Information Office at the Natural History Museum (Earth Galleries), Exhibition Road, South Kensington, London SW7 2DE
☎ 020-7589 4090  Fax 020-7584 8270
 ☎ 020-7942 5344/45  email: bgslondon@bgs.ac.uk

Forde House, Park Five Business Centre, Harrier Way, Sowton, Exeter, Devon EX2 7HU
☎ 01392-445271  Fax 01392-445371

Geological Survey of Northern Ireland, Colby House, Stranmillis Court, Belfast BT9 5BF
☎ 028-9038 8462  Fax 028-9038 8461

Maclean Building, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB
☎ 01491-838800  Fax 01491-692345

Columbus House, Greenmeadow Springs, Tongwynlais, Cardiff, CF15 7NE
☎ 029–2052 1962  Fax 029–2052 1963

Parent Body

Natural Environment Research Council, Polaris House, North Star Avenue, Swindon, Wiltshire SN2 1EU
☎ 01793-411500  Fax 01793-411501
 www.nerc.ac.uk
Contents

Figure 1  A: Part of the geological timescale with colour bars representing the rocks of West Lothian. Yellow bar = Carboniferous sedimentary rocks; red bars = extrusive igneous rocks; green bars = intrusive igneous rocks. B: Classification of Carboniferous strata in West Lothian.

Figure 2  Bedrock geology of West Lothian.

Figure 3  Maximum limits of Late Devensian glaciation in Britain. Solid line – mapped limit; dotted line – inferred confluence with Scandinavian ice. (from Boulton et al., 1977).

Figure 4  Superficial deposits of West Lothian.

Figure 5  Mines and Quarries from the BGS BritPits database and the Scottish Quarries database.

Figure 6  Potential West Lothian geodiversity sites from desk study.

Figure 7  Geological and landscape designations of West Lothian.

Figure 8  NEXTMap Orthorectified radar Digital Surface Model of West Lothian.

Figure 9  SNH Landscape Character Assessment of West Lothian.

Figure 10  Biological designations and other biodiversity sites of West Lothian.

Figure 11  Scheduled Monuments and archaeological sites of West Lothian.

Figure 12  West Lothian Geodiversity Sites (WLGS).

Figure 13  Inverclyde Group geodiversity sites of West Lothian.

Figure 14  View across Harperrig Reservoir from Auchinoon Quarry (WLGS 36) beside the A70. The south-east boundary of West Lothian runs along the skyline from East Cairn Hill to West Cairn Hill. Inverclyde Group rocks form the hills and most of the low ground beyond the reservoir.

Figure 15  Section in gently dipping mudstones, siltstones and thin sandstones of the Ballagan Formation (Inverclyde Group) capped by glacial till. Section approximately 5 m high. Baad Park Burn (WLGS 1) [NT 1125 6014], south-east of Harperrig Reservoir.

Figure 16  West Lothian’s highest hill – West Cairn Hill (562m) from Baad Park Burn, south-east of Harperrig Reservoir. West Cairn Hill is formed from Kinesswood Formation (Inverclyde Group) sandstones. WLGS 2 is located close to the break of slope on the right skyline of the hill.

Figure 17  East Cairn Hill (561 m summit) from Baad Park Burn (WLGS 1), south-east of Harperrig Reservoir. The gently-inclined Kinesswood Formation (Inverclyde Group) sandstones show small-scale scarp featuring.

Figure 18  Laminated and cross-bedded red sandstones of the Ballagan Formation (Inverclyde Group). Baad Park Burn (WLGS 1) [NT 1103 6037], south-east of Harperrig Reservoir. East Cairn Hill in background.

Figure 19  Strathclyde Group geodiversity sites of West Lothian.

Figure 20  Sign beside entrance gate [NS 9895 6891] to East Kirkton Quarry, Bathgate (WLGS 4).

Figure 21  Quarry face in East Kirkton Quarry [NS 9901 6913], East Kirkton Limestone, West Lothian Oil Shale Formation (WLGS 4).

Figure 22  Quarry face in East Kirkton Quarry [NS 9901 6913], East Kirkton Limestone, West Lothian Oil Shale Formation (WLGS 4).

Figure 23  The same face as Figure 22, taken in 1994. BGS Photograph P2882 © NERC. WLGS 4.

Figure 24  West Lothian’s most distinctive landmarks – the Five Sisters oil-shale bings [NT 009 641] (WLGS 5) near West Calder, viewed from the south-west. The bings are 91 m in height with a summit altitude of 240 m. They are protected as a Scheduled Monument.

Figure 25  Five Sisters oil-shale bings [NT 009 641] (WLGS 5) from the south. Burnt oil-shale is initially dark blue-grey (“blaes”), but rapidly oxidises to a characteristic red colour in contact with the elements.

Figure 26  Greendykes (Broxburn) [NT 087 736] oil-shale bing viewed from the west (WLGS 7).
Figure 27  South-west face of Seafield Law [NT 005 667] (WLGS 6), Seafield. This oil-shale bing has been re-profiled to replicate one of the most distinctive natural landforms of West Lothian – a ‘crag and tail’ glacial feature.

Figure 28  Weathered spent oil-shale on Seafield Law [NT 005 667] (WLGS 6).

Figure 29  Sluice weir on the River Almond 500 m upstream from the Almond Valley Heritage Centre NT 0325 6689 (WLGS 8).

Figure 30  Sandstone and siltstone beds of the Gullane Formation exposed in the bank of the Murieston Water [NT 0733 6658] (WLGS 9). The section is approximately 3 m high and the beds show fault-related deformation from the Calder Fault.

Figure 31  *Stigmaria* tree root fossil in Calders Member, West Lothian Oil Shale Formation, Almondell [NT 0887 6885] (WLGS 10).

Figure 32  View of steeply dipping Burdiehouse Limestone [NT 0860 6840] (WLGS 10). Calders Member, West Lothian Oil Shale Formation, Almondell.

Figure 33  Overfold in Broxburn Shale [NT 0790 6710], Hopetoun Member, West Lothian Oil Shale Formation, Calderwood (WLGS 10).

Figure 34  Small oil-shale bing at Upper Uphall [NT 0550 7225]. Hopetoun Member, West Lothian Oil Shale formation (WLGS 11).

Figure 35  Sitts resulting from he collapse of underground stoop and room working. Upper Uphall [NT 0550 7225] (WLGS 11). Hopetoun Member, West Lothian Oil Shale formation.

Figure 36  Ironstone nodules, Upper Uphall [NT 0550 7225] (WLGS 11). Hopetoun Member, West Lothian Oil Shale formation.

Figure 37  Obelisk Quarry, Hopetoun [NT 0942 7859] (WLGS 13). Quarry face in Dunnet Sandstone (Hopetoun Member, West Lothian Oil Shale Formation).

Figure 38  Obelisk Quarry, Hopetoun [NT 0942 7859] (WLGS 13). Close-up of Figure 37. Fine grained sandstone with interbeds of very fine grained sandstone and laminated carbonaceous siltstone (“tiger-stripe”).

Figure 39  Obelisk Quarry, Hopetoun [NT 0942 7862] (WLGS 13). Fluvial channel features in Dunnet Sandstone.

Figure 40  Entrance to Obelisk Quarry, Hopetoun [NT 0942 7862] (WLGS 13).

Figure 41  Society East Shore 2. Sandstone overlying oil-shale, Dunnet Sandstone, Hopetoun Member, West Lothian Oil Shale Formation [NT 1058 7879] (WLGS 14).

Figure 42  Society East Shore 3. Sandstone with carbonate nodules overlying limestone. Dunnet Sandstone, Hopetoun Member, West Lothian Oil Shale Formation [NT 10538 78805] (WLGS 14).

Figure 43  Society East Shore 4. Cross-bedded sandstone. Dunnet Sandstone, Hopetoun Member, West Lothian Oil Shale Formation [NT 1052 7882] (WLGS 14).

Figure 44  Society East Shore 6. Dunnet Sandstone outcrops with Forth bridges beyond. Hopetoun Member, West Lothian Oil Shale Formation [NT 1048 7884] (WLGS 14).

Figure 45  Trough cross-bedded sandstone at Society Point. Binny Sandstone, Hopetoun Member, West Lothian Oil Shale Formation [NT 1009 7902] (WLGS 15).

Figure 46  Steps cut in cross-bedded sandstone at Society Point. Binny Sandstone, Hopetoun Member, West Lothian Oil Shale Formation [NT 1009 7902] (WLGS 15).

Figure 47  Sandstone dyke and carbonaceous lags in cross-bedded sandstone at Society Point. Binny Sandstone, Hopetoun Member, West Lothian Oil Shale Formation [NT 1009 7902] (WLGS 15).

Figure 48  A: Damage to sandstone caused by core-cutting. B: Close-up of Figure 47 – carbonaceous lags (plant debris) in sandstone. Society Point, Binny Sandstone, Hopetoun Member, West Lothian Oil Shale Formation [NT 1009 7902] (WLGS 15).

Figure 49  *Stigmaria* tree root fossil at Society Shore 1 [NT 0967 7910] (WLGS 16). Barracks Limestone, Hopetoun Member, West Lothian Oil Shale Formation.

Figure 50  Blending in – wall of local sandstone built on eastward-dipping Dunnet Sandstone at Society Shore 2 [NT 0954 7913] (WLGS 16). Hopetoun Member, West Lothian Oil Shale Formation.

Figure 51  Easterly-dipping sandstone on the east limb of the Hopetoun anticline at Hopetoun Shore 1 [NT 0935 7919] (WLGS 17). Calders Member, West Lothian Oil Shale Formation.
Figure 52  Ripple-marked sandstone bedding-plane – close-up of Figure 51. Hopetoun Shore 1 [NT 0935 7919] (WLGS 17). Calders Member, West Lothian Oil Shale Formation.

Figure 53  Burdiehouse Limestone on the west limb of the Hopetoun anticline. Hopetoun Shore 3 [NT 0894 7935] (WLGS 17), Hopetoun Member, West Lothian Oil Shale Formation.

Figure 54  Small fault in Burdiehouse Limestone – close up of Figure 53. Hopetoun Shore 3 [NT 0894 7935] (WLGS 17), Hopetoun Member, West Lothian Oil Shale Formation.

Figure 55  Small-scale open fold in Burdiehouse Limestone – close up of Figure 53. Hopetoun Shore 3 [NT 0894 7935] (WLGS 17), Hopetoun Member, West Lothian Oil Shale Formation.

Figure 56  Outcrop of Binny Sandstone at Abercorn Point 1 [NT 0843 7950] (WLGS 18). Hopetoun Member, West Lothian Oil Shale Formation.

Figure 57  Cross-bedding in sandstones at Abercorn Point 3 [NT 0827 7954] (WLGS 18). Hopetoun Member, West Lothian Oil Shale Formation.

Figure 58  The Forth Bridges from Abercorn Point (WLGS 18).

Figure 59  Coarsening-up sequence Midhope Burn 2 [NT 0784 7981] (WLGS 19). Hopetoun Member, West Lothian Oil Shale Formation.

Figure 60  Midhope Burn 2 [NT 0784 7981] (WLGS 19). Hopetoun Member, West Lothian Oil Shale Formation. Section is to the right of that in Figure 59.

Figure 61  Broxburn Shale at Midhope Burn 1 [NT 0787 7898] (WLGS 19). Hopetoun Member, West Lothian Oil Shale Formation.

Figure 62  Bathgate Group geodiversity sites of West Lothian.

Figure 63  Stone circle and burial cairn on Cairnpapple Hill, viewed from the south-west. Rock types used are mainly local – basalt from the Bathgate Hills Volcanic Formation and quartz-dolerite from nearby intrusions [NS 9872 7174] (WLGS 20).

Figure 64  Stone circle and burial cairn on Cairnpapple Hill, viewed from the south-east. The cairn is a reconstruction representing the original Bronze Age cairn. [NS 9872 7174] (WLGS 20).

Figure 65  Stone circle and satellite burial chambers on Cairnpapple Hill. Rock types used are mainly local – basalt from the Bathgate Hills Volcanic Formation and quartz-dolerite from nearby intrusions [NS 9872 7174] (WLGS 20).

Figure 66  Historic Scotland interpretation board at Cairnpapple (WLGS 20).

Figure 67  Well-preserved lime kilns at Wairdlaw Quarry [NS 9955 7304] (WLGS 21).

Figure 68  View eastwards to Arthur’s Seat from the northern boundary of Wairdlaw Quarry [NS 9952 7313] (WLGS 21).

Figure 69  Main quarry face at Wairdlaw Quarry. Wairdlaw Limestone ((Lower Limestone Formation, Clackmannan Group) above lava of Bathgate Hills Volcanic Formation [NS 9952 7313] (WLGS 21).

Figure 70  Wairdlaw Quarry – small quartz dolerite quarry to north-west of main quarry [NS 9953 7320] (WLGS 21).

Figure 71  Drystone dyke of Wairdlaw Limestone at Wairdlaw Quarry [NS 9952 7313] (WLGS 21).

Figure 72  *Siphonodendron* coral fossil in the Wairdlaw Limestone at Wairdlaw Quarry [NS 9952 7313] (WLGS 21).

Figure 73  Wairdlaw Quarry flora – wild raspberry (*Rubus idaeus* var. *strigosus*), blueberry (*Vaccinium myrtillus*) and Scottish Bluebell (*Campanula rotundifolia*) [NS 9952 7313] (WLGS 21).

Figure 74  Clackmannan Group geodiversity sites of West Lothian.

Figure 75  Levenseat Sandstone above bedded black siltstones and mudstones. Quarry face is approximately 15 m high. Passage Formation, Levenseat working quarry 2 [NS 9397 5748] (WLGS 23).

Figure 76  Levenseat Sandstone, Passage Formation. Quarry face is approximately 15 m high. Levenseat working quarry 2 [NS 9397 5748] (WLGS 23).

Figure 77  Large fluvial channel in Levenseat Sandstone, Passage Formation. Quarry face is approximately 15 m high. Levenseat working quarry 1 [NS 9410 5763] (WLGS 23).

Figure 78  Old mine entrance in Castlecary Limestone, Upper Limestone Formation, Levenseat quarries & mines [NS 9547 5799]. Fauldhouse can be seen in the distance (WLGS 24).
Figure 79  Old mine entrance in Castlecary Limestone, Upper Limestone Formation, Levenseat quarries & mines [NS 9547 5799] (WLGS 24). Close-up of Figure 78.

Figure 80  Levenseat landfill site from Leven Seat hill [NS 9540 5762] (WLGS 24).

Figure 81  Skolie Burn [NS 9871 6240] (WLGS 25). View north from bridge to section in Lower Limestone Formation.

Figure 82  Skolie Burn [NS 9871 6240] (WLGS 25). Section in Lower Limestone Formation immediately north of bridge.

Figure 83  Skolie Burn [NS 9871 6240] (WLGS 25) section beneath the bridge. A picrite sill can be seen in the bed of the burn, overlain by sandstones and the Top Hosie Limestone of the Lower Limestone Formation.

Figure 84  Fossiliferous mudstone from the Lower Limestone Formation, Skolie Burn [NS 9871 6240] (WLGS 25).

Figure 85  Entrance sign to Petershill Reservoir Quarry, off the Bathgate to Bangour road [NS 9849 6952] (WLGS 26).

Figure 86  General view within Petershill Reservoir Quarry with bullrushes (*Typha latifolia*) [NS 9849 6952] (WLGS 26).

Figure 87  Bedding plane outcrop of fossiliferous Petershill Limestone in the Petershill Reservoir Quarry [NS 9852 6969] (WLGS 26).

Figure 88  Fossil corals from Petershill Quarries (WLGS 26). A: *Aulophyllum*  B: *Siphonodendron junceum*.

Figure 89  Looking south-west in the Rifle Range Quarries [NS 9890 7087] (WLGS 27). Petershill Limestone, Lower Limestone Formation.

Figure 90  Main quarry face in the Rifle Range Quarries [NS 9890 7087] (WLGS 27). Petershill Limestone, Lower Limestone Formation.

Figure 91  Fossiliferous Limestone from the Rifle Range Quarries [NS 9890 7087] (WLGS 27). Petershill Limestone, Lower Limestone Formation.

Figure 92  Gigantoproductid brachiopod fossils from the Rifle Range Quarries [NS 9890 7087] (WLGS 27). Petershill Limestone, Lower Limestone Formation.

Figure 93  View south-east from Cairnpapple Hill (WLGS 20) to Hilderston Silver Mine and Quarry [NS 9908 7135] (WLGS 28). Pentland Hills in distance.

Figure 94  View north from Hilderston Quarry [NS 9908 7135] (WLGS 28) to Hilderston Silver Mine [NS 9917 7158] (WLGS 29). Silver was worked here intermittently from 1606 to the late 1800s.

Figure 95  View north-east across Hilderston Silver Mine [NS 9917 7158] (WLGS 29).

Figure 96  Main quarry face at Hilderston Quarry [NS 9908 7135] (WLGS 28). Excellent coarsening upward sequences in mudstones, siltstones and sandstones of the Lower Limestone Formation above Petershill Limestone.

Figure 97  Hilderston Quarry [NS 9908 7135] (WLGS 28). A: *Thalassinoides* trace-fossils. B: Small-scale cross-bedding in sandstone, Lower Limestone Formation.

Figure 98  Lead–Zinc mine adit at Hilderston Silver Mine [NS 9917 7158] (WLGS 29).

Figure 99  Lead–Zinc mine adit at Hilderston Silver Mine [NS 9917 7158] (WLGS 29).

Figure 100  Notice board at Beechwoods Country Park. Hillhouse Quarry and Mine [NT 0046 7487] (WLGS 30) is located immediately north of the ‘you are here’ arrow.

Figure 101  View north-east from Hillhouse Quarry and Mine [NT 0046 7487] (WLGS 30).

Figure 102  Stoop and room workings in Hillhouse Limestone, Lower Limestone Formation, Hillhouse Quarry and Mine [NT 0046 7487] (WLGS 30).

Figure 103  Thistle and Willowherb at Hillhouse Quarry and Mine [NT 0046 7487] (WLGS 30).

Figure 104  Small quarry to the north-west of the mine, Hillhouse Quarry and Mine [NT 0029 7517] (WLGS 30).

Figure 105  Wallace’s Arch, River Avon [NS 9459 7305] (WLGS 32). A natural arch in Passage Formation sandstone.

Figure 106  Wallace’s Arch, River Avon [NS 9459 7305] (WLGS 32). A natural arch in Passage Formation sandstone.

Figure 107  Coal Measures (Scotland) Group geodiversity sites of West Lothian.

Figure 108  Braehead Quarry [NS 9205 6055] west of Fauldhouse, an infilled and landscaped former building stone quarry.

Figure 109  Volcanic vents and plugs geodiversity sites of West Lothian.

Figure 110  View south-west from Jock’s Hill towards the volcanic vent of Carsie Hill [NT 0150 7547] (WLGS 35) (low hill in middle distance). Carsie Hill is also a Crag and Tail.
Figure 111 Pyroclastic breccia in volcanic vent on Carsie Hill [NT 0150 7547] (WLGS 35).
Figure 112 Outcrop of pyroclastic breccia in the Society Shore vent. Society Point can be seen in the distance to the right of the trees. Society East Shore 8 [NT 1021 7886] (WLGS 13).
Figure 113 Close-up of pyroclastic breccia from the Society Shore vent. Society East Shore 8 [NT 1021 7886] (WLGS 13).
Figure 114 Alkali-dolerite sills geodiversity sites of West Lothian.
Figure 115 Auchinoon Hill from south-east of Harperrig Reservoir. Auchinoon Quarry (WLGS 36) left of centre.
Figure 116 Auchinoon Quarry [NT 0919 6175] (WLGS 36) with the Pentland Hills beyond. Dolerite sill in lower part of quarry with Gullane Formation laminated siltstones above.
Figure 117 Auchinoon Quarry [NT 0919 6175] (WLGS 36). 5 m of dolerite sill in lower part of quarry face with thermally metamorphosed laminated siltstones of the Gullane Formation above.
Figure 118 Centre section of Auchinoon Quarry [NT 0919 6175] (WLGS 36). Approximately 5 m of dolerite sill in lower part of quarry face with thermally metamorphosed laminated siltstones of the Gullane Formation above.
Figure 119 Auchinoon Quarry [NT 0919 6175] (WLGS 36). Dolerite sill in lower part of quarry with Gullane Formation laminated siltstones above. Siltstones have been thermally metamorphosed to calc-silicate hornfels by contact with sill. Face approximately 4 m high.
Figure 120 The Dalmahoy Sill (alkali-dolerite) in the bank of the Linhouse Water. Linhouse Water Glasgow Viaduct 2 site [NT 0772 6562] (WLGS 37).
Figure 121 Teschenitic dolerite sill intruded into the core of the Hopetoun anticline at Hopetoun Shore 2 [NT 0932 7918] (WLGS 17).
Figure 122 Quartz-dolerite sills geodiversity sites of West Lothian.
Figure 123 Panoramic view east to south-east from The Knock (305 m) [NS 9906 7114] (WLGS 38) towards Edinburgh and the Pentland Hills.
Figure 124 The Knock from the north-west [NS 9906 7114] (WLGS 38). Quartz-dolerite sill on the summit intrudes basalt lavas of the Bathgate Hills Volcanic Formation.
Figure 125 Quartz-dolerite sill, south-east face of The Knock [NS 9906 7114] (WLGS 38). The chilled contact with the basalt lavas of the Bathgate Hills Volcanic Formation can be seen here.
Figure 126 Sphaeroidal weathering in dolerite on The Knock [NS 9906 7114] (WLGS 38).
Figure 127 Millenium Stone circle, Knock Farm [NS 9912 7130] (WLGS 38). Cairnpapple Hill on top left (WLGS 20).
Figure 128 Witch Craig Viewpoint stone shelter [NS 9908 7275] (WLGS 39). Cockleroy can be seen above right-hand end of shelter.
Figure 129 Witch Craig Viewpoint [NS 9908 7275] (WLGS 39) and view north-west to Lochcote Reservoir.
Figure 130 Witch Craig Viewpoint display board [NS 9908 7275] (WLGS 39).
Figure 131 View from Witch Craig Viewpoint [NS 9908 7275] (WLGS 39) towards Grangemouth.
Figure 132 Torphichen Preceptory ‘refuge stone’ with cross, Witch Craig [NS 9910 7273] (WLGS 39).
Figure 133 A misleading (pre-outdoor access code) sign on Cockleroy [NS 9894 7437] (WLGS 40).
Figure 134 Quartz-dolerite outcropping on the slopes of Cockleroy [NS 9894 7437] (WLGS 40). Cockleroy is composed of Bathgate Hills Volcanic Formation basalts intruded by a quartz-dolerite sill.
Figure 135 View west from Cockleroy [NS 9894 7437] (WLGS 40). Cockleroy is composed of Bathgate Hills Volcanic Formation basalts intruded by a quartz-dolerite sill.
Figure 136 Cockleroy [NS 9894 7437] (WLGS 40) rocks and flowers A: Vesicular basalt B: Scottish Bluebell (Campanula rotundifolia).
Figure 137 Entrance sign at Beecraigs Country Park [NT 0071 7425] (WLGS 41).
Figure 138 Beecraigs Quarry face climbing wall [NT 0080 7390] (WLGS 41) composed of quartz-dolerite, Beecraigs Country Park.
Figure 139 Dry stone dyke composed of quartz-dolerite. Beecraigs Quarry [NT 0080 7390] (WLGS 41), Beecraigs Country Park.
Figure 140 Panoramic view Binny Craig from the south – a classic ‘Crag and Tail’ landform sculpted from a basalt sill intruding the West Lothian Oil Shale Formation. ‘Crag’ on left and ‘Tail’ on right [NT 0432 7346] (WLGS 42).

Figure 141 Binny Craig Sill displaying columnar jointing in basalt. Binny Craig [NT 0432 7346] (WLGS 42).

Figure 142 View south from Binny Craig summit [NT 0432 7346] (WLGS 42) to the Pentland Hills

Figure 143 Basalt of the Binny Craig Sill overlying baked shales of the West Lothian Oil shale Formation [NT 0432 7346] (WLGS 42).

Figure 144 Exposure of a quartz-dolerite dyke in Kildimmery Fishery Quarry [NT 0220 7603] (WLGS 43).

Figure 145 Exposure of a quartz-dolerite dyke in Kildimmery Fishery Quarry [NT 0220 7603] (WLGS 43).

Figure 146 Exposure of a quartz-dolerite dyke in the Linhouse Water at Linhouse Water – Calderwood 1 [NT 0790 6705] (WLGS 45).

Figure 147 Quaternary Landscape Characterisation of West Lothian.

Figure 148 A: Oblique hill-shaded digital surface model showing Binny Craig (outlined) and surrounding crag and tails (dashed lines). Contours at 25 metre intervals. B: Binny Craig clearly showing the outcrop of resistant basalt and ‘tail’ of protected softer rock (WLGS 42).

Figure 149 Deep channels cut by glacial meltwater along faults in Torphichen Hill [NS 975 725] (WLGS 46).

Figure 150 Drumlínized zone to the west of West Lothian. A transition from the drumlin zone to the crag and tail topography occurs where igneous rocks outcrop at the surface.

Figure 151 Streamlining of upland terrain around Leven Seat.

Figure 152 Post-glacial cemented raised beach deposits above the modern beach at Abercorn Point 2 [NT 0835 7952] (WLGS 18).

Figure 153 Linlithgow Loch and Linlithgow Palace. The loch is very large kettle hole formed by the melting of a large detached mass of ice trapped within glacial deposits [NT 004 776] (WLGS 47).

Figure 154 A glacial erratic of dolerite on the shore at Abercorn Point 3 [NT 0827 7954] (WLGS 18).

Figure 155 View west-south-west from Seafied Law to Easter Inch Moss [NT 0010 6666] (WLGS 50).

Figure 156 View west-south-west from Seafied Law to Easter Inch Moss [NT 0010 6666] (WLGS 50).

Figure 157 Seafield Law from Easter Inch Moss from [NT 0010 6666] (WLGS 50).

Figure 158 Peat on Easter Inch Moss [NT 0010 6666] (WLGS 50).

Figure 159 Soil on terraced gravel on glacial till in an area of active erosion and deposition. Linhouse Water [NT 0734 6613].
Figure 5  A: Part of the geological timescale with colour bars representing the rocks of West Lothian. Yellow bar = Carboniferous sedimentary rocks; red bars = extrusive igneous rocks; green bars = intrusive igneous rocks. B: Classification of Carboniferous strata in West Lothian.
Figure 2

Figure 3  Maximum limits of Late Devensian glaciation in Britain. Solid line – mapped limit; dotted line – inferred confluence with Scandinavian ice. (from Boulton et al., 1977).
Figure 4

Figure 5

Mines and Quarries from the BGS BritPits database and the Scottish Quarries database. BGS, © NERC 2006.
Figure 6  Potential West Lothian geodiversity sites from desk study.

Key:
- Red: Highest value sites (27)
- Orange: 3rd highest value (59)
- Yellow: 2nd highest value (44)
- Green: 1st highest value (35)
- Blue: Lowest value sites (39)

West Lothian boundary

Scale: 0 - 2 - 4 - 8 Kilometers
Figure 7: Geological and landscape designations of West Lothian. SSSI boundaries supplied under licence from SNH. © Scottish Natural Heritage.
Figure 8 NEXTMap Orthorectified Radar Digital Surface Model of West Lothian.
Figure 9

SNH Landscape Character Assessment of West Lothian. Data supplied under licence from SNH. © Scottish Natural Heritage.
Figure 10
Biological designations and other biodiversity sites of West Lothian. Ramsar, SPA, SAC supplied by JNCC. © Crown copyright. All rights reserved. Scottish Natural Heritage, 100017908. [2006]
Scheduled Monuments and archaeological sites of West Lothian. Scheduled monument area information derived from Historic Scotland data dated 4-Aug-2005 © Crown Copyright (Historic Scotland). SMR data provided by WOSAS (West of Scotland Archaeology Service).
Figure 12: West Lothian Geodiversity Sites (WLGS).

Key
- WLGS sites 23Mar06
  - Geological features of great value, worthy of interpretation and conservation
  - Geological features of some value - may be worthy of interpretation and conservation
  - West Lothian boundary

West Lothian boundary

Legend:
- Red circles: Geological features of great value, worthy of interpretation and conservation
- Yellow circles: Geological features of some value - may be worthy of interpretation and conservation

Scale:
0  2  4  8 Kilometers
**Figure 13** Inverclyde Group geodiversity sites of West Lothian.
Figure 14  View across Harperrig Reservoir from Auchinnoon Quarry (WLGS 36) beside the A70. The south-east boundary of West Lothian runs along the skyline from East Cairn Hill to West Cairn Hill. Inverclyde Group rocks form the hills and most of the low ground beyond the reservoir.

Figure 15  Section in gently dipping mudstones, siltstones and thin sandstones of the Ballagan Formation (Inverclyde Group) capped by glacial till. Section approximately 5 m high. Baad Park Burn (WLGS 1) [NT 1125 6014], south-east of Harperrig Reservoir
Figure 16  West Lothian’s highest hill – West Cairn Hill (562m) from Baad Park Burn, south-east of Harperrig Reservoir. West Cairn Hill is formed from Kinesswood Formation (Inverclyde Group) sandstones. WLGS 2 is located close to the break of slope on the right skyline of the hill.

Figure 17  East Cairn Hill (561 m summit) from Baad Park Burn (WLGS 1), south-east of Harperrig Reservoir. The gently-inclined Kinesswood Formation (Inverclyde Group) sandstones show small-scale scarp featuring.
Figure 18  Laminated and cross-bedded red sandstones of the Ballagan Formation (Inverclyde Group), Baad Park Burn (WLGS 1) [NT 1103 6037], south-east of Harperrig Reservoir. East Cairn Hill in background.
Figure 19 Strathclyde Group geodiversity sites of West Lothian.
Figure 20  Sign beside entrance gate [NS 9895 6891] to East Kirkton Quarry, Bathgate (WLGS 4).

Figure 21  Quarry face in East Kirkton Quarry [NS 9901 6913], East Kirkton Limestone, West Lothian Oil Shale Formation (WLGS 4).
Figure 22  Quarry face in East Kirkton Quarry [NS 9901 6913], East Kirkton Limestone, West Lothian Oil Shale Formation (WLGS 4).

Figure 23  The same face as Figure 22, taken in 1994. BGS Photograph P2882 © NERC. WLGS 4.
West Lothian’s most distinctive landmarks – the Five Sisters oil-shale bings [NT 009 641] (WLGS 5) near West Calder, viewed from the south-west. The bings are 91 m in height with a summit altitude of 240 m. They are protected as a Scheduled Monument.

Five Sisters oil-shale bings [NT 009 641] (WLGS 5) from the south. Burnt oil-shale is initially dark blue-grey ("blaes"), but rapidly oxidises to a characteristic red colour in contact with the elements.

Greendykes (Broxburn) [NT 087 736] oil-shale bing viewed from the west (WLGS 7).
Figure 27  South-west face of Seafield Law [NT 005 667] (WLGS 6), Seafield. This oil-shale bing has been re-profiled to replicate one of the most distinctive natural landforms of West Lothian – a ‘crag and tail’ glacial feature.

Figure 28  Weathered spent oil-shale on Seafield Law [NT 005 667] (WLGS 6).
Figure 29  Sluice weir on the River Almond 500 m upstream from the Almond Valley Heritage Centre NT 0325 6689] (WLGS 8).

Figure 30  Sandstone and siltstone beds of the Gullane Formation exposed in the bank of the Murieston Water [NT 0733 6658] (WLGS 9). The section is approximately 3 m high and the beds show fault-related deformation from the Calder Fault.
Figure 31  *Stigmaria* tree root fossil in Calders Member, West Lothian Oil Shale Formation, Almondell [NT 0887 6885] (WLGS 10).

Figure 32  View of steeply dipping Burdiehouse Limestone [NT 0860 6840] (WLGS 10). Calders Member, West Lothian Oil Shale Formation, River Almond.