

HISTORIC SANDSTONE PAVEMENT IN THE NEW TOWN OF EDINBURGH: A STUDY OF MATERIALS AND PAVING PATTERNS

A report for Edinburgh World Heritage
and The City of Edinburgh Council
by British Geological Survey



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Historic sandstone pavement in the New Town of Edinburgh: A study of materials and paving patterns

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Detail of typical original
sandstone pavement, Bell's Brae
Edinburgh.

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EXECUTIVE SUMMARY

The New Town of Edinburgh is acknowledged as one of the finest examples of designed urban architecture in Europe. The use of local sandstone has given the area a distinctive character –not only the buildings but also related elements such as boundary walls, pavements, entranceways and other features of the historic streetscape. Almost all of the original sandstone paving was removed from public footpaths in the late 20th century and replaced by concrete paving slabs. Future streetscape projects plan to reinstate natural stone paving. To date there has been little if any detailed appraisal of the original sandstone paving used historically in Edinburgh. This study provides a documentation and analysis of these paving patterns and materials in order to provide information to assist the future specification of appropriate natural stone paving.

Only a fraction of the original sandstone paving survives in the Edinburgh New Town, mostly in areas which were fortuitously preserved such as back lanes, and as a few larger areas mostly adjacent to prestigious public buildings. Eighteen locations of historic sandstone pavement have been identified and described, and a number of representative sections (seven lanes and six street pavements) selected for detailed survey to record the geological characteristics of the stone and produce measured drawings of paving patterns. The surveys provide a detailed record of the nature of representative areas of original historic pavement in the Edinburgh New Town.

Forty samples of paving stone were collected from historic pavements, which on the basis of geological characteristics can be divided into four types of original sandstone; ‘Hailes’, ‘Craigleith’, ‘Central Scotland sandstone’ and ‘Angus flagstone’, and two types of modern replacement stone; ‘Yorkshire sandstone’ and ‘Caithness Flagstone’. All of the quarry sources of the original sandstones are now closed and supplies are no longer available.

Comparison of the historical stone types with the currently-available replacement sandstones show that they are quite different in geological make-up and character. By far the most commonly used historical sandstone paving in the Edinburgh New Town is Hailes sandstone, formerly obtained from quarries on the western outskirts of the city. This stone has distinctive characteristics giving it particular properties and appearance which are different from most currently-available sandstones today.

In order to obtain future supplies of sandstone paving that have characteristics compatible with historic paving types, two courses of action are proposed. In the short term, it may be possible to identify substitute replacement stone types from existing sandstone quarries currently operating in northern England producing stone with some similar properties to Hailes sandstone. Secondly, future supplies of local stone of the same characteristics as the historical material could be secured by reopening former quarries or opening new quarries in adjacent geological formations. A resource assessment exercise is required to identify potential sites to the west of Edinburgh and in Central Scotland to determine whether the re-starting of sandstone pavement production is possible. Because the potential market for this product is likely to extend beyond Edinburgh, it is recommended that the Scottish Stone Liaison Group become involved in coordinating this work.

CONTENTS

1. INTRODUCTION.....	1
1.1 Background.....	1
1.2 The Edinburgh New Town.....	1
1.3 Scope of this study & report structure.....	2
<u>Survey Methodology.....</u>	<u>2</u>
<u>Terminology.....</u>	<u>3</u>
 2. EXISTING DOCUMENTARY EVIDENCE FOR HISTORIC PAVING IN EDINBURGH.....	 5
2.1 Sources of paving stone from ‘Building Stones of Edinburgh’....	5
2.2 Edinburgh Standard for Streets	6
2.3 Edinburgh World Heritage Streetscape Survey 1999.....	8
 3. SURVEYS OF AREAS OF HISTORIC SANDSTONE PAVING.....	 10
3.1 Survey of areas of sandstone paving.....	10
<u>1: Ann Street area.....</u>	<u>10</u>
<u>2: Bell’s Brae & Dean Bridge area.....</u>	<u>17</u>
<u>3: Lynedoch Place Lane.....</u>	<u>19</u>
<u>4: Atholl Crescent & Coates Crescent area, including Atholl Crescent Lane.....</u>	<u>21</u>
<u>5: Thistle Street Lanes.....</u>	<u>24</u>
<u>6: Hill Street Lanes.....</u>	<u>26</u>
<u>7: Young Street Lanes.....</u>	<u>26</u>
<u>8: Royal Terrace.....</u>	<u>32</u>
<u>9: Carlton Terrace Area.....</u>	<u>32</u>
<u>10: Regent Terrace.....</u>	<u>35</u>
<u>11: Regent Road.....</u>	<u>37</u>
<u>12: Waterloo Place & Calton Hill Area.....</u>	<u>40</u>
<u>13: Register House.....</u>	<u>42</u>
<u>14: Gloucester Lane.....</u>	<u>45</u>
<u>15: Wemyss Place Area.....</u>	<u>47</u>
<u>16: Charlotte Square.....</u>	<u>51</u>
<u>17: Glenfinlas Street.....</u>	<u>54</u>
<u>18: St Stephen Place.....</u>	<u>56</u>
3.2 Horonizing.....	59
<u>19: Glenfinlas Street.....</u>	<u>59</u>
<u>20: St Colme Street.....</u>	<u>59</u>
<u>21: Ainslie Place.....</u>	<u>60</u>
<u>22: Moray Place.....</u>	<u>62</u>
3.3 Additional areas of natural stone paving in Edinburgh New Town.....	63
3.4 Summary of information on paving patterns from surveyed areas.....	64
<u>Results of measured sections in lanes.....</u>	<u>64</u>
<u>Results of measured sections in streets.....</u>	<u>66</u>

4. ANALYSIS OF SAMPLES, IDENTIFICATION OF PAVING STONE TYPES AND QUARRY SOURCES.....	68
4.1 Origin of the samples	68
4.2 Detailed description of the different sandstone types identified....	70
<u>Hailes type</u>	70
<u>Craigleith type</u>	74
<u>Central Scotland type</u>	76
<u>Angus type</u>	78
4.3 Discussion of results from the sample analysis.....	80
4.4 Current supply of paving stone in the UK.....	80
<u>Caithness Flagstone</u>	80
<u>Yorkshire Sandstone</u>	82
4.5 Future supply of matching stone for historic paving in the Edinburgh New Town.....	86
<u>Alternative (substitute) paving types resembling Hailes Sandstone</u>	86
<u>The potential for opening or reopening a quarry in Hailes or similar sandstone</u>	87
<u>George Street paving test panels</u>	89
4.6 Recommendations.....	89
5. SUMMARY OF FINDINGS AND DISCUSSION	91
5.1 Background.....	91
5.2 Paving Patterns.....	91
5.3 Paving Materials: the sandstone types used.....	92
5.4 Current and future supply of paving stone.....	93
5.5 Skills and related issues.....	94
ACKNOWLEDGEMENTS.....	95
REFERENCES.....	95
 APPENDIX 1:	 Location maps of areas of historic stone pavement in the Edinburgh New Town
 APPENDIX 2:	 Data sheets from street surveys of historic paving

1. INTRODUCTION

1.1 Background

Like many other European cities, Edinburgh has a history of stone paving. The availability of local sandstone, which was extensively used as building stone for the construction of the Edinburgh New Town in the late 18th and the 19th centuries, meant it was used for paving footpaths throughout the city. In the second half of the 20th century almost all of the natural stone paving was removed and replaced by concrete slabs. In recent years there has been a move back to natural stone paving, and many parts of the Edinburgh Old Town have been re-paved using Caithness Flagstone. Currently there are a number of proposed pedestrian schemes in both the Old and New Towns where natural stone paving is likely to be used, and it seems likely that natural stone paving will be used increasingly in the future as the existing concrete slab comes to the end of its life.

Little is known about the sandstone paving that was once present on the footpaths of the Edinburgh New Town. The few remaining areas of original stone paving, in a small number of streets or as overlooked remnants in back lanes, are the only remaining direct evidence of the nature of the original pavements. Because so little is known and the remaining sites have not been characterised, there is little basis on which to inform the design and selection of materials for future paving schemes from an historical perspective. Whilst there is considerable awareness of the importance of selecting appropriate stone types used to repair buildings in the New Town, there has been relatively little attention paid to the stone elements of the surrounding streetscape, and perhaps a failure to recognise their importance in contributing to the overall historic built environment.

The aim of this study is to characterise the nature of the original sandstone paving used in the Edinburgh New Town by documenting the remaining areas and analysing representative areas of these original pavements. The study is intended to provide information on both the pattern of historical paving (i.e. slab size and laying pattern), and to identify the materials used (i.e. stone type and origin). The data is intended to provide a basis for future guidance for the specification of new replacement natural sandstone pavement in the New Town in a way that respects the historical context of the area.

1.2 The Edinburgh New Town

The Edinburgh New Town forms an area of just over 3 km² in the northern and western part of the centre of the City of Edinburgh. It is acknowledged as one of the foremost examples of formal urban design, the streets being laid out in a strict geometric pattern beginning with James Craig's first plan in the 1760's and developed over the following century. Most of the area is still intact and is typified by rows of terraced Georgian houses with facades built of distinctive grey ashlar sandstone. In 1995 the centre of Edinburgh was designated a UNESCO World Heritage Site, partly in recognition of the influence of the New Town on the history of European urban planning. Whilst not subject to specific planning restrictions, the New Town lies within established Conservation Areas and contains many listed buildings. Descriptions of the history of local building stone quarries and sources of stone used in Edinburgh are given in Craig (1893) and McMillan et al. (1999). The principal

stone type used for the ENT was Craigleith sandstone from Edinburgh, which at the time earned a world-wide reputation as a first rate building material. The rapid development of the ENT in the late eighteenth century created a great demand for high quality sandstone, and material was obtained from various quarries around Edinburgh, such as Hailes, Redhall and Barnton. With time quarries in West Lothian and Fife were used to supply stone from farther afield such as Binny, Cullalo and Grange. By the late 19th century many of the quarries in or near Edinburgh were worked out or becoming less productive, and improvements in transport allowed building stone to be imported from greater distances, such as red sandstone from Dumfriesshire and latterly pale buff sandstone from Northumberland. These and other factors resulted in the closure of many of the local quarries around the end of the 19th century, and those that operated beyond this time were much reduced in output.

1.3 Scope of this study & report structure

This study was commissioned by Edinburgh World Heritage (EWH) and Edinburgh City Council (ECC), and undertaken by the British Geological Survey (BGS) between August and December 2006.

The report is divided into three main sections. The first section provides a brief compilation of available documentary evidence of what is already known about the historic paving materials used in the Edinburgh New Town. The second section presents results from a number of key representative locations where original sandstone paving is preserved throughout the New Town. Detailed description of both the stone types and paving patterns are given. The third section presents the results of analysis of a set of historic paving stone samples collected during the study. The various stone types present and their origins in terms of quarry sources are identified. The samples are compared to currently-available stone types, and the issue of sourcing supplies of appropriate paving stone in the future are addressed.

Survey Methodology

The sites of remaining areas of historic sandstone paving were initially identified from the 1999 Edinburgh World Heritage Streetscape Survey (see below). Each pavement identified in that study as having natural stone paving was visited and assessed for the presence of historic sandstone and original laying patterns. From this, a number of key localities were identified for detailed study. At each locality a representative area of the pavement was examined in detail and surveyed to produce a measured drawing of the paving pattern. A pro forma sheet was also completed to capture key information regarding the geological nature of the stone type and other physical characteristics of the paving slabs.

The pro forma sheets were designed to record the following information for each locality:

Geological Data:

- Colour variation and range (colour codes measured using Munsell Colour System).
- Grainsize measured using the standard classification, i.e. Fine sand (<250 micron), Medium sand (250-500 micron) and Coarse sand (500-1000 micron).
- Observations of the mineral content and texture.

Paving Pattern:

- Overall pattern, slab dimensions and relationship to adjacent elements (e.g. kerbstones) shown on a measured drawing.
- Details of courses (orientation, uniformity etc.)
- Edge characteristics, joint width etc.
- Overall condition and repairs
- Other relevant observations

A set of samples of original stone paving was collected from the representative areas of historic paving where it was possible to do so without affecting the integrity or appearance of the existing pavement. To avoid unnecessary damage, samples were taken only from already damaged slabs, for example parts of already broken corners were easily removable, whilst in other areas a core drill was used to remove a small (c.40mm) diameter plug from an already damaged section. The samples were examined in the laboratory to identify the different sandstone types present, and compared to known historic quarry sources from the BGS building stone collections. Finally, the samples were compared to specimens from active quarries throughout the UK which currently supply paving stone.

Terminology

The terminology throughout this report has been used with the non-geological reader in mind. However, some of the terms relating specifically to paving stone require clarification. This study is concerned primarily with natural stone paving made from sandstone. This is commonly referred to as ‘flagstone’, with individual stone blocks called ‘flags’ or sometimes ‘slabs’. In general terms a flagstone is a sandstone or a finer grained sedimentary rock which is thinly bedded, and can be split along these bedding planes to produce thin ‘flags’ suitable for paving. In strict terms, a sandstone is defined as a sedimentary rock with an average grainsize between 0.06 and 2 mm, whilst below this grainsize it is termed a siltstone or mudstone. Some varieties of natural paving stone contain grains at the smaller end of the spectrum (e.g. Caithness Flagstone typically contains grains of <0.05 mm). For the present purposes most sedimentary rocks commonly used for paving in Edinburgh can be referred to as sandstones.

As well as paving, sandstone has also been used for a number of other functions associated with footpaths. Original sandstone kerbstones are preserved in several areas, and in places where there is a large height difference between the street level and pavement, they have been used as multiple levels of kerbs, here termed *kerb steps*. Particularly large blocks of sandstone are occasionally preserved at the pavement edge, commonly opposite property entrances. Where such large blocks protrude above pavement level and into the roadway beyond the kerb they are referred to as ‘mounting blocks’. The term *kerb block* is used for a stone forming part of the kerb which is much larger than the other kerbstones, again commonly opposite property entrances. Sandstone has also been used for a number of other elements such as *lighting plinths* which are foundation stones for former (presumably gas) lights; and *spur stones* which are large stone blocks placed at corners in front of walls to protect properties from vehicle strike.

A few specific masonry terms are used in this study. The term *broaching* is commonly used to describe a series of parallel grooves cut across the stone surface, a technique normally used by the mason to achieve a roughly flat surface, especially in stone where the bedding planes are not regular and parallel. On pavement, widely spaced broaching was occasionally used specifically to give added grip to a sloping pavement surface. The term *horonizing* is used to refer to a pavement composed of tightly packed small elongate pieces of stone (usually whinstone or granite), thought to be a by-product from the manufacture of setts. The long axis of the stones is placed vertically, and they are typically aligned perpendicular to the pavement direction. Horonizing is seen in sloping areas (providing slip resistance) and in lower status pavements (such as back streets). For detailed information on historic masonry tooling methods and the terminology used in Edinburgh see McMillan et al. (1999).

2. EXISTING DOCUMENTARY EVIDENCE FOR HISTORIC PAVING IN EDINBURGH

At an early stage in this study it became apparent that little documentary evidence is available regarding the origin of historic paving in Edinburgh. It was recognised that considerable information may be present in various sources such as the City Archives, but pursuing this was beyond the scope of the present study. Consequently a small scoping study was commissioned by EWH and ECC (by Nick Haynes, Historical Buildings Consultant) to identify historical sources of information which might compliment the survey and investigation of materials presented here. The results of this historical study are presented elsewhere (Haynes 2006).

There is general evidence to suggest that the presence of surfaced footpaths and streets was planned as part of the development of the Edinburgh New Town. The 1767 Act passed to control development of the New Town specified that pavements should be of a certain width and laid and maintained at the expense of the householder (Youngson 1993). In the late 18th century a public overseer was appointed to control the uniformity of the streets, lanes and flagstone pavements (Alvares 2005). Unlike in the Edinburgh Old Town, where street and pavement surfacing came as part of later improvement schemes, the use of stone for the surfacing of streets and footpaths can be viewed as an integral component of the designed historic townscape.

2.1 Sources of paving stone from ‘Building Stones of Edinburgh’ (McMillan et al. 1999)

More information is known about the sources of igneous paving materials than sandstone flagstones. Locally obtained igneous stone, mostly dolerite (colloquially known as *whinstone*) was used for setts and kerbstones, initially quarried at Salisbury Crags and other prominent igneous rock outcrops around the city e.g. Corstorphine, Calton and Blackford Hills. The Salisbury quarries in Holyrood Park supplied stone for Regent Road and Waterloo Place from 1810-1820, the quarries reaching a peak in production about this time. From 1820 similar material was brought into the city from further west along the Union Canal, including quarries at Ratho and Kirknewton. The abundance of whinstone setts, kerbs and gutter stones, still widely seen throughout Edinburgh, indicates that large quantities of this material were coming into the city throughout the 19th century. Granite setts were brought into Edinburgh largely by sea (via Leith), most notably from the Aberdeen area.

Large amounts of sandstone flagstone were used in Edinburgh, not only for paving external public footways, but also as steps, entrance plats, stairways, landings and internal flooring. This was initially locally produced from thinly-bedded sandstone deposits in nearby quarries such as Hailes, and as by-products from existing building stone quarries such as Craighleith -exploiting the thinly bedded sandstone that was not suitable for use as ashlar. Following the canal link in the 1820's sandstone was brought from further afield in central Scotland (e.g. West Lothian), and flagstone from Denny, near Falkirk is recorded as being imported by canal at this time (Hutton 2002). Large amounts of flagstone are reputed to have been imported by sea from Angus, via Arbroath (known as ‘Arbroath or Dundee pavement’ or ‘Carmyllie

stone'), and subsequently from Caithness (later also by railway), although little documentary evidence is actually available to support this.

Hailes quarry is cited as having been the single most important source of paving flagstone for Edinburgh. The quarry produced a distinctive laminated sandstone characterised by a ripple bedded texture, marked by thin layers of dark carbonaceous matter and mica. It was one of the largest and longest-lived quarries in Edinburgh, with workings first recorded in the early 1600's and continuing through to the 1920's (Photos 1 & 2). The large scale nature of the quarry is indicated by the fact it had a steam engine for pumping water by 1787 and was exporting stone to London by 1893. It employed over 200 men in 1899. Smith (1835) states that the laminated stone produced strong and hard flags which were extensively used for the footpaths of Edinburgh streets, and that the finer grained beds were used for stair steps, plats and internal paving.

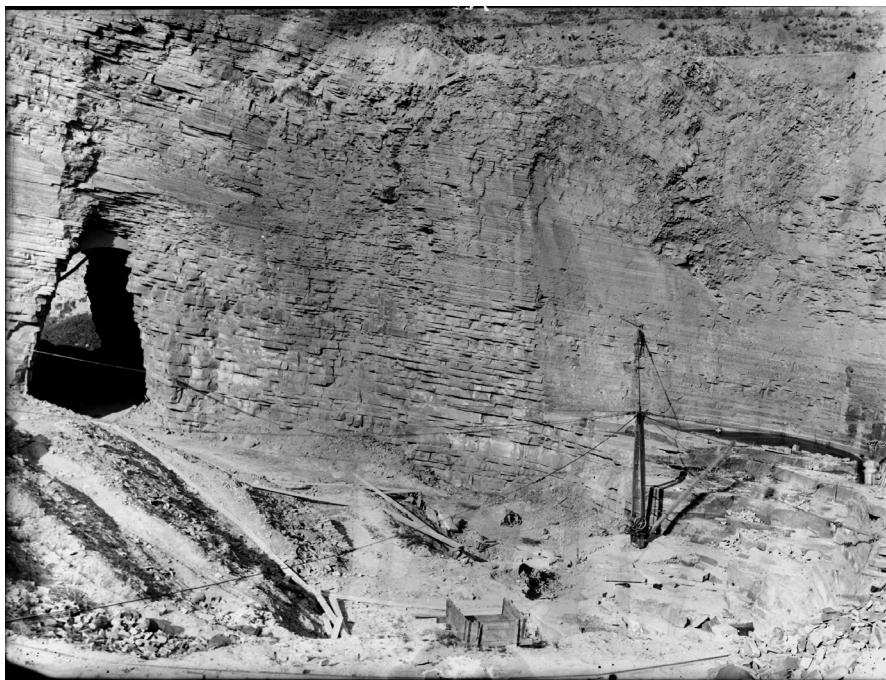
Other sandstone quarries in the Edinburgh area also probably provided flagstone paving. It is recorded that in Craigleith quarry thinly bedded stone that was unsuitable for ashlar was used for steps, plats and paving, and towards the end of its life Craigleith quarry produced stone almost exclusively for steps and paving (Craig 1893; Smith 1835). For example, the specification for the construction of Edinburgh Academy in 1823 states that steps and landings should be of Craigleith stone and the hearths and floors of entrance lobbies should be of Dundee or Arbroath pavement (McMillan et al. 1999).

Stone from Angus (also known as 'Carmyllie, Arbroath or Dundee flagstone') is recorded as having been imported into Leith from 1810 and was specified for the following buildings in Edinburgh: Register House (1774 to 1834); Edinburgh Academy (1823); New College/Assembly Hall (1845); and internal paving for the Bank of Scotland, The Mound (1864). The flagstone quarries at Carmyllie produced a fine grained greenish-brown sandstone which had a reputation for being very hard, the best materials giving slabs ranging from 1 to 14 inches thick. The quarries also supplied sandstone slabs to London and other towns in England in the early 19th century, and the industry expanded to other quarries throughout Angus until production peaked around 1890. From this time the industry declined until closure in the mid-20th century.

Flagstone imported from Caithness in northern Scotland is also reputed to have been used for pavements and for internal flooring, particularly in Edinburgh Old Town (McMillan et al. 1999). However, little documentary evidence has been compiled to support this.

2.2 Edinburgh Standards for Streets

The Edinburgh Standards for Streets document (Edinburgh City Council 2006) provides guidance to promote good design and best practice for public spaces in the city. It acknowledges the importance of natural stone paving in retaining the historic character of Edinburgh's streets and providing an appropriate setting for buildings. The document provides a general outline of the materials used and some laying practices for historic roads and footways. It also describes the range of related stone features including honoring, mounting blocks and lighting plinths.



Photos 1 & 2. Hailes quarry in 1913. Photo 1 (Top image; BGS photo P000183) shows general view of the quarry looking north showing a steam pump engine house with Corstorphine Hill and Donaldson's Hospital in the background. Photo 2 (Bottom image; BGS photo P000184) is detail of part of the quarry face showing the thinly bedded nature of the sandstone at the south end of the quarry. Hailes quarry is now infilled and used as a public park.

The Standards for Streets states that most footways were modernised in the second half of the 20th century, when precast concrete slab was used to replace almost all the natural stone paving (in some places concrete and more rarely asphalt have been laid). Despite the loss of sandstone paving flags, in many places the key elements of kerb,

drainage channel and in some cases setted roadway remain. It is recognised that very few areas of original sandstone paving remain.

The Standards for Streets document includes ‘Setts in the City’, a report produced by Edinburgh World Heritage and BGS in 2005 which documents the traditional road materials used, focussing on the roadway surfaces (setts, kerbstones and gutter channels) rather than the pavements. It discusses the geological characteristics and quarry origins of the materials (mainly granite and whinstone), and describes block sizes and laying practices. There is little information on footways and sandstone paving.

2.3 Edinburgh World Heritage Streetscape Survey 1999

Areas of natural stone paving were recorded as part of the 1999 Streetscape Survey of the Edinburgh World Heritage Site, carried out by the Edinburgh World Heritage Trust. This study was intended to provide a baseline for future monitoring and record all streetscape materials including footway, carriageway and kerb materials (and also street furniture). In terms of natural stone it identifies areas of *setted road*, *stone kerbing*, *Caithness natural stone paving* and *blonde natural stone paving*. This last category includes areas of original historical sandstone/flagstone paving of relevance to this current study, although it does not discriminate between historic and modern sandstone paving.

The 1999 Streetscape Survey demonstrates that very few areas of blonde stone paving remain in the Edinburgh World Heritage Site. Although it does not provide quantitative data, it is apparent that original paving stone today comprises only a few per cent of total pavement area, and the dominant material present (well over 90%) is concrete paving slab. The surveys identifies *Caithness natural stone paving* only in the Old Town, yet unfortunately does not distinguish between ‘historic’ Caithness paving, and ‘modern’ (i.e. late 20th century onwards). The Streetscape Survey does not identify any Caithness paving in the New Town (although several areas were documented as part of the present study –see below).

Although it is a valuable source of information, the Streetscape Survey is inaccurate in several places. For example, at Waverley Bridge and the west side of Usher Hall areas of ‘modern’ natural sandstone pavement are recorded as grey concrete slab. A further error occurs in Grassmarket, where substantial areas recorded as *blonde natural sandstone paving* are in fact ‘modern’ Caithness flagstone. Despite these inaccuracies, the 1999 Streetscape Survey has provided a useful starting point for the present study, in terms of identifying areas of *blonde natural stone paving* for further investigation. All the areas of *blonde natural sandstone paving* identified in the 1999 Streetscape Survey are listed in Table 1.

Table 1. Areas of ‘blonde natural stone paving’ in Edinburgh New Town identified in the 1999 Streetscape Survey.

Ann Street and Dean Terrace
Atholl Crescent Lane (west end)
Bells Brae (parts of)
Carlton Hill Place
Carlton Terrace Lane
Charlotte Square (north side)
Dean Path
Glenfinlas Street
Hawthorn Bank Lane (by Drumsheugh Baths)
Regent Terrace
Register Place
St Stephens Church, St Stephens Street
St Stephens Place
Waterloo Place
West Register Street
Young Street Lane North (west end)

3. SURVEYS OF AREAS OF HISTORIC SANDSTONE PAVING

All of the areas classified as *blonde natural stone paving* from the 1999 Streetscape Survey were visited as part of this study. Using this information combined with a general walkthrough of the entire area, eighteen specific locations of historic sandstone pavement were identified in the New Town which had enough material remaining for study. In addition four localities of whinstone horonizing pavement were also identified for study. The location of the studied localities is shown in Figure 1, and they are listed in Table 2. Twenty-two localities were considered to containing representative historic pavement patterns suitable to produce measured drawings, and at each of these localities a pro forma record of the geological characteristics of the stone material was completed. All of the documented localities are described in turn below. Appendix 1 shows the detailed locations for each area, and pro forma descriptions are given in Appendix 2.

It was noted during the surveys that there is considerable variation in the style and function of sandstone paving throughout the New Town, ranging from large areas of high status ‘formal’ pavement (e.g. Charlotte Square, General Register House), to simpler ‘functional’ paving in back lanes (e.g. Gloucester Lane; Lynedoch Place Lane), the latter typically consisting of a single line of slabs. Sandstone pavement from a number of ‘typical’ residential streets was also recorded (e.g. Ann Street; St Stephen’s Place). The areas selected for measured drawings and detailed surveys were chosen as being representative of the range of sandstone paving types present throughout the New Town. It should be emphasised that that the ability to study original historic sandstone paving in Edinburgh New Town is severely constrained by the lack of remaining areas, and that any study of historic pavement must be viewed with this in mind.

3.1 Survey of areas of sandstone paving

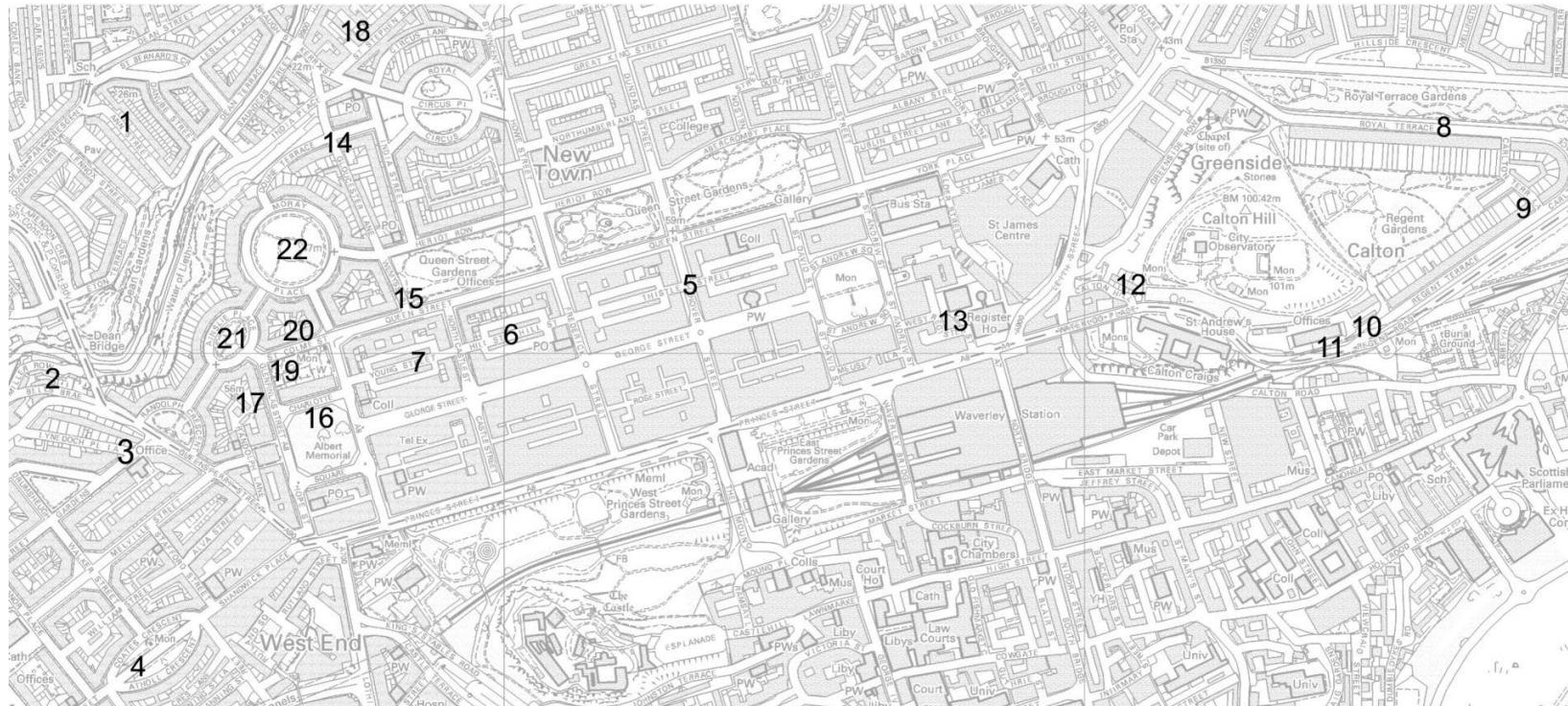
1: Ann Street area (Map1)

A relatively large area of historic natural sandstone paving is present at **Ann Street**. The paving extends from the junction with **Dean Park Crescent** and covers both sides of the entire length of Ann Street, continuing on the west side of **Upper Dean Terrace** to the corner with **Danube Street**.

The paving is a dullish grey-brown sandstone, worn to give a smooth surface, some blocks showing ripple bedding with variable stronger reddish-brown colour. The slabs are aligned perpendicular to the kerb with an irregular course width, and multiple blocks of mixed width are present within a course (Photo 3). The slab size is variable with relatively small sizes in some parts of the street and larger slabs dominating in other areas. The kerbs are whinstone, with a setted gutter comprising three rows of whinstone setts aligned parallel to the kerb. The road surface comprises whinstone setts.

The paving style shows significant variation, with smaller slab size in some places, larger in others. Most of the north side of the street has single slabs per course, whilst much of the northeast area appears to have been re-laid with a more regular slab size, many with sawn edges, and a more even surface and cement pointing. Adjacent to several property entrances the paving has been re-laid, some crudely with cement

Figure 1. Map of central Edinburgh showing locations of historic stone pavement surveyed in this study



Sandstone paving

- 1 = Ann Street area
- 2 = Bell's Brae & Dean Bridge area
- 3 = Lynedoch Place Lane
- 4 = Atholl Crescent & Coates Crescent area
- 5 = Thistle Street Lanes
- 6 = Hill Street Lanes
- 7 = Young Street Lanes
- 8 = Royal Terrace
- 9 = Carlton Terrace area

- 10 = Regent Terrace
- 11 = Regent Road
- 12 = Waterloo Place & Calton Hill area
- 13 = Register House
- 14 = Gloucester Lane
- 15 = Wemyss Place area
- 16 = Charlotte Square
- 17 = Glenfinlas Street
- 18 = St Stephen Place

Horonizing

- 19 = Glenfinlas Street
- 20 = St Colme Street
- 21 = Ainslie Place
- 22 = Moray Place

		PAVEMENT SURFACE TYPE			NOTES/OBSERVATIONS	ADDITIONAL SANDSTONE COMPONENTS PRESENT							
		Stone pavement (original)	Stone pavement ('modern' replacement)	Horonizing		Kerbs	Kerb blocks	Kerb steps	Mounting blocks	Plinths	Spur stones	Cellar entrance	Gutter stones
Surveyed areas of natural stone pavement													
1	Ann Street area	x											
2	Bell's Brae & Dean Bridge area	x		x	Pavement relaid		x			x			
3	Lynedoch Place Lane	x											
4	Atholl Crescent & Coates Crescent area	x				x	x		x		x		
5	Thistle Street Lanes	x				x						x	
6	Hill Street Lanes	x				x							
7	Young Street Lanes	x				x					x	x	
8	Royal Terrace					x	x	x	x				
9	Carlton Terrace area	x				x	x						
10	Regent Terrace	x				x						x	
11	Regent Road	x				x						x	
12	Waterloo Place& Calton Hill area	x			Pavement relaid	x							
13	Register House	x			large entrance steps	x						x	
14	Gloucester Lane	x											
15	Wemyss Place area	x								x			
16	Charlotte Square	x				x		x	x				
17	Glenfinlas Street	x			Pavement relaid	x							
18	St Stephen Place	x			Pavement relaid								
19	Glenfinlas Street (horonized area)			x									
20	St Colme Street			x									
21	Ainslie Place			x						x			
22	Moray Place			x						x			
Additional areas (not surveyed)													
	Findlay Court (west side National Portrait Gallery)		x		Modern decorative paving (Caithness Flagstone)								
	Castle Street		x		Modern pedestrian scheme (Caithness Flagstone)								
	Elder Street		x		Modern pavement (Caithness Flagstone)								
	St Andrew & St George Church	x			Large area of historic sandstone paving to west and east sides. Some has been re-laid.								
	George Street test panels		x		Sample panels of different stone types (two areas)								
	Cheyne Street (east side)		x		Modern' natural stone pavement (probable Scout Moor stone)								

Table 2. Areas of natural stone paving in the Edinburgh New Town, described in this study.

mortar. Many flagstones immediately adjacent to the kerb are commonly broken due to vehicles parking on the pavement edge (Photo 4).

Two areas were surveyed in detail, both on the northwest side of Ann Street, each selected as representative of the paving type and style (detailed descriptions below).

Flagstones at the sloping corner of Ann Street with Upper Dean Terrace are tooled with broad deep ribbing grooves aligned perpendicular to the slope, presumably to give a slip-resistant surface. (Photo 5).

The sandstone paving in Ann Street is a good illustration of the importance of stone materials in both the streetscape and the buildings. There is a continuity in the use of stone from the roadway, pavement, low boundary walls and the buildings themselves (Photo 6).

Measured section 1 (Figure 2; adjacent to No. 9 Ann Street)

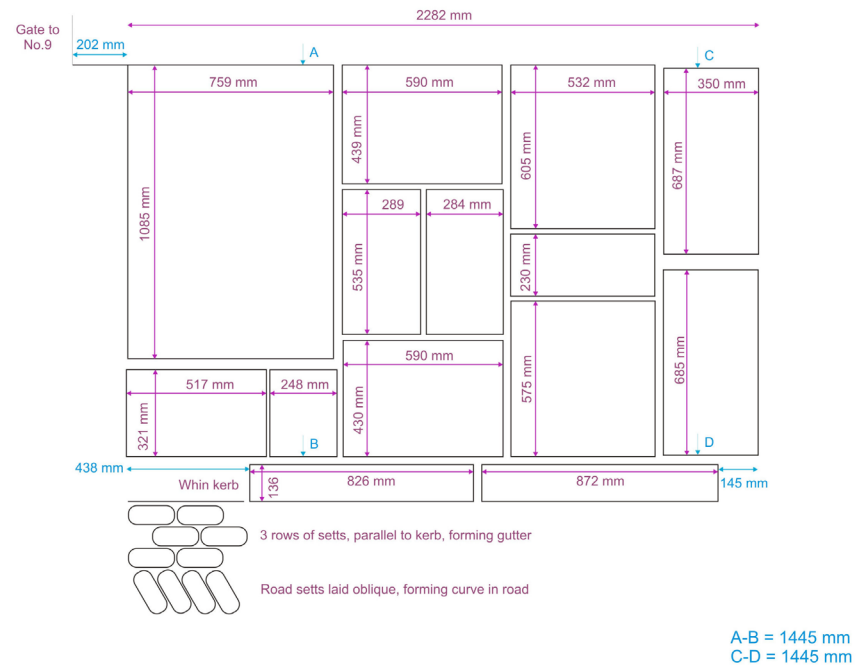
The area is typified by grey-brown to reddish-brown coloured sandstone slabs. The palest coloured blocks are medium-grained and the more red coloured blocks are finer grained. Surface textures are mostly smooth, although some ripple bedding laminae gives textured surfaces. Some slabs preserve coarse broached tooling on the surface.

Measured section 2 (Figure 3; adjacent to No17 Ann Street)

The area is a short section which typifies the more variable and smaller size of sandstone slab in the street. The presence of multiple blocks per course is an unusual feature of Ann Street, with single blocks per course being dominant in all the other streets surveyed in this study.

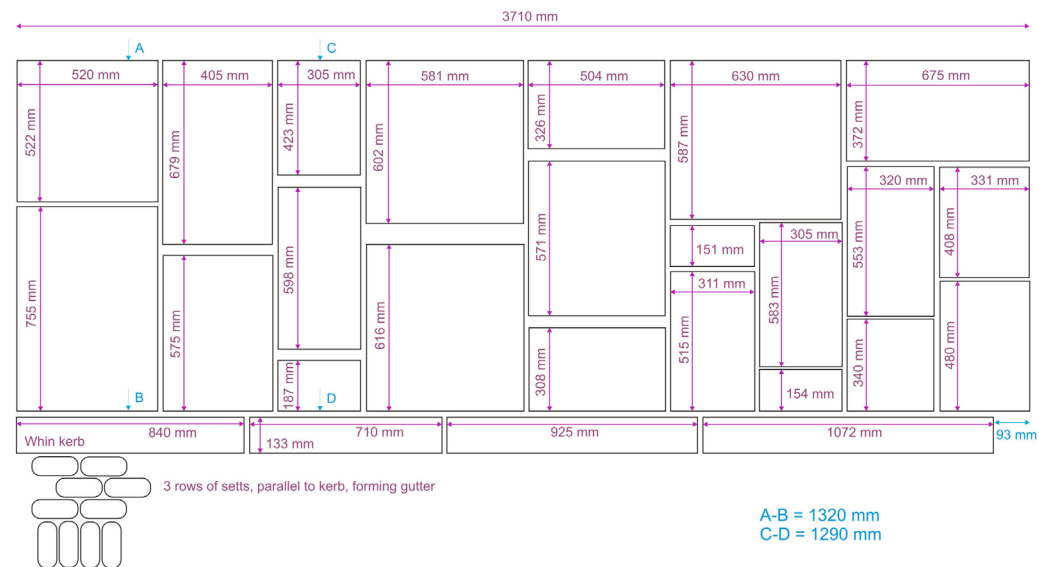


Photo 3. Typical section of sandstone paving in Ann Street showing relatively small slab size and range of colours from grey to reddish-brown. Note the variable surface texture including ripple textured surface to some blocks.



Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 2. No. 9 ANN STREET (SW SIDE)



Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 3. No. 17 ANN STREET (SW SIDE)



Photo 4. Illustration of the modern pressures on traditional paving. The parking of vehicles on the pavement edge causes flagstones to break. (Ann Street).



Photo 5. Corner of Ann Street and Upper Dean Terrace with slabs showing tooling with parallel grooves cut as an anti-slip measure on the slope. Note the course width fan-out around the corner.



Photo 6. Traditional stone materials with whinstone roadway (setted street, gutter and kerbs) and sandstone flags to pavement, with sandstone boundary walls and buildings. The preservation of natural stone materials provides a continuity between the streetscape and buildings. (Ann Street).

2: Bell's Brae & Dean Bridge area (Map 2)

Several areas of sandstone pavement are present in the area around **Bell's Brae** and the Dean Village. Substantial sections occur along parts of the north side of Bell's Brae, on the bridge across Water of Leith at Dean, and on parts of the south side of **Dean Path**. The nearby lane and steps leading from **Belford Road** on the southwest side of Drumsheugh Baths are also paved with sandstone. Four large sandstone steps are preserved at the entrance to Belford Road from Randolph Cliff, although the pavement itself is now concrete. Several spur stones are preserved on Bell's Brae at the entrance to **Hawthornbank Lane** (quartz sandstone) and **Miller Row** (whinstone; Photo 7). An area of unusual horonized paving using a mixture of rounded cobble stones of various stone types and with variable-sized reclaimed setts is present on the north side of Dean Path (Photo 8). The cobbles are carefully laid to give an overall smooth surface with a camber sloping down to the kerb to allow drainage of surface water.

At **Drumsheugh Lane** the steps and platform levels are a reddish grey-brown to grey-brown sandstone. The uppermost steps are a more ripple bedded sandstone, whilst the lower section has a mixture of stone types including whinstone, some of it having been re-laid.

On the north side of the main part of Bells Brae there is a near-continuous section of sandstone paving (Photo 9). Unfortunately most of it appears to have been re-dressed and re-laid with little care to avoid irregular joint widths (Photo 10). Many blocks display sawn edges and in places there are repairs of asphalt. The sandstone has an overall grey-brown colour with some more reddish blocks. The surfaces are typically smooth, with some distinctive ripple textured surfaces. The block size is generally small, similar to Ann Street, and ribbed tooling is occasionally preserved on the surfaces of less worn slabs. The kerbs are whinstone and granite.

Because of the poor quality of the re-dressing and re-laying no measurements or drawings were made of the Bells' Brae section.



Photo 7. Spur stone (whinstone) protecting a corner, Bell's Brae.



Photo 8. Pavement on Dean Path constructed using a mixture of cobbles of different stone types and reclaimed whinstone setts.



Photo 9. Traditional sandstone paving showing the typical range of colours and natural surface textures caused by presence of ripple bedding within the sandstone. This provides a natural anti-slip surface (Bell's Brae).



Photo 10. Poor quality re-laid pavement using original sandstone slabs cut with a mechanical saw. Slab edges and joint widths are irregular and the hard cement mortar is broken. Scale is 1 metre (Bells Brae).

3: Lynedoch Place Lane (Map 3)

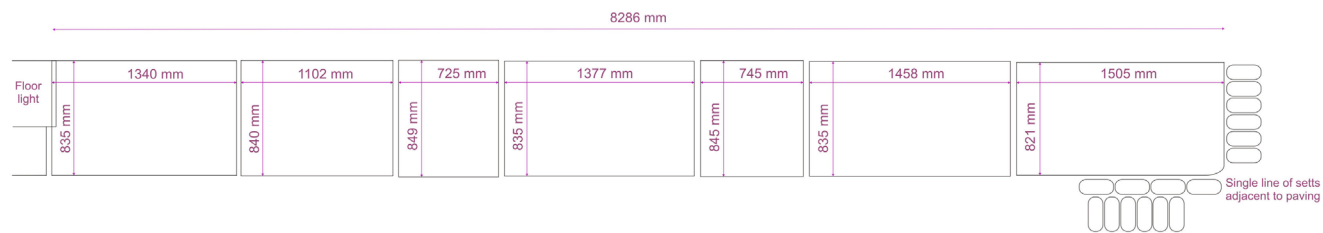
A single row of sandstone paving slabs are present on the south side at the east end of **Lynedoch Place Lane**, near the entrance to **Drumsheugh Gardens** (Photo 11). The slabs are large in size and aligned parallel to the lane. No kerb is present, and a thin whinstone gutter borders the whinstone setted roadway. The sandstone is fine to medium grained, with a pale buff-brown colour varying to a reddish-brown patina where worn. The surfaces commonly displays a ripple bedded ‘contour-textured’ surface. The measured drawing of Lynedoch Place Lane is shown in Figure 4. The slab size is a fixed width (c.840 mm) with variable length ranging from 725 to c.1500 mm. Many blocks are cracked at the pavement edge where mounted by vehicles (Photo 12). Some slabs are missing and have been replaced by asphalt and cement.



Photo 11. Typical single width sandstone paving in a lane, with large slabs aligned parallel to the lane, and no kerbstone. Note the poor maintenance of the whinstone setted lane. (Lynedoch Place Lane).



Photo 12. Typical damage to natural sandstone paving caused by parked vehicles mounting the footway. (Lynedoch Place Lane).



Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 4. LYNEDOCH PLACE LANE

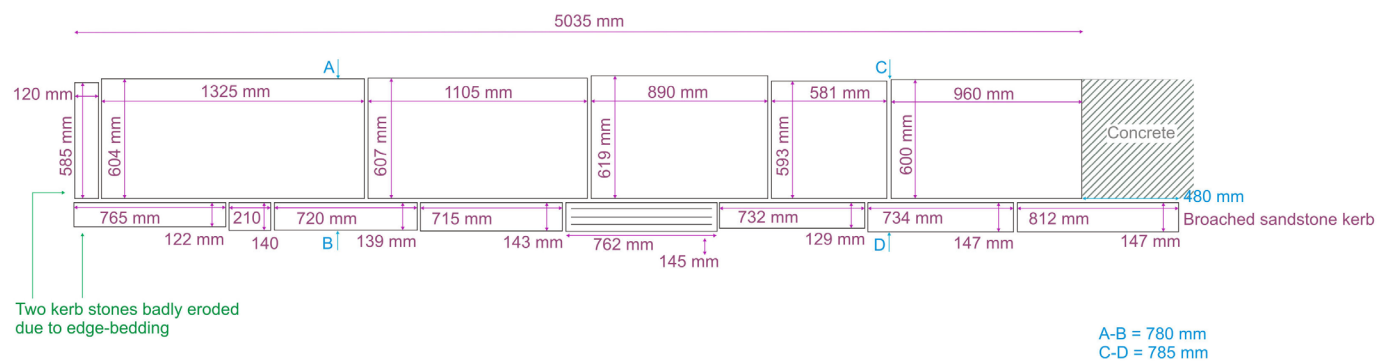
4: Atholl Crescent & Coates Crescent area, including Atholl Crescent Lane (Map 4)

A number of areas of historic sandstone paving and related features are present around the western end of Shandwick Place at Atholl Crescent Lane, Atholl Crescent and Coates Crescent. On **Atholl Crescent** between property numbers 10 and 18, sandstone surrounds to cellar entrances survive in the (now asphalt) roadway, immediately adjacent to the concrete pavement (Photos 13 & 14). The cellar entrances are made from squared sandstone kerb blocks of variable size. On **Coates Crescent** a small number of individual broad sandstone kerbstones and mounting blocks have survived in the pavement opposite property entrance numbers 8, 12, 14, 16 and 20 (Photo 15).

On the west side of the west end of **Atholl Crescent Lane** at the junction with Shandwick Place, original paving is present with a single row of sandstone slabs aligned parallel to narrow sandstone kerbstones. The sandstone is fine to medium grained with a variable pale buff-brown to stronger reddish-brown colour and a rippled or finely pitted surface texture. The measured drawing of Atholl Crescent Lane is shown in Figure 5. The slabs have a fixed width of c.600 mm, and length varying from c.580 to 1325 mm. The sandstone kerbs are laid edge bedded (making the stone prone to damage), and shows coarse broaching along the kerb length, with droved margins. The lane roadway has whinstone setts.



Photo 13. Example of one of the few remaining sandstone surrounds to cellar entrances on Atholl Crescent, on the road adjacent to the pavement. The entrance itself is infilled by a metal plate.



Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 5. ATHOLL CRESCENT LANE



Photo 14. View of Atholl Crescent showing the presence of unsightly concrete pavement. A number of entrances to coal cellars are present at the road edge, marked with sandstone surrounds.



Photo 15. Large sandstone mounting block opposite a property entrance in Coates Crescent (No. 16). A number of these original mounting blocks are still present, although all the pavement surfaces have been replaced by concrete.

5: Thistle Street Lanes (Maps 5 & 6)

Three areas of sandstone paving are preserved in **Thistle Street NE Lane**; a small area of sandstone kerb on the west side at the western entrance to Thistle Street; an area of sandstone slabs and kerbs aligned perpendicular to garage entrances on the north side at the west end (adjacent to property No. 50); and a well preserved area of sandstone paving and kerbs on the north side near the eastern end of the Lane.

Thistle Street NW Lane has a section of five sandstone flagstones which are aligned perpendicular to the kerb on the east side near the western entrance with Thistle Street. No kerbstones are present. A few sandstone gutter stones are present on the north side of **Thistle Street SW Lane**, immediately to the east of property No. 32. Well preserved examples of sandstone paving are present in **Thistle Court**, although these are not in the public domain. The four properties (Nos. 1 to 4) have a substantial area of paving adjacent to the property fronts, including channelled sandstone gutter stones.

The measured section of sandstone paving in Thistle Street NE Lane (Figure 6) consists of a single course of slabs aligned parallel to the kerb, with an unusually thick sandstone kerb, and dished whinstone gutter and setted roadway (Photo 16). The slabs have a relatively dark purple to grey-brown colour with smooth surfaces. Less worn slabs show remnants of coarse broaching aligned perpendicular to the slab direction. The sandstone kerb blocks are c.345 mm wide with a variable block length ranging from c.600 to c.1340mm, with a ripple bedded texture on surfaces. Several blocks are cracked, other show asphalt repairs (Photo 17). Caithness flagstone (now badly broken) has been used in the lane further to the west.



Photo 16. Thistle Street NE Lane. Single row of sandstone flags aligned parallel to the broad sandstone kerb, with dished whinstone gutter and whin setted roadway. Note tarmac repairs to broken and missing kerbstone.

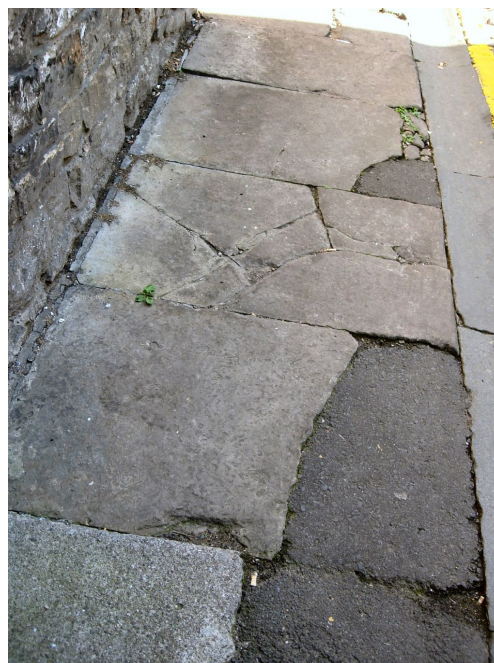
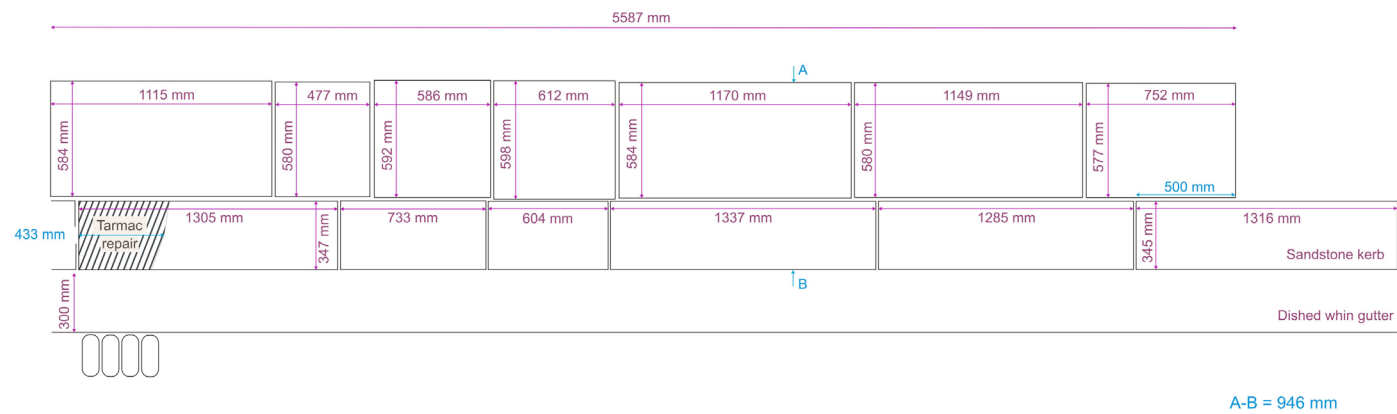


Photo 17. Original sandstone paving in Thistle Street NW Lane, showing damage due to vehicle parking with tarmac and concrete repairs.



Note: This is not an accurate scale drawing.
 Dimensions are for paving slab sizes only,
 and do not include joint spaces.

Figure 6. THISTLE STREET NE LANE

6: Hill Street Lanes (Map 7)

Two small areas of sandstone pavement remain at the west end of **Hill Street North Lane**, with some remnants of small flagstones and narrow sandstone kerbs on the west side of 23 **Hill Street**. The remains of a paved sandstone garage entrance is present at the western end and north side of Hill Street North Lane (Photo 18).



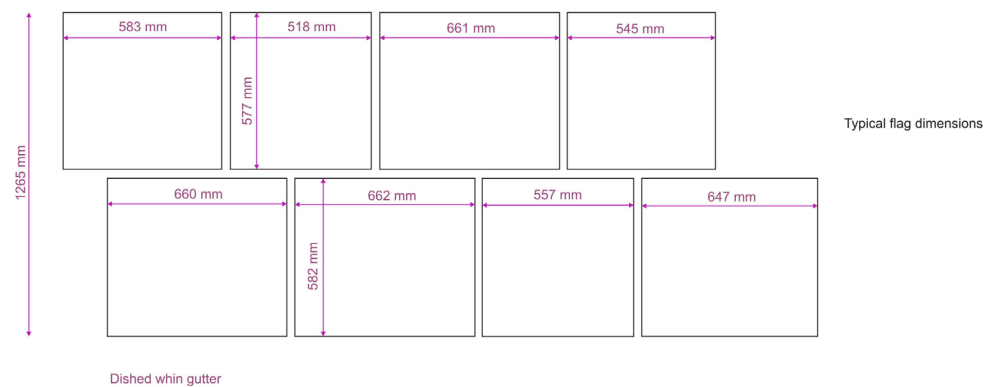
Photo 18. Damaged area of sandstone paving with whinstone kerb and gutters in Hill Street North Lane.

7: Young Street Lanes (Map 7)

The west end of **Young Street North Lane** has two areas of sandstone paving, both of which have been surveyed (Figures 7 & 8). Both areas have a broad dished whinstone gutter and setted roadway. On the southern side a double row of square flags is present (Photo 19; Fig. 7), and the east side of the western return of the lane has a single row of large flags aligned perpendicular to sandstone kerbs (Photo 20; Fig. 8). At the former the slabs are relatively square typically of dimensions of 500 to 700 mm. The latter area has large single width slabs ranging in width from c.600 to c.910 mm, with a long axis of c.1037mm. At both areas the sandstone slabs have a brown-buff colour with a strong reddish-brown patina and generally have smooth surfaces with a faint ripple bedded texture. The sandstone kerbs are edge bedded, and generally in good condition. The former area is in generally good condition (although overpainted by yellow lines), whilst the latter is badly broken due to vehicle parking, and has cement and asphalt repairs.

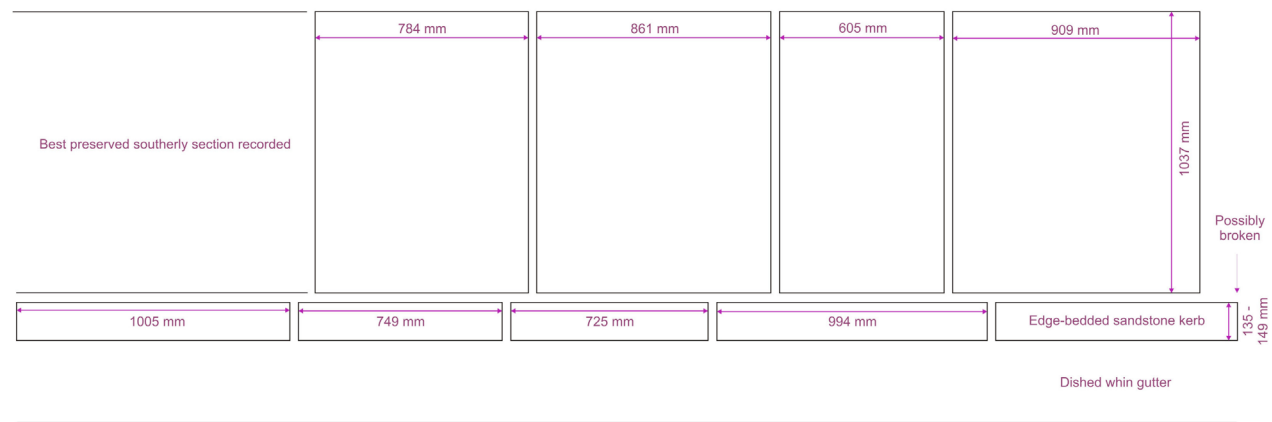
At the western end of **Young Street South Lane** a few small remnants of sandstone paving survive, with some blocks channelled to form a drain below a downpipe outfall on the return section to Young Street with a broad whinstone kerb and dished whinstone gutter (Figure 9; Photo 21). Original broached tooling is preserved on the less worn area on the inside of the pavement immediately adjacent to the buildings. On the South Lane itself there is an area of large single-width slabs forming a garage entrance, with whinstone setted street (Figure 10). It has been patched with asphalt and cement.

A cellar entrance is formed from sandstone kerb blocks on the south side at the east end of **Young Street** (Property No. 8, Oxford Bar). The stone is a pink-grey coloured edge-bedded sandstone showing heavy pitting.



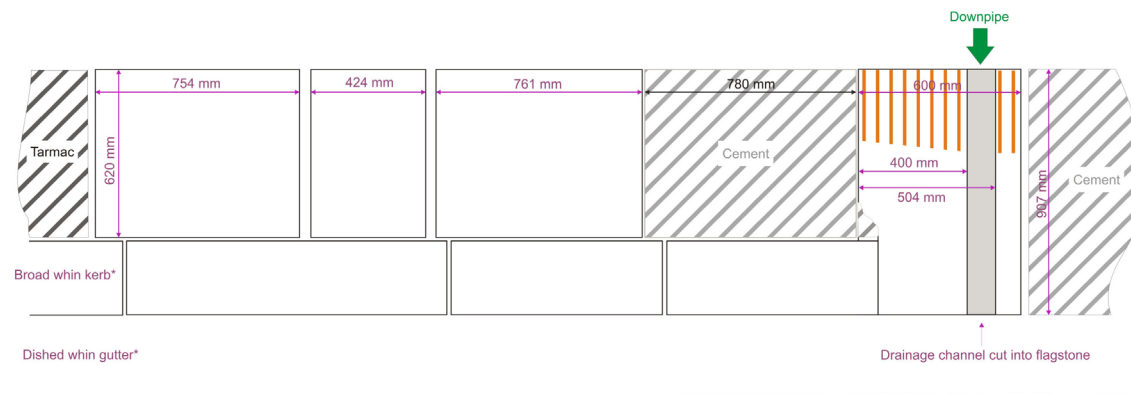
Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 7. YOUNG STREET NORTH LANE - a



Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 8. YOUNG STREET NORTH LANE - b



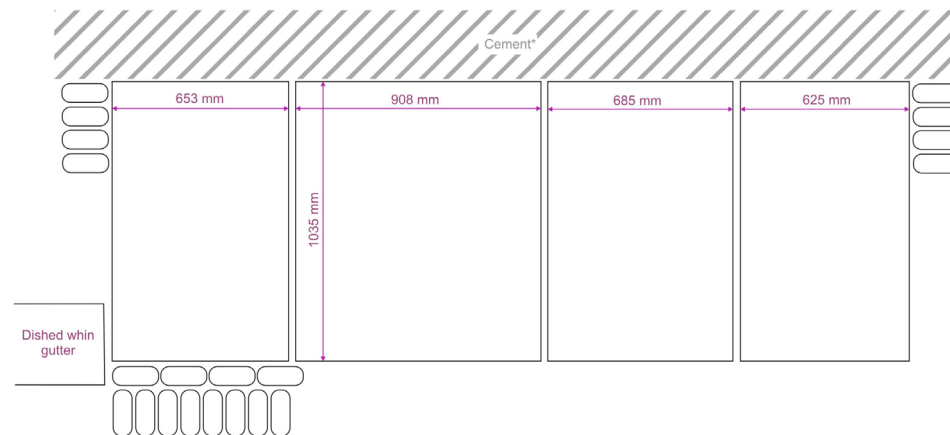
* Dimensions of kerb and drainage channel shown approximately



Broached surface tooling, perpendicular to building, preserved in unworn section adjacent to building

Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 9. YOUNG STREET SOUTH LANE - a



* Unclear whether or not cement covers top edge of flags

Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 10. YOUNG STREET SOUTH LANE - b



Photo 19. Well-preserved section of sandstone paving in Young Street N Lane, showing a double row of sandstone flags aligned parallel to the kerb, with dished whinstone gutter and whinstone setted roadway.

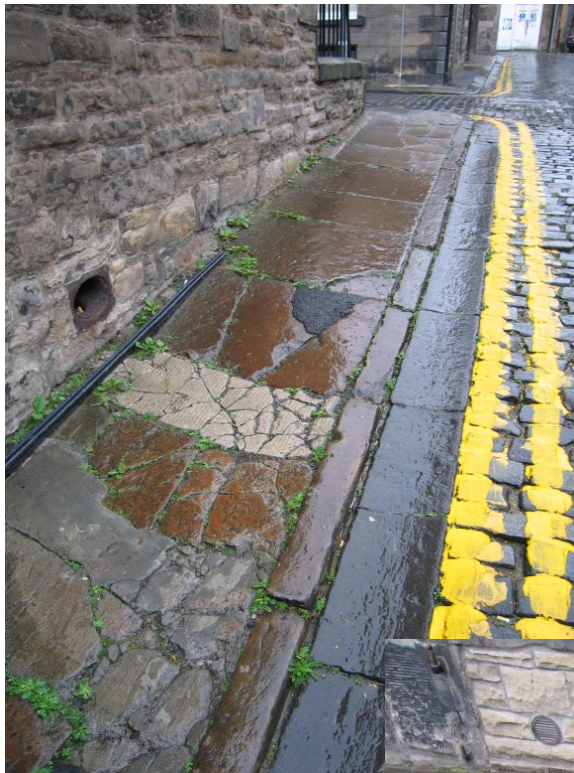


Photo 20. Poorly preserved area of sandstone paving, severely damaged by vehicle parking, with a single row of large sandstone flags with sandstone kerb, dished whinstone gutter and setted roadway (Young Street N Lane, west return to Young Street).

Photo 21. Poorly preserved area of original sandstone paving with carved drainage channel in sandstone below the downpipe outfall. Note the light coloured cement patch repairs (Young Street S Lane, west return to Young Street).



8: Royal Terrace (Map 8)

Areas of sandstone kerbstones, kerb steps and isolated sandstone mounting blocks are present on the south side of Royal Terrace, westwards from No. 5 to Greenside Church (Photo 22). The top/upper kerbstone is whinstone along the entire length of the street. A number of individual wide kerbstones (kerb block) are present opposite the entrances to Nos. 18, 21, 22, 24, 27, 37 and 40 at the east end of Royal Terrace. On the pavement itself, the original paving slabs have all been replaced with coloured concrete slab.

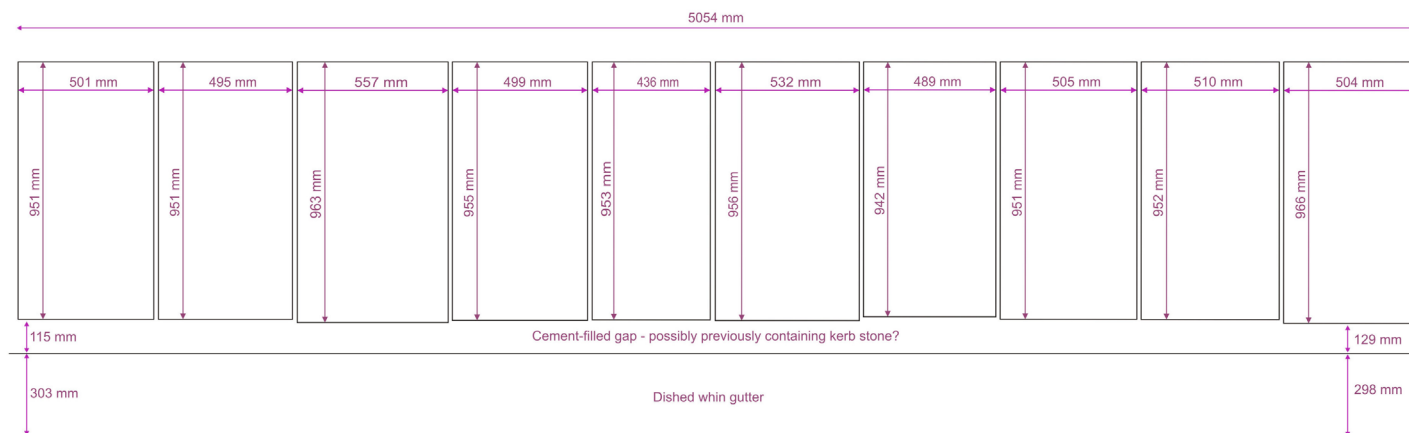


Photo 22. Original sandstone kerb block at the pavement edge (large grey block), directly opposite a property entrance, with whinstone kerbs, dished whinstone gutters and setted roadway. The pavement itself has been re-laid with coloured concrete slabs.

9: Carlton Terrace area (Map 9)

A number of original stone paving features are preserved around **Carlton Terrace**. The entire south and west side of Carlton Terrace has a broad sandstone kerb, and several large sandstone kerb blocks are present running westwards from No. 14, flush with the pavement surface (Photo 23). Three of these blocks are directly opposite doorways. A single whinstone spur stone is present at the northwest corner of **Carlton Terrace Mews** and Carlton Terrace Lane (Photo 24).

The southeast entrance to **Carlton Terrace Lane** has sandstone paving on both sides, each side having a single row of slabs oriented perpendicular to the kerb (Figure 11; Photo 25). The flags are elongate, with a fixed length of c.950 mm and a variable width of c.430 to c.560 mm. There is no kerb, although a cement-filled gap may represent the space a where kerbstone was once present. A broad dished whinstone gutter is present and the roadway is whinstone setts. The sandstone is fine to medium grained with a pale grey-buff colour and reddish-brown buff patina where the surface is worn. The surface texture is smooth with a slight ripple-bedded texture, and they have a broad broached ribbing along the length of the surface (i.e. across the pavement direction) with finely tooled droved margin along the kerb edge. Some



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Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 11. CARLTON TERRACE LANE (NE SIDE)

blocks are cracked, mostly at the kerb edge due to vehicle parking. Minor asphalt patch repairs are present.



Photo 23. Original sandstone kerb and mounting block, Carlton Terrace. The paving slabs have been replaced by concrete slab. Mounting blocks are present adjacent to a number of the property entrances.



Photo 24. Whinstone spur stone Carlton Terrace Mews, with whinstone setted roadway and dished gutter stones.

Photo 25. Typical sandstone paving with a single row of large slabs aligned perpendicular to the kerb. The flagstones have a naturally rough surface due to the presence of ripple bedding laminae. The original kerb has been removed and replaced by concrete, and a dished whinstone gutter and setted roadway are present. (Carlton Terrace Lane).



10: Regent Terrace (Map 10)

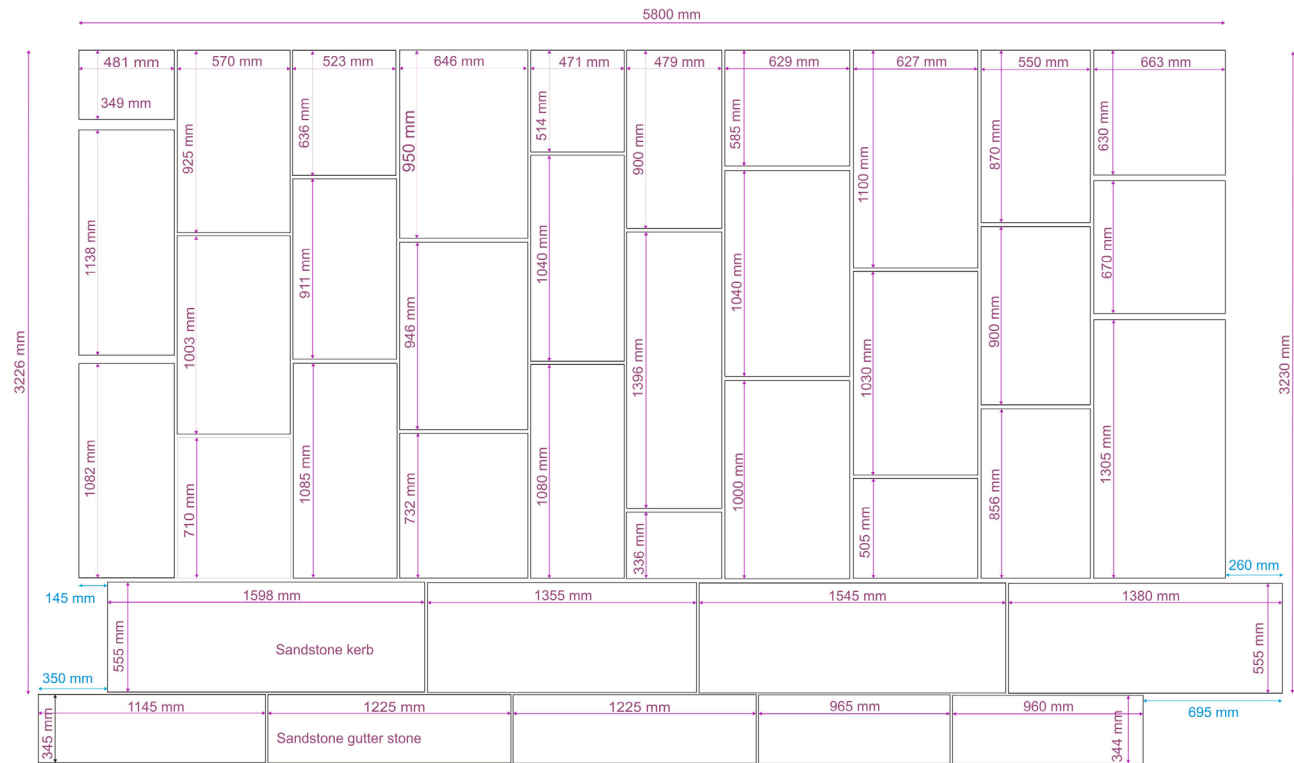
A sandstone kerb is present along the north side of the entire length of Regent Terrace. At the western end a substantial length of sandstone paving and kerb is present on the north side to the junction with Regent Road. Sandstone gutter stone is also present for a short section at the western end of Regent Terrace, and thereafter (eastwards) a dished whinstone gutter is present. The sandstone kerbstone is a pale buff to dull orange colour, with stronger reddish-brown colours where worn.

The sandstone paving at the west end of Regent Terrace adjoins the sandstone paving on Regent Road. Both are of different styles and slightly different sandstone types. Representative areas of both sections were surveyed (each described separately below).

The sandstone paving at the west end of Regent Terrace has a relatively uniform size and composition (Figure 12; Photo 26). It is a medium grained sandstone, weathering to a reddish-brown buff colour. Some blocks have more variable patchy strong red-brown colours in areas of more wear. Most blocks have a smooth surface with a 'contour effect' due to wear through the bedding laminae. Approximately 25% of the blocks show a rippled surface. Slabs are present in courses aligned perpendicular to the kerb, each course of irregular width and containing multiple blocks per course. Rare broached tooling is preserved in less-worn areas on the inside of the pavement. The orientation of the tooling varies between different blocks. The roadway is whinstone setts with sandstone gutter stones preserved along a part of the paved area. The sandstone flags are of relatively large size, dominantly c.470 to 660 mm wide and 900 to 1100 mm length. Sandstone gutter stones are more uniform, typically 345 mm wide and 960 to 1300 mm long. The pavement is in good condition with little damage and only minor repairs.



Photo 26. Sandstone pavement in Regent Terrace, showing relatively regular-sized and uniform large blocks with typical dark grey-buff colour with a reddish brown patina on worn surfaces. The variable, naturally rough surface is caused by the ripple bedded nature of the sandstone.



Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 12. REGENT TERRACE

11: Regent Road (Map 10)

A section of original sandstone paving is present at the junction of Regent Road and Regent Terrace (Photos 27 & 28). The pattern and sandstone type are slightly different from that on the adjacent Regent Road. The sandstone is fine to medium grained with a pale grey-brown colour, ranging to stronger reddish-brown orange in many blocks. Surfaces are generally smooth but commonly have a rippled surface texture and less common linear bedding features. The pavement consists of courses of variable width, aligned perpendicular to the kerb. Surface tooling is preserved on less worn areas on the inside of the pavement with coarse broaching along the length of blocks with finer droved tooling at right angles. The pavement blocks are of widely variable size, with widths ranging from 435 to c.750mm and widely varying lengths up to c.1300mm. The pavement is in good condition with little damage and rare minor repairs, although some damage has been caused by recent service repairs.

Shortly before the survey (Autumn 2006) part of this pavement was lifted and re-laid, apparently as part of utility maintenance works (Photos 29 & 30). The slabs have been crudely replaced using a grey cement mortar, and some have been damaged. In addition, several of the sandstone flags have not been replaced in the correct position within courses, resulting in less worn blocks from the inside edge of the pavement which preserve broached surface tooling being re-laid in other positions, disturbing the historical pattern.

The measured drawing of Regent Road is shown in Figure 13. The kerbstone is a similar sandstone type showing broached tooling along the length on the top surface, typically 150 mm wide and up to 1500 mm length. Gutter stones also appear to be the same sandstone, but of large block sizes typically 350 mm wide and up to 1845 mm length.

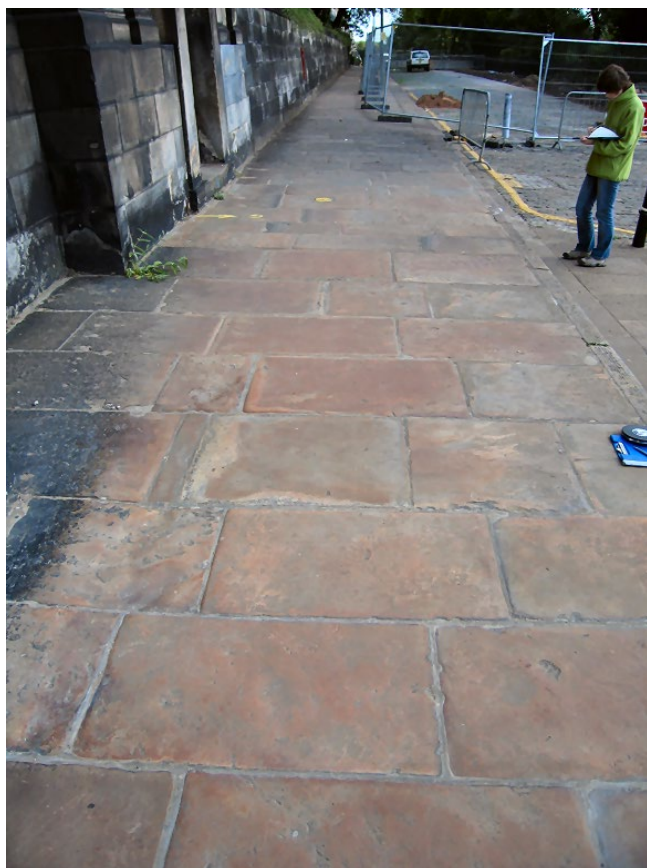
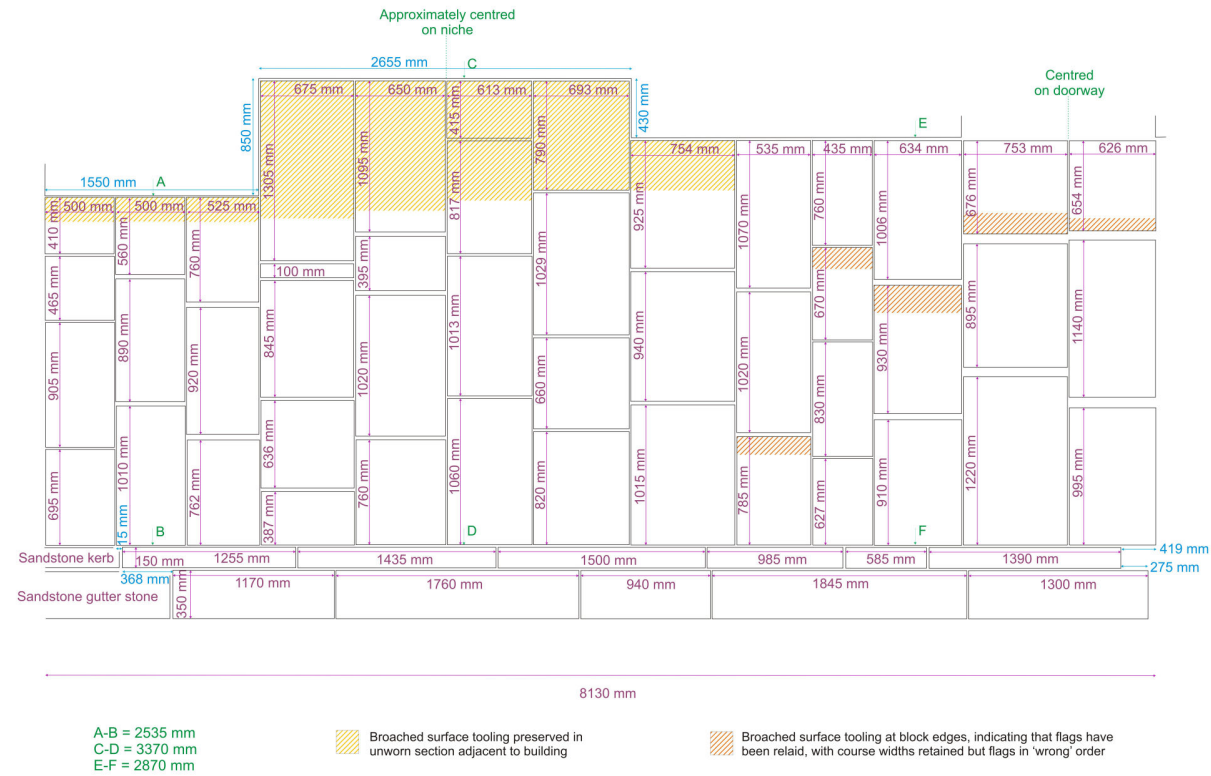


Photo 27. Sandstone paving in Regent Road showing attractive strong reddish brown patina on worn surfaces with a variable surface texture caused by the presence of bedding and ripple laminations in the stone.



Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 13. REGENT ROAD



Photo 28. Detail of sandstone paving in Regent Road showing the courses aligned perpendicular to the kerb, with long kerbstones and gutter stones both made from similar sandstone. Note the dark discoloured surface where the slabs are less worn along the inside of the pavement -here the original broached tooled surface of the sandstone is preserved. Scale is 1 metre long.



Photo 29. Part of the sandstone pavement on Regent Road recently re-laid following utility maintenance works. The slabs have been crudely replaced using a grey cement mortar, and some have been damaged.



Photo 30. Part of the sandstone pavement on Regent Road recently re-laid following utility maintenance works. The slabs have been crudely replaced using a grey cement mortar, several have been damaged, and the two (now broken) darker slabs in the centre of the image were originally located against the wall on the inside of the pavement, having been re-laid in the wrong position.

12: Waterloo Place & Calton Hill area (Map 11)

A substantial area of sandstone pavement is present at the eastern end of the north side of Waterloo Place, continuing round the corner along the south side of Calton Hill (Photos 31 & 32). Both areas appear to have been re-laid and many original blocks have sawn edges, with areas of replacement Caithness and modern ‘York sandstone’ paving particularly adjacent to the kerb where it has presumably been damaged by parked cars. The slabs appear to have been re-laid to a poor standard and many are loose and broken. A short section of narrow sandstone kerb is present on Calton Hill, alongside a broad cast iron drainage channel.

On the north side of Calton Hill there is a smaller area of sandstone paving with steps which extends into the raised pavement area behind the properties at the eastern end (Photos 33 & 34). Much of this appears to be original, contributing to the historic character of the area, although there is evidence of relaying at the western end. Because of the large amount of re-laid paving, no measured sections were surveyed in the Waterloo Place/Calton Hill area.



Photo 31. Re-laid sandstone paving in Waterloo Place, showing a mixture of original sandstone blocks which have been redressed to smaller uniform sizes, interspersed with Caithness flagstone (dark blue-grey slabs) and modern York sandstone paving (uniform buff-grey colour). The original sandstone flags have a more variable colour and variable surface texture.

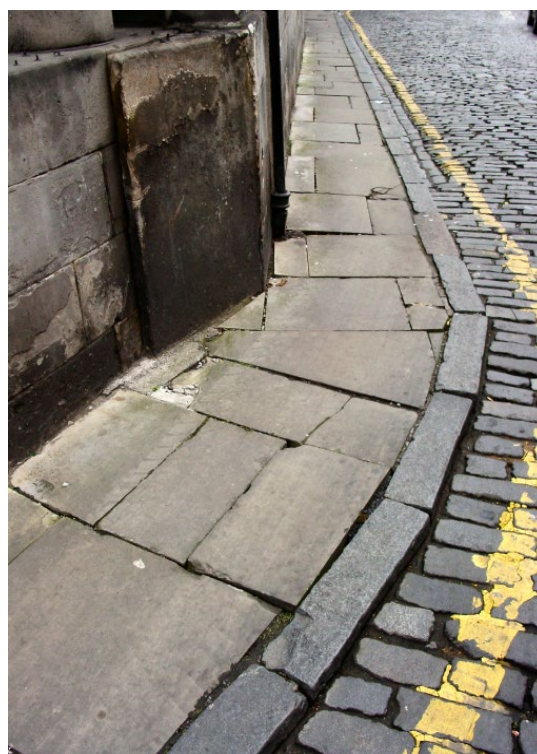


Photo 32. Corner of Waterloo Place and Calton Hill, showing ‘modern’ York sandstone paving with poorly detailed and badly laid sawn slabs, many of which are now loose. The buff-grey colour is more uniform and bland than nearby areas of original sandstone paving with more variable colours and surface texture.



Photo 33. Original sandstone pavement and steps on the north side of Calton Place, with whinstone kerbs and setted roadway. Although the paving slabs are now in poor condition, the continuity of stone materials from roadway, footpath, entrance steps and buildings adds to the character of the historic built environment.

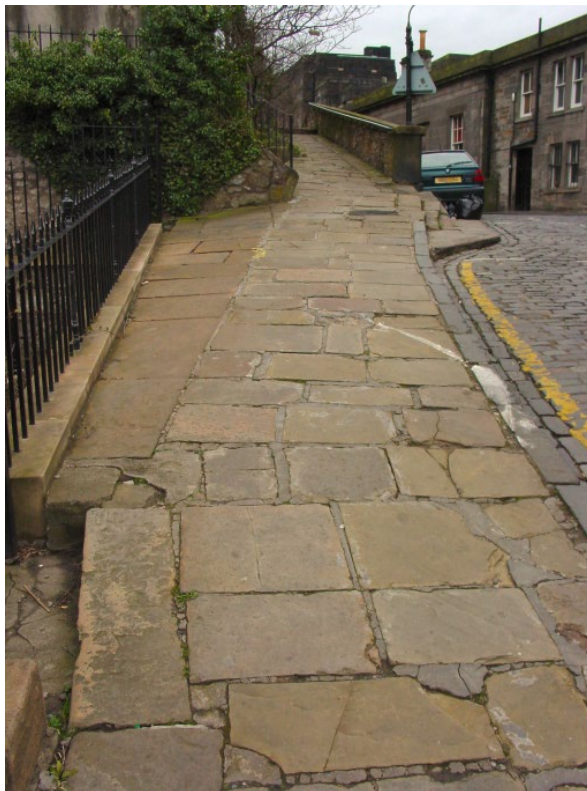


Photo 34. North side of Calton Hill showing original sandstone paving, now in poor condition, but showing typical varied character with variable block size and colour. The paving on the left-hand side adjacent to the railings appears original, whilst that to the right may have been re-laid (note latter has irregular layout, variable slab sizes and wide and irregular joint spaces).

13: Register House (Map 12)

Several areas of sandstone paving are present surrounding both General Register House and New Register House. Most are not in areas of regular public access, but are included in this study because of the range of paving types present and their relationship to the known (i.e. dated) stages of development of the buildings on the site. In addition, at the time of this survey (Autumn 2006) several areas of paving had been lifted for repair works, providing an opportunity to closely examine the material and obtain samples from broken blocks.

The external steps and landings at the main entrance to General Register House are large blocks of reddish-brown coloured, fine to medium grained sandstone, showing internal ripple bedding with textured surfaces (Photos 35 & 36). These slabs are of the same sandstone type as most of the remaining original paving observed throughout the New Town. However the stone at Register House represents a higher quality variety (finer grained and more uniform) of particularly large block size, presumably specifically chosen for use on the entrance to such a prestigious public building.

At New Register House a large area of sandstone paving in the entrance courtyard is a mixture of various stone types, including 'modern' York sandstone and Caithness flagstone (Photo 37). Some historical paving is present, such as a set of grooved sandstone blocks adjacent to the gated entrance, and a small area of original paving to the east of the entrance steps to the building. Channelled sandstone drains and sandstone kerbstones are also present. In addition, an area of historic sandstone paving and kerbstones is preserved to the west of New Register House on the eastern side of Register Place and the turning circle at the north end.

General Register House has two types of sandstone paving surrounding the building. On the east side at basement level the paving is a fine to medium grained brown-buff to reddish-brown coloured sandstone with a common ripple bedded texture, forming thick slabs with coarse broached tooling on the surfaces (Photo 38). The north side (rear) of the building is paved with a distinct fine grained darker greenish-grey coloured sandstone which has planer bedding with micaceous bedding planes (Photo 39). This may be a later area of paving relating to extension of the building, or the construction of New Register House.

The main construction of General Register House is recorded as c.1778 with completion of the dome in 1785. It is recorded that Hailes stone was used at this time (Paton 1930), and it is likely that the paving seen on the east side of the building is of this type. The front steps are also likely to be Hailes stone, although of better quality than that used for footpaths. It is recorded that additional construction to the north side of the building during the 1820s used paving stone from Craigleith, Hailes and Carmyllie. This fits with the two types of paving described above, with reddish-brown rippled bedded sandstone representing Hailes sandstone, and finer grained greenish-grey stone which is likely to be Carmyllie flagstone. The latter is similar to the internal paving used in the entrance hall at the front of the building. The characteristics of the two distinct paving types are summarised in the Table 3.

Table 3. External sandstone paving surrounding General Register House.

<u>Location</u>	<u>General description</u>	<u>Average slab size</u> (thickness x length x width)	<u>Origin</u>
East side	Reddish-brown colour; Ripple bedded texture	15mm 135mm 54mm (average of 7 samples)	Hailes
North side	Greenish-grey colour; fine grained, laminated texture	6 mm x 75mm x 53mm (average of 7 samples)	Carmyllie/ Angus

The pavement surrounding New Register House includes areas of historic (i.e. not late 20th century) Caithness flagstone to the north (rear) and west sides, as well as some areas to the front (mixed with modern repairs). These ‘old’ Caithness slabs are of typically a larger size and have a more variable and paler colour than ‘modern’ Caithness sandstone paving. Some modern replacement Caithness slabs are present on the west side of the building. The east side is paved using a modern ‘Yorkshire sandstone’ paving stone. The abundance of ‘old’ Caithness flagstone surrounding New Register House suggests that following construction of this building in 1863 Caithness flagstone paving was available and being used in Edinburgh.



Photo 35. Main entrance steps, General Register House, showing characteristic greyish-brown colour with reddish-brown patina on worn surfaces.



Photo 36. Detail of main entrance steps, General Register House, showing reddish-brown patina to worn surfaces, with pitted surface caused by effect of ripple bedding. These features are very similar to much of the remaining original sandstone paving present throughout the Edinburgh New Town, and is typical of local 'Hailes-type' sandstone.



Photo 37. 'Historic' Caithness flagstone paving surrounding New Register House, showing variable dark colours with a distinctive dark 'flecked' surface texture typical of this stone type.



Photo 38. Lifted (and mostly overturned) paving slabs from the basement area on the east side of General Register House. The unworn underside surfaces show the characteristic irregular ripple bedding defined by dark carbonaceous layers, typical of Hailes sandstone. Note the uppermost slab, which is the correct way up, shows a typically smooth worn surface which is darker in colour with traces of ripple bedding.



Photo 39. Lifted and broken paving slabs from basement level at the rear (north) side of General Register House, showing dark purplish-grey-green colour with a fine grained uniform texture. These features are characteristic of Carmyllie flagstone.

14: Gloucester Lane (Maps 13 & 14)

An area of sandstone paving is present on the east side of the north end of Gloucester Lane, with a single row of slabs aligned perpendicular to the kerb (measured area described below) (Photos 40 & 41). Various other small areas of original sandstone paving are present on both sides of the lane, notably small areas adjacent to Nos. 6, 11, 12 to 21 (including an entire garage floor interior), 22 and 26.

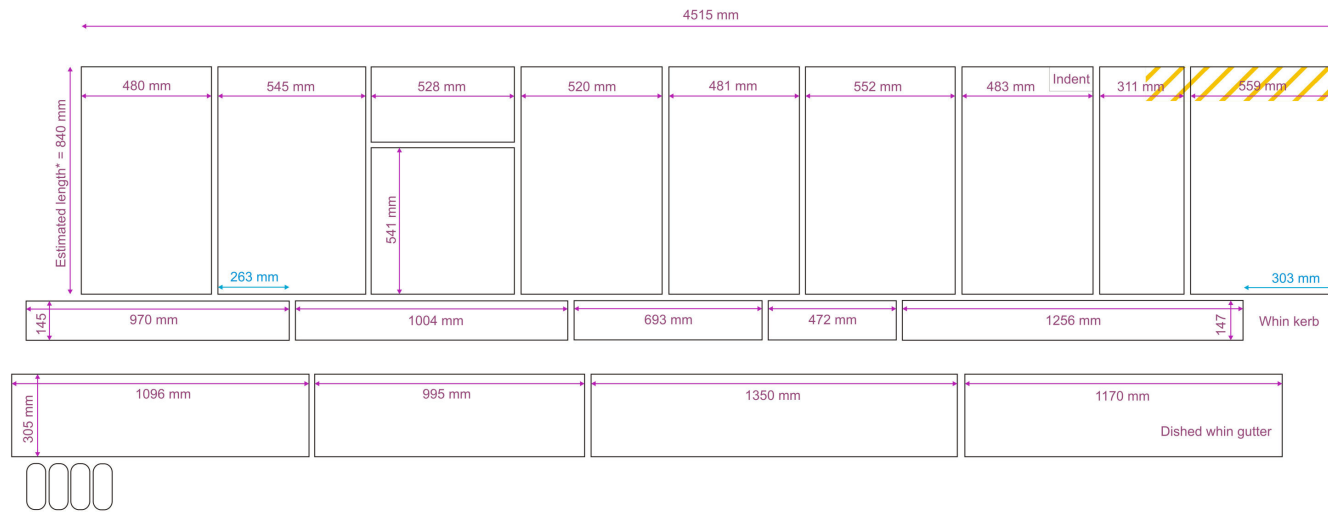
The measured area (Figure 14) is a fine to medium grained uniform grey-buff sandstone with a generally smooth surface, some blocks having ripple laminae on surfaces. Several blocks show broad ribbed broached tooling perpendicular to the kerb (Photo 42). Approximately 30 sandstone slabs are remaining, some broken, and about a third having been damaged by insertion of utility service points (mostly partially repaired with concrete). The lane has a whinstone kerb, dished gutter and setts (all whinstone).



Photo 40. Entrance to Gloucester Lane showing typical arrangement of a single row of sandstone slabs aligned perpendicular to the kerb, with whinstone kerb, dished gutter and setted road surface. The pavement surface is a grey-brown sandstone with a reddish-brown patina on worn surfaces.



Photo 41. Gloucester Lane pavement showing sandstone slabs, whinstone kerb, dished whinstone gutter stone and setted road surface. Scale is 1 metre long.



* Slab length estimated due to infilling of corner between gable wall and pavement with protruding cement fill



Soiled edges in unworn section adjacent to building

Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 14. GLOUCESTER LANE



Photo 42. Detail of sandstone paving slab in Gloucester Lane showing typical brownish-grey colour and fine to medium grained texture, with remains of original broached tooled surface preserved where less worn close to the wall (left-hand side). Ruler scale is c.750 mm long.

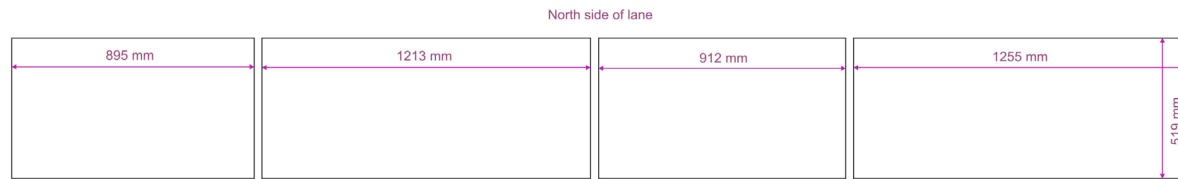
15: Wemyss Place area (Map 14)

The covered lane leading to **Wemyss Place Mews** has a single row of narrow sandstone pavement on either side with slabs aligned parallel to the lane (Figure 15; Photo 43). A single remaining original sandstone spur stone is present at the northeast corner, and new replacement sandstone spur stones have been recently installed at the archway entrance (Photo 44). The paving slabs are approximately 520 mm width and 835 – 1255 mm length. No kerbstones are present. A detailed assessment of the nature of the sandstone paving was not possible due to recent building works.

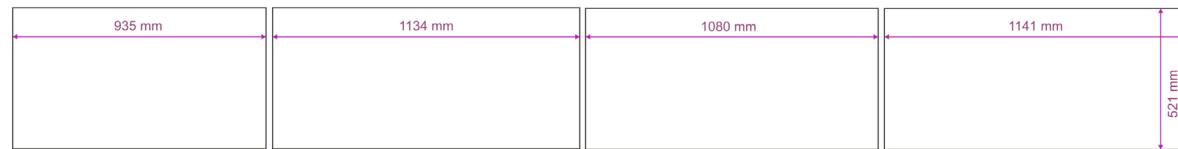
A small area of original sandstone paving with large slab size is preserved on the west side at the south end of **Wemyss Place** (Figure 16; Photo 45). These slabs, the largest of which is almost 2 metres in length, exhibit ripple bedding and vary in colour from pale grey-brown to orange-red.



Photo 43. Recently refurbished covered lane entrance to Wemyss Place Mews, with original sandstone pavement and setted roadway. Spur stones are present on three of the four corners.



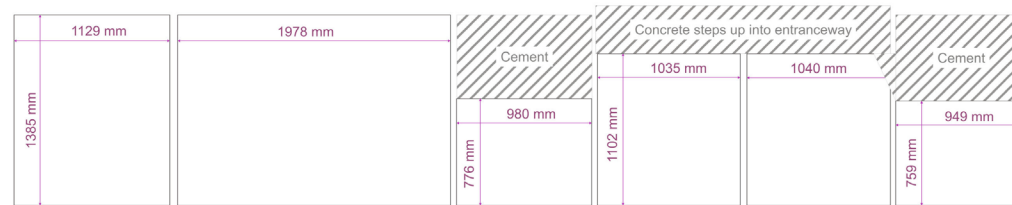
Typical flag dimensions



South side of lane

Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 15. LANE TO WEMYSS PLACE MEWS



Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 16. WEMYSS PLACE



Photo 44. Recently reinstated replacement sandstone spur stone at entrance to Wemyss Place Mews.



Photo 45. Remains of original stone paving in Wemyss Place with large slabs of characteristic orange-brown weathering sandstone, with replacement concrete slab over most of the pavement. The steps to the adjacent property entrance are also sandstone.

16: Charlotte Square (Map 15)

The entire north side of Charlotte Square has a sandstone paved footpath with large sandstone mounting blocks, and sloping kerb slabs (Photo 46). The curved corner to the east end has stepped sandstone kerbstones (Photo 47). All are composed of the same sandstone type, typified by a fine to medium grained grey and reddish-buff-grey colour with stronger orange-brown patches in some slabs (Photo 48). Most have a natural slip-resistant surface caused by the presence of ripple bedding, whilst some slabs have smooth surfaces or occasional linear bedding structures. Occasional sandstone flagstones have been replaced by slabs of concrete, recent 'York sandstone' paving, Caithness flagstone and some red sandstone. A large c.15 metre long representative section of the pavement was measured.

The measured drawing of Charlotte Square is shown in Figure 17. The slab size is highly variable. Over the measured section it is observed that larger sized slabs (greater course width) are present adjacent to the principal property entrances, with smaller slab sizes (narrower course widths) in between. The relationship of these wider courses to the principal property entrances is not consistent along the length of the street however, perhaps reflecting the fact that individual feu holders were responsible for the paving in front of each property, leading to a range of patterns.

Kerbstone blocks are typically 290 to 310 mm width and variable in length, some well over 1 metre. Sloping kerb slabs and mounting blocks are mostly of uniform size (see measured section). Most of the mounting blocks have been detailed with curved front corners.

Natural sandstone paving is also present on the adjacent Glenfinlas Street. At the corner junction between these two streets the Charlotte Square paving continues across (i.e. is dominant over) the Glenfinlas Street paving. The Charlotte Square paving is therefore either earlier, or has been laid as 'superior' to Glenfinlas Street. This arrangement is also seen at the corner with North Charlotte Street.



Photo 46. General view of the north side of Charlotte Square showing large area of original sandstone pavement with sloping kerb slabs and large mounting blocks opposite the principal entrances.

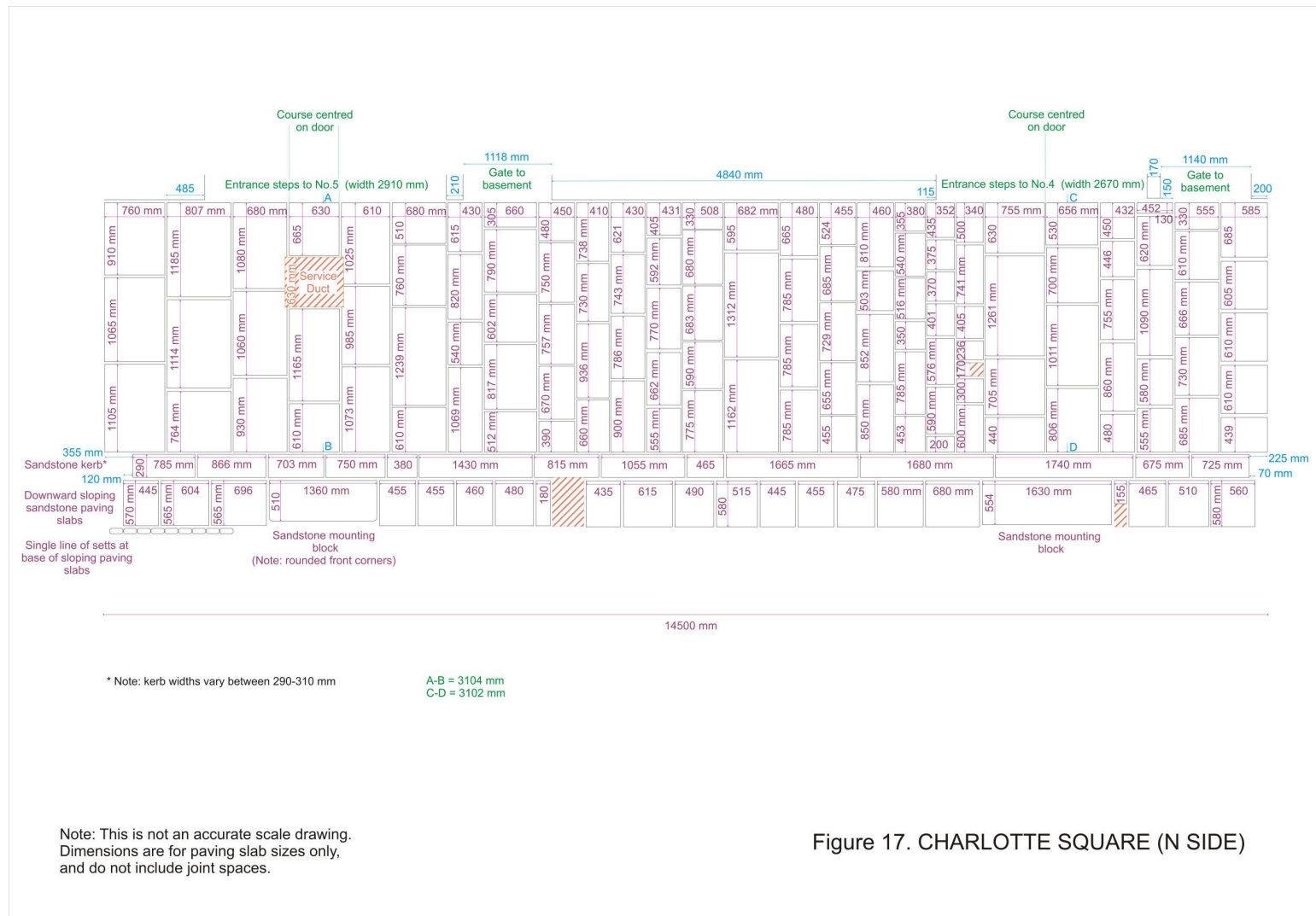


Figure 17. CHARLOTTE SQUARE (N SIDE)



Photo 47. Recently repaired and re-laid original sandstone paving and kerb at the northeast corner of Charlotte Square, reinstating the previous paving arrangement following disruption from repeated service works over many years. Because of damage to some original kerb stones, the middle row of kerb steps has been replaced using a sandstone from the north of England. The standard of workmanship and the care taken to reuse original materials where possible should be seen as a model of good practice. The photo was taken immediately after completion of the work before the area had been cleaned to remove excess sand and mortar.



Photo 48. Sandstone paving on the north side of Charlotte Square, showing typical variable appearance ranging from dominantly greyish to reddish-brown colour with variable surface texture from smooth to rippled surface. These variations are typical of the original sandstone paving found throughout in the Edinburgh New Town. The pale grey slab (centre right-hand side) is a later replacement sandstone (note the straight sawn edges). Scale ruler is c.750 mm long.

17: Glenfinlas Street (Map 15)

Sandstone paving is present on both the west and east side of Glenfinlas Street. The west side has been re-laid and the slabs have straight sawn edges, resulting in a large variation in block size and course width. Some replacement Caithness flagstone is also present. Many of the blocks are poorly cut to size, resulting in large and variable joint widths. Blocks are crudely cut to the radius around the corner with Ainslie Place.

The south end of the east side of Glenfinlas Street has a short section of original sandstone paving, with the remainder to the north comprising whinstone horonizing which continues to the north corner and along the entire length of the south side of St Colme Street (see separate section on horonizing).

A measured section was made of the original sandstone paving on the east side of Glenfinlas Street (Figure 18). The sandstone is fine to medium grained with a variable appearance from buff-orange to grey-buff with occasional stronger orange-brown colours. The slabs have a strong surface texture showing ripple and linear bedding features. Original coarse broached tooling is preserved in areas of low wear immediately adjacent to the inside wall (Photo 49). The tooling is perpendicular to slope of pavement and gives a 'ribbed' surface which would have provided slip resistance. The slab size is generally large and uniform with a relatively uniform course width, aligned perpendicular to the kerb. This contrasts with the more variable slab sizes in Charlotte Square, though the stone type is very similar. Occasional recent replacement slabs of red sandstone and buff 'York sandstone' are present.

The pavement area has a sandstone kerb, with a lower concrete kerb step (possibly replacing an original sandstone step). The kerb appears to be the same sandstone type as the paving slabs. Some blocks are cracked with cement repairs.



Photo 49. Sandstone paving in Glenfinlas Street, showing original broad broached tooling preserved in the less-worn areas adjacent to the inner boundary wall. The paving shows the typical variation in colour and texture characteristic of original sandstone paving in Edinburgh.

18: St Stephen Place (Map 16)

The footways in St Stephen Place cul-de-sac are paved with sandstone, all of which appears to have been re-laid using a mixture of original and re-cut slabs. The paving connects directly with steps and plats to property entrances and basements (some entrance steps have been recently replaced using 'York sandstone').

A section of paving was measured where the majority of the slabs appear to be of original block sizes (Figure 19). In addition, a large number of slab sizes were measured from blocks throughout the cu-de-sac which appear to have original edges and have not been re-cut.

The sandstone is generally fine to medium grained, with a variable grey to reddish-brown colour with a strong orange-brown patina on worn surfaces (Photos 50 & 51). Some slabs have rough surfaces from ripple textures, whilst others are smooth. Occasional slabs have a surface texture showing linear bedding. The pavements are coursed with irregular course widths, the courses aligned perpendicular to the kerb. Some original coarse parallel broached tooling is preserved on slab surfaces. Occasional replacement slabs of Caithness flagstone are also present, noticeably darker and more uniform in colour, and with a smoother surface. A whinstone kerb is present.

Many of the slabs have been redressed using a mechanical saw typically on one side, indicating that the slab sizes present are smaller than the original. The paving pattern is also likely to be different, and most has been laid as a regular pattern of only two slabs per course with a uniform offset, similar to many modern concrete slab pavements.

A notable feature of this pavement is the way in which utility service covers, bollards etc. have been inserted into the flags, mostly by mechanical sawing. Some of these are very crudely executed with a cement infill and damage to surrounding flagstones (Photos 52 & 53).



Photo 50. Sandstone paving in St Stephen Place showing typical variable appearance and surface textures, with colour ranging from grey to reddish-brown. The steps and entrance plat are replacement 'York sandstone' rebuilt in 1985.



Note: This is not an accurate scale drawing.
Dimensions are for paving slab sizes only,
and do not include joint spaces.

Figure 19. ST. STEPHEN PLACE



Photo 51. Detail of original paving in St Stephen Place showing typical variation in colour and surface texture and uniform offset laying arrangement.



Photo 52. 'Recent' installation of bollard into sandstone paving, St Stephen Place, with over-large sawn area patched using cement and cracks to the sandstone slab.



Photo 53. Detail of sandstone paving, St Stephen Street showing installation of utility service point, showing unsightly sawing of slab and cement patching.

3.2 Horonizing

19: Glenfinlas Street (Map 15)

The east side Glenfinlas Street has a long (c.50 metre) section of horonized paving, continuing eastwards along the south side of St Colme Street (see below). The style of horonizing between the two streets is different.

The horonizing on Glenfinlas Street is a mixture of generally subangular elongate fragments or slivers of grey granitic and mid-dark grey doleritic material with smaller amounts of dark grey basaltic material (Photo 54). The fragments are well compacted and laid neatly with long axes aligned perpendicular to the kerb, with a single row of fragments laid adjacent and parallel to the kerb. The kerbstones are roughly-squared whinstone setts. In places there is also a single line of fragments laid parallel to the boundary wall on the inside of the footpath.

Variations in the workmanship and quality of the horonizing are evident, for example the first c.12 metres of horonizing to the north of the sandstone paving is neatly laid and well packed with a strongly perpendicular arrangement, whereas the remainder of the street has a more variable pattern. Some poor quality repairs are present, with some asphalt patching and other areas where the horonizing has been lifted and re-laid using a cement mortar.



Photo 54. Horonizing in Glenfinlas Street, showing typical well packed dolerite (whinstone) fragments. Scale ruler 50cm long.

20: St Colme Street (Map 15)

Horonizing is present along the entire south side of St Colme Street for approximately 100 metres in length. This is a continuation of the horonizing on Glenfinlas Street, although it is distinctly different. At the corner between Glenfinlas Street and St Colme Street there is a distinct change from the well packed and regular grey granitic and doleritic horonizing on Glenfinlas Street, to a more irregular and less well packed style (Photo 55) dominated by angular fragments of darker grey doleritic and basaltic rocks types (with an absence of granitic types).

The fragments vary in size from area to area within the street, with some areas dominated by relatively large fragments, others dominantly smaller. The fragments are laid with long axes aligned perpendicular to the kerb, laid directly to the kerb

edge. A single line of fragments is laid parallel to the boundary wall on the inside of the pavement. The kerb is made from whinstone setts along most of the street. The laying arrangement exhibits much greater irregularity and is less well packed compared to Glenfinlas Street. In several areas poor repairs are present with asphalt patch repairs and areas re-laid in cement mortar.



Photo 55. Horonizing on St Colme Street showing irregular sized whinstone fragments, noticeably less well packed than that on Glenfinlas Street. The kerb is formed from a single line of whinstone setts. Scale rule is 50cm long

21: Ainslie Place (Map 15)

Horonized pavement is present surrounding the central gardens in Ainslie Place. Garden entrances have a distinctive perpendicular arrangement with sandstone entrance steps (Photo 56). The horonizing has a compact neat arrangement, dominated by subangular fragments of grey granitic, dark grey doleritic and basaltic rock types, laid with long axes aligned perpendicular to the kerb (Photo 57).

In front of the garden entrances at the west, east and south sides the horonizing is laid parallel to the kerb, fanning out in width from the gate step to the kerb. The north garden entrance has two large sandstone flagstone slabs laid in front of the gateway. All the garden entrances have single sandstone steps which are a grey-brown sandstone with stronger reddish colour and a rippled surface texture giving a pitted surface.

The horonizing is laid directly to the kerb which is formed from variably-sized whinstone setts. A single line of whinstone fragments are laid parallel to the boundary wall on the inside of the pavement. Some parts to the south and west side of the gardens have larger and more angular fragments of dolerite and basalt. Occasional asphalt patch repairs are present, as well as areas where utility service points have been installed, some re-laid using loosely packed reddish whinstone fragments in a cement matrix (Photo 58).

Three sandstone lighting plinths are present, set into the horonizing, protruding slightly beyond the kerb edge, each c.600 x 600 mm size (Photo 59). The same type of sandstone has been used for the steps and lighting plinths.



Photo 56. Northern garden entrance, Ainslie Place, with two large sandstone slabs partly covered in asphalt.



Photo 57. Whinstone horonized pavement in Ainslie Place, with whinstone kerb and granite gutter and setted road surface. Note the wear to the kerb stones.



Photo 58. Poor attempt to mimic horonizing following installation of service duct, using a mixture of original material and red whinstone fragments, loosely packed in a cement matrix. South-eastern side of Ainslie Place.



Photo 59. Entrance to central gardens area, Moray Place, showing whinstone horonized pavement with perpendicular pattern adjacent to the entrance, with whinstone setted kerb, and granite setted gutter and road surface. An original sandstone lighting plinth is preserved to the right-hand side of the entrance.

22: Moray Place (Map 14)

Horonized pavement surfaces surround the central gardens in Moray Place, with common sandstone lighting plinths and single sandstone steps to garden entrances. The horonizing comprises a mixture of subangular grey granitic and dark grey doleritic and basaltic rock fragments. Some areas are dominated by more angular fragments of dolerite and basalt. The fragments are laid with long axes aligned perpendicular to the kerb. A single line of fragments is laid parallel to the boundary wall on the inside of the pavement. The horonizing is laid directly to the edge of the kerb, which is formed from a line of roughly squared setts adjacent to sloping setts laid perpendicular to the kerb, sloping towards the road.

Of the four garden entrances on Moray Place, only the NW entrance is marked by a change in the horonizing arrangement, with the fragments laid parallel to the kerb in a section which fans out from the gate step to the kerb (Photo 60). Single sandstone steps are present to all garden entrances.

Numerous sandstone lighting plinths are present, made from reddish-brown/grey ripple bedded sandstone, with the exception of one plinth opposite No. 34 which is an unusual crystalline sandstone. The typical plinth size is approximately 600 x 600mm. The lighting plinths generally protrude beyond the kerb line into the roadway, so that many have been broken due to vehicle strikes.



Photo 60. Typical whinstone horonized pavement with perpendicular pattern adjacent to garden entrance, with whinstone setted kerb, and granite setted gutter and road surface. Northwest garden entrance, Moray Place.

3.3 Additional areas of natural stone paving in Edinburgh New Town

There are a number of other areas of natural stone paving in the Edinburgh New Town which were not surveyed, mainly because they are not footpaths *per se* or are recently-laid ‘modern’ pavements (i.e. late 20th century onwards). Modern paving is present in a number of notable locations, in particular recent Caithness Flagstone used for a pedestrian schemes in Castle Street and at Elder Street, and in a decorative area in Findlay Court (west side of National Portrait Gallery). Modern replacement paving using natural ‘blonde’ sandstone is present on the east side of Cheyne Street and at the corner of Waverly Bridge and Princes Street, both apparently using Scout Moor sandstone. An area of historic sandstone paving is present on the west and east side of St Andrew & St George Church, George Street, but was not surveyed in detail (as it does not represent a footpath *per se*).

Two localities on George Street contain test paving panels of different types of currently-available natural stone pavement. These were laid by ECC in early 2003 in order to trial various paving stone types and jointing materials. Both panels consist of four courses of the following stone types: Crossland Hill, Shire Hill, Scout Moor (Appleton) and Caithness. One panel is on the north side at 131-133 George Street, the other on the south side at 62-66 George Street. The objective is to monitor the performance of the various stone types with a view to assessing them for future use in the New Town. It should be noted that the aesthetic character and sympathetic appearance to the surrounding historical built environment is only one of a number of criteria being assessed, with other issues such as strength, slip resistance, ease of cleaning and chewing gum removal given considerable importance.

Several other areas of both historic and modern natural stone paving are present in the Old Town and other parts of Edinburgh, but have not been included in this study.

It is apparent that substantial quantities of natural stone paving have been used throughout the Edinburgh New Town in areas that are not in the public realm, for example in open basements below street level and for steps and entrance platforms (‘plats’). Most of these areas are not in the public realm and have not been included in this study. General observation of these areas during the course of the fieldwork indicates that much of the stone appears to be of the same type of sandstone as that used for the footpaths.

Natural stone paving has also been extensively used internally for flooring (particularly entrance halls, kitchens etc.) and as steps and landings (particularly used for common stairwells). General observation suggests that much of the internal paving is a finer grained and darker-coloured paving stone than used for the external footpaths and in many places it appears more similar to Angus paving stone. This is backed up by limited documentary evidence, e.g. the use of Carmyllie stone as internal paving for the Bank of Scotland building on the Mound, and the entrance hall to General Register House. These observations suggest that whilst local sandstone was used for the external footpaths, steps and basements, imported stone from Angus (and possible also Caithness) was favoured for internal use.

3.4 Summary of information on paving patterns from surveyed areas.

Historic sandstone paving was identified in eighteen sites from around the Edinburgh New Town, all of which are described in this study. Four additional sites were described where horonizing (split whinstone setts) paving is present. Sandstone is also used for a number of additional related features such as kerb stones, mounting blocks, channelled gutter stones, lighting plinths and spur stones. Locations of these have also been recorded.

Eighteen measured drawings have been made of representative original sections of sandstone pavement from thirteen of the identified sites. These can be divided into seven lanes and six street pavements. The lanes are Carlton Terrace, Wemyss Place (two sections measured), Gloucester Lane, Young Street (four sections measured), Thistle Street, Atholl Crescent and Lynedoch Place. The street pavements are Ann Street (two sections measured), Charlotte Square, Glenfinlas Street (east side), Regent Road, Regent Terrace and St Stephen Place. The slab dimensions for each lane are summarised in Fig. 20 and those for streets are summarised in Fig. 21.

Results of measured sections in lanes

The seven surveyed lanes can be grouped into three principal styles of paving.

1. The pavement comprises a single course of slabs with the long axes aligned parallel to the roadway, with or without kerbstones (e.g. Fig. 4, Photo 1). A broad sandstone kerb is present in some localities. This paving style is seen at Thistle Street NE lane, Lynedoch Place Lane, Atholl Crescent Lane and Young Street S Lane. The slabs are generally large with lengths ranging from c.1500 to 424 mm, and widths from c.600 to 837 mm, the width being constrained by the overall width available in each lane.
2. The pavement is formed from a single course of slabs with the long axes aligned perpendicular to the roadway (e.g. Fig. 11, Photo 25). This style is present at Gloucester Lane, Young Street N Lane, Young St S Lane and Carlton Terrace. Kerbstones are sometimes present, and both sandstone or whinstone kerbs are used. The slab length ranges from 840 to 1037 mm, and the width is variable from 311 to 909 mm.
3. Only one lane (Young Street North Lane) has two courses, each of relatively square slabs, laid in an off-set pattern with no kerb and a dished whinstone gutter (e.g. Fig. 7, Photo 19).

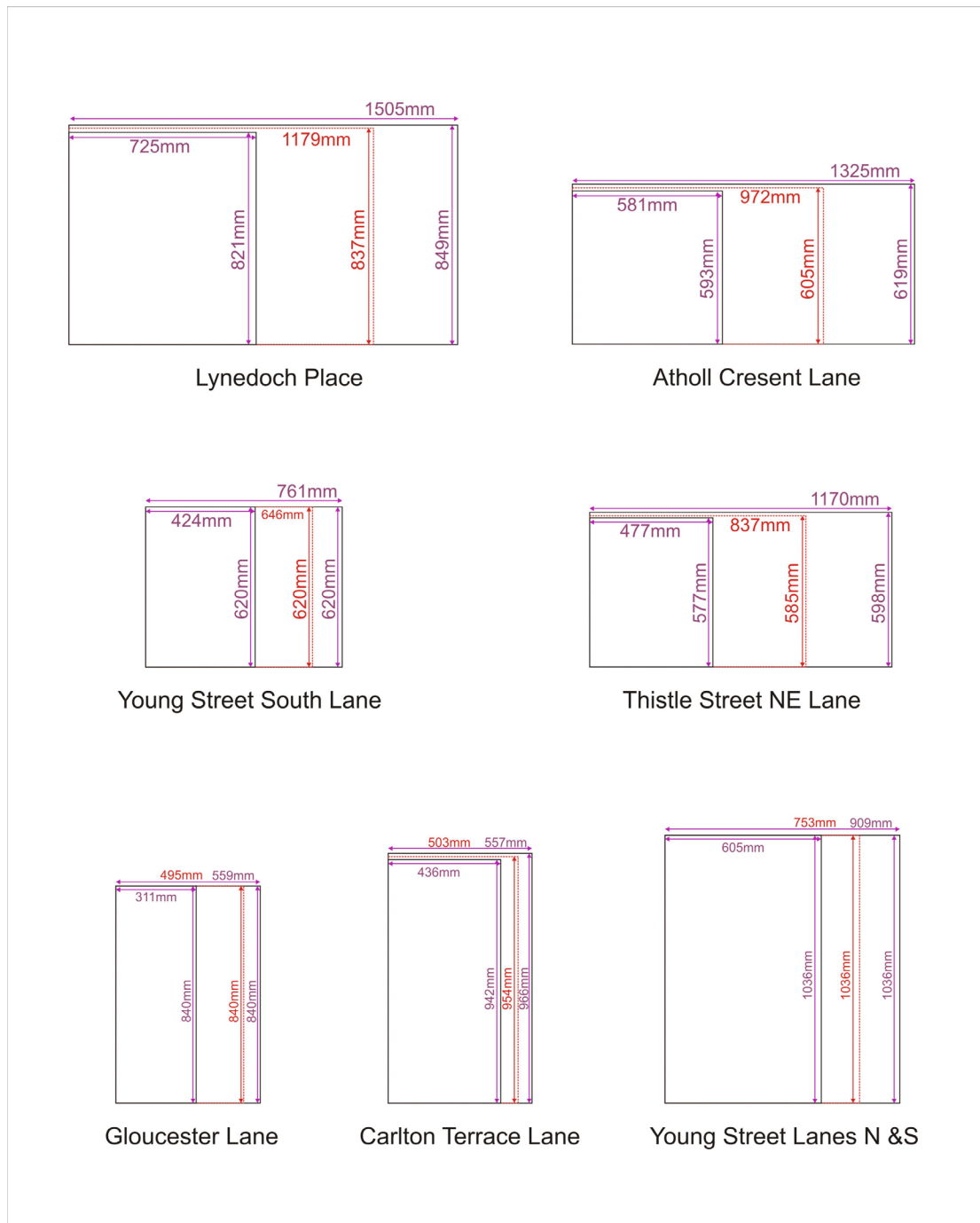


Figure 20. Diagrammatic figures showing maximum, minimum and average slab lengths and widths for the seven measured survey sites of historic sandstone pavement in lanes in the Edinburgh New Town. Average dimensions for each site are shown in red. At four of the sites the long axis of the slab (i.e. slab length) is parallel to the road direction, whilst three sites have the long axis of the slab (i.e. slab length) perpendicular to the road direction.

Results of measured section in streets

In all the streets where original sandstone paving is present the slabs are arranged in courses with the long axes aligned perpendicular to the road direction. In all but one locality (Ann Street) each course is made up of a single fixed slab width, which varies between courses (e.g. Fig. 12, Photo 26). In Ann Street the are courses made up using multiple slabs of smaller sizes (e.g. Fig. 2).

The plots of average slab dimensions (Fig. 21) shows that there is a general similarity of slab sizes between most of the different sites. The largest slabs have lengths typically up to 1300 to 1360 mm with more variable widths from 630 to c.800 mm. The smallest slab sizes show greater variability, particularly in Charlotte Square which has a much wider range of slab sizes than other streets (largely because of its bimodal paving pattern –see description in section 3.1 above), and this is reflected in the smaller average slab size for Charlotte Square in Fig. 21. Ann Street has smaller sized slabs and a smaller average slab size because of the presence of multiple slabs within courses. This is also reflected in a much smaller average slab dimensions for Ann Street (Fig. 21).

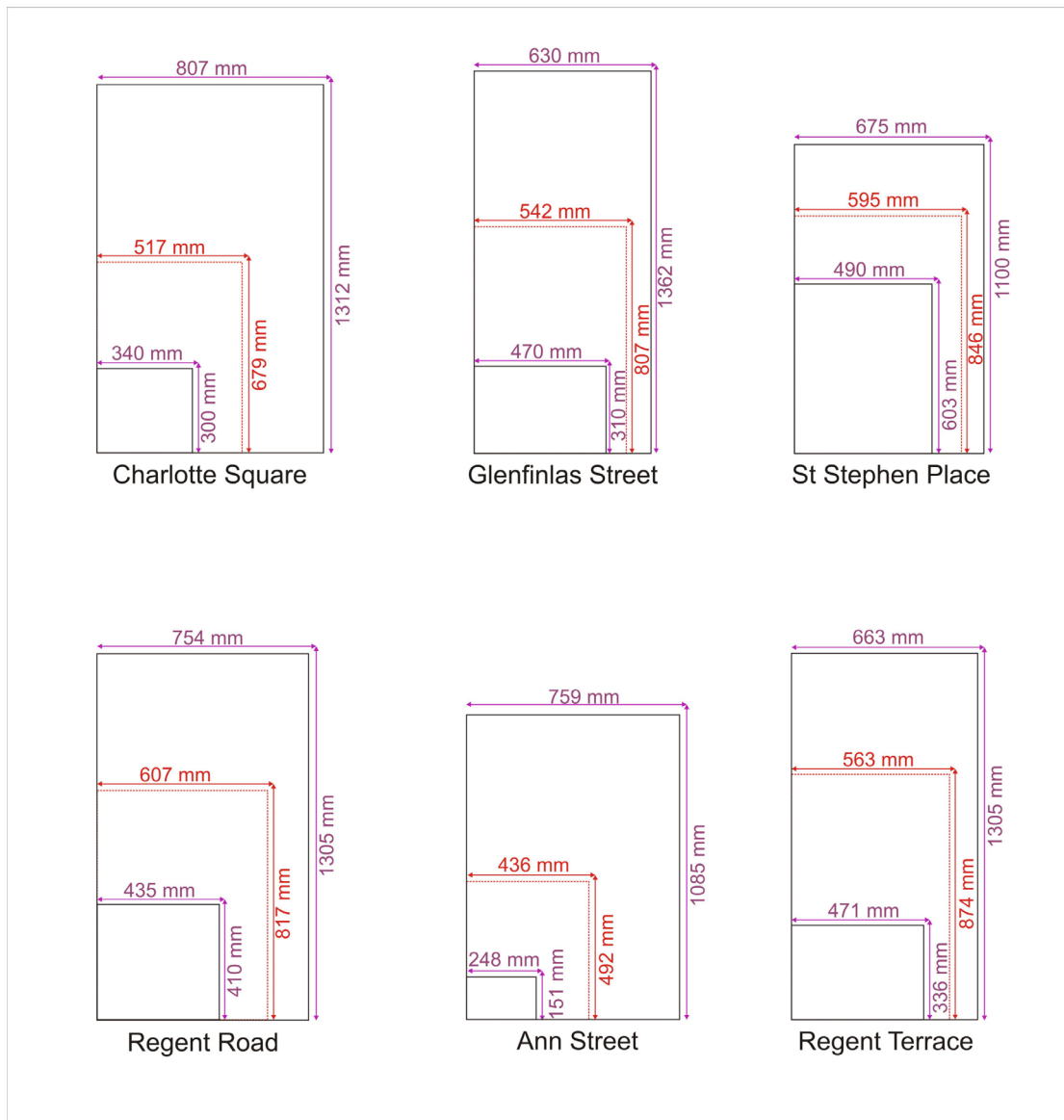


Figure 21. Diagrammatic figures showing maximum, minimum and average slab lengths and widths for the six measured survey sites of historic sandstone pavement in roads in the Edinburgh New Town. Average dimensions for each site are shown in red. At all sites the long axis of the slab (i.e. slab length) is perpendicular to the road direction.

4. ANALYSIS OF SAMPLES, IDENTIFICATION OF PAVING STONE TYPES AND QUARRY SOURCES.

Forty samples of sandstone paving stone were collected from twenty locations throughout the Edinburgh New Town. All the locations are paved areas in the public realm, and most have been surveyed during this study. Most of the samples are sandstone paving slab, with a small number of sandstone kerbstones. Six samples were collected from one locality on the north side of Charlotte Square, where repair works at the northeast corner allowed access to broken pavement and kerb material. Similarly, repair works at General Register House at the time of this study enabled nine samples to be collected from lifted pavement at that locality.

All the samples were collected from already damaged and broken blocks, and most samples are less than 100 mm in size, many obtained by simply removing loose and broken fragments. In a few places, samples were taken from larger damaged slabs using a portable core drill with a 400 mm diamond bit. In all cases any holes and spaces left following sampling were infilled using cement mortar. Following the sampling many areas were left in better condition than before, as loose and unstable material was removed and/or consolidated with mortar.

The samples were washed and examined in the laboratory and described in order to identify the sandstone types present and to provide information on the origin of the stone. Of the forty samples, fifteen representative specimens were selected for thin sectioning and detailed microscopic (petrographic) analysis. These were compared with thin sections of samples of known historical flagstone quarries and currently-operating quarries from the BGS archive collections.

Microscopic examination of thin sections of the samples has been used as a tool to help ‘fingerprint’ the origin of the stone types. In all cases the petrographic characteristics of the samples (e.g. grainsize, texture, mineral composition, porosity etc.) are distinctive and characteristic enough to discriminate between a number of sandstone types, the origins of which can be identified by comparison with specimens from known quarry sources.

4.1 Origin of the samples

The samples are listed in Table 4, with summary descriptions. Based on petrographic criteria the samples can be grouped into five sandstone types. The majority of the samples (24 out of 40) are of ‘Hailes type’, representing 16 of the 20 localities sampled. Eight of the samples are ‘Angus type’ flagstone, from three localities. ‘Craigleith type’ was found at two localities (both at Register House), and ‘Central Scotland type’ was identified at three localities (Regent Road, Regent Terrace and Thistle Street NE Lane). ‘Yorkshire type’ paving was found at 3 localities (at Register House) where it has been used for ‘modern’ (i.e. late 20th century) repairs to pavements. The characteristics of the five sandstone types are summarised below.

‘Hailes type’: These samples have distinctive petrographic characteristics typical of sandstone from Hailes quarry in Edinburgh, and nearby quarries (e.g. Redhall, Craigmill) which also worked the Hailes Sandstone beds on the south-western outskirts of Edinburgh. The Hailes Sandstone is from the West Lothian Oil-Shale

SAMPLE DETAILS			ANALYSIS		IDENTIFICATION OF SANDSTONE TYPE					GEOLOGICAL CHARACTERISTICS
Location	Sample (ED number)	Comments	Hand Specimen	Thin Section	"Hailes-type"	"Central Scotland sandstone"	"Craigleith-type"	"Angus-type"	"Yorkshire sandstone"	
Ann Street	10148	North corner area	Y	Y				Y		concentrations of carbonaceous fragments and white mica. Weathering to darker greenish-brown. surfaces containing black carbonaceous fragments and white mica. Contains carbonate. carbonaceous fragments, large white micas and orange-brown altered iron grains. grained orange iron oxides. Ripple bedded texture defined by laminae with concentrations of black carbonaceous fragments and mica flakes. laminae defined by black carbonaceous fragments with large muscovite flakes and concentrations of orange-weathering iron oxide grains. black carbonaceous fragments large white mica flakes throughout and concentrated in ripple laminae. Weathering to darker orange-brown colour. ripple laminae with black carbonaceous fragments and large white micas. Well developed reddish-brown coloured mica-rich laminae. reddish-brown laminae with carbonaceous fragments and white mica. lined by dark carbonaceous fragments, white mica and specks of orange-brown altered as ED10166 carbonaceous fragments throughout and large white mica flakes. minor bedding laminae defined by grainsize variation. Strong orange-brown weathering Fine to medium grained, greenish-grey uniform sandstone with planer bedding. Typical Woodkirk-type 'York Stone'.
Ann Street	10164		Y		Y					
Ann Street	10175	NW corner area	Y					Y		
Ann Street	10176		Y					Y		
Bell's Brae	10162		Y		Y					
Blenheim Place	10174	Stepped kerb	Y		Y					
Calton Hill	10151		Y	Y	Y					
Carlton Terrace Lane	10169		Y		Y					
Charlotte Square	10152	NE corner	Y	Y	Y					
Charlotte Square	10155	NE corner	Y		Y					
Charlotte Square	10155	NE corner	Y		Y					
Charlotte Square	10158		Y		Y					
Charlotte Square	10160	NE corner	Y		Y					
Charlotte Square	10166	NE corner kerb	Y		Y					
General Register House	10193		Y				Y			
		Modern' replacement paving								
General Register House	10194		Y						Y	
General Register House	10195		Y					Y		
Glenfinlas Street	10159	Kerb	Y		Y					
Gloucester Lane	10149		Y	Y	Y					
Gloucester Lane	10171		Y		Y					
Hill Street North Lane	10165		Y		Y					
Lynedoch Place Lane	10153		Y	Y	Y					
Lynedoch Place Lane	10161		Y		Y					
Regent Road	10147		Y	Y		Y				
Regent Terrace	10146		Y	Y		Y				
Regent Terrace	10156	Kerb	Y		Y					
Register House	10186	Sample 1	Y	Y			Y			
		Sample 2. 'Modern' replacement paving								
Register House	10187		Y	Y					Y	As 10194
		Sample 3. 'Modern' replacement paving								
Register House	10188		Y	Y					Y	As 10194
Register House	10189	Sample 4	Y	Y				Y		bedding surfaces. Highly compact with poorly sorted angular grains. Framework grains dominated by quartz and feldspar with lesser lithic grains. Elongate flakes of whi
Register House	10190	Sample 5	Y	Y				Y		
Register Place	10154		Y	Y	Y					colour. Highly compact with minimal porosity. Angular framework grains dominated by quartz, with common lithic and feldspar grains, and irregular flakes of white mica, biotite a
St Stephens Place	10145		Y	Y				Y		grained black carbonaceous fragments and white mica. carbonaceous fragments and large white mica flakes throughout, defining thin bedding with orange iron oxide grains throughout. carbonaceous fragments and white mica scattered throughout. black carbonaceous fragments and orange-brown ferruginous grains. Weathers to variable by black carbonaceous fragments, large muscovite flakes and orange ferrugenous grains. Weathered surfaces have strong variable orange colours. with concentrations of black carbonaceous fragments and large white mica flakes.
St Stephens Place	10177		Y					Y		
Thistle Street NE Lane	10167		Y		Y					
Thistle Street NE Lane	10173		Y			Y				
Upper Dean Terrace	10150		Y	Y	Y					
Waterloo Place	10163		Y		Y					
Young Street North Lane	10157		Y		Y					
Young Street North Lane	10170	Kerb (edge-bedded)	Y		Y					

Table 4. Locations of samples of sandstone paving collected in this study, with summary geological descriptions and identification of origin.

Formation of the Strathclyde Group of the Carboniferous rocks of the Scottish Midland Valley.

‘Angus type’: Petrographic characteristics typical of documented historical pavement quarries in Angus county, such as the well-known quarries at Carmyllie, Pitairlie, Slade and others. These are mostly from the Dundee Formation from the Lower Devonian succession in the north-eastern part of the Scottish Midland Valley.

‘Craigleith type’: Samples which have characteristics similar to the Craigleith Sandstone beds, such as that formerly obtained from Craigleith quarry, Edinburgh, and other nearby quarries (e.g. Craigcrook, Maidencraig, Granton, Ravelston quarries and others -see McMillan et al. 1999). The Craigleith Sandstone beds occur within Carboniferous rocks of the Gullane Formation of Western Edinburgh.

‘Central Scotland type’: These samples have characteristics typical of Carboniferous sandstones from Central Scotland, but distinct from the Craigleith stone obtained from quarries in the Edinburgh area. They are typical of much of the sandstone building stone imported into the city during the 19th century from a range of sandstone-bearing formations of Carboniferous age throughout the Midland Valley.

‘Yorkshire type’: Samples with characteristics typical of the West Yorkshire Sandstones (Leary 1986), a series of quarries in Carboniferous sandstones from the Coal Measures or Millstone Grit. The name ‘York Stone’ is used by the industry as a collective generic term for stone from these quarries. The samples identified all appear to represent relatively new (i.e. replacement) pavement from the late 20th century.

4.2 Detailed description of the different sandstone types identified

Hailes type

‘Hailes type’ sandstone is typically a fine or medium grained quartz-rich sandstone with a pale cream to very pale orange colour. The most distinguishing feature is the presence of ‘ripple bedding’ seen as thin irregular and discontinuous laminae at an oblique angle to the principle bedding plane defined by planar concentrations of black carbonaceous fragments, with flakes of white mica and sometimes iron oxide grains which weather to a red-brown colour. The sandstone is typically hard and compact. The weathered surface of Hailes stone when used as paving is distinctive with a variable colour ranging from grey to orange-red patina, combined with a ‘contour effect’ surface texture created by wearing through different ripple bedding layers. The formation of ripple bedding and its resultant visual effect on the surface of paving blocks is shown in Photo 61. Examples of sandstone samples showing the characteristic features of Hailes type sandstone are given in Photo 62.

The ubiquitous presence of thin bedding laminae in this type of sandstone would have allowed it to be split or riven into thin ‘flags’ relatively easily along the bedding planes (a process that would have been done by hand historically). Secondly, the stone is relatively strong when laid with the bedding horizontal. These factors, plus the relatively compact, fine grained and quartz-rich nature of Hailes sandstone have made it particularly suitable for use as a paving stone. The characteristic internal texture of

Hailes sandstone is illustrated in Photo 63 which shows microscope images of a sample of pavement from Calton Hill compared to a specimen from the original Hailes quarry.

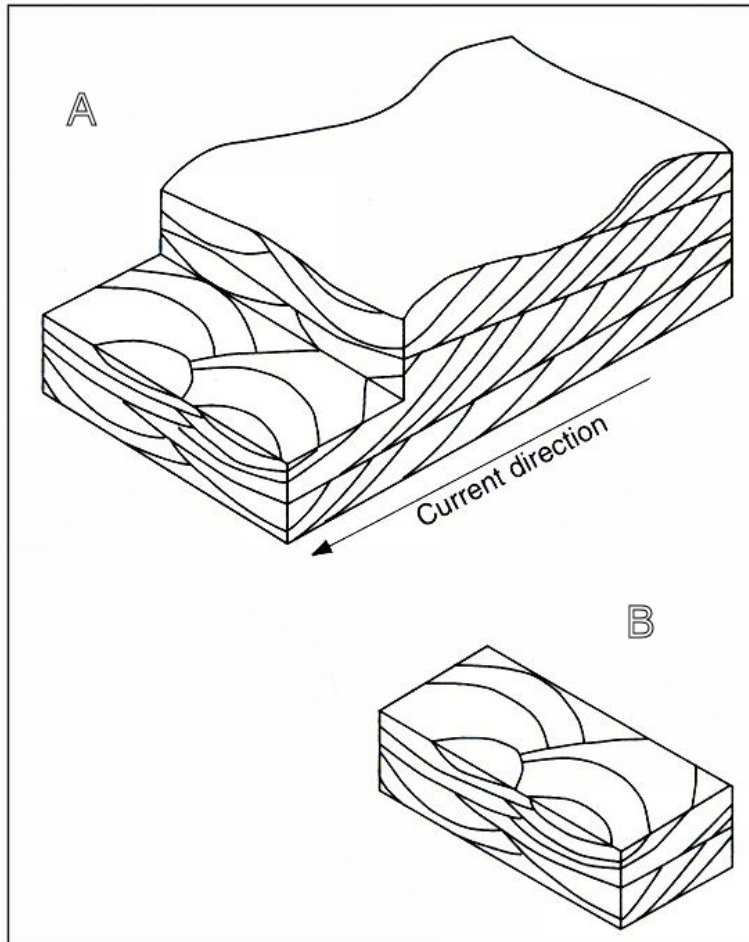


Photo 61. Cartoon block diagram showing the internal bedding structure of ripple bedded sandstone (A), and its origin from the deposition of sand layers in a flowing water current. The thin beds contain a series of multiple, thin oblique ripple (or trough) bedding laminae. On the upper surface of the stone block this gives a 'contour effect' (B), enhanced as the stone becomes worn with use. This is the familiar surface texture seen on many original sandstone paving slabs in Edinburgh.

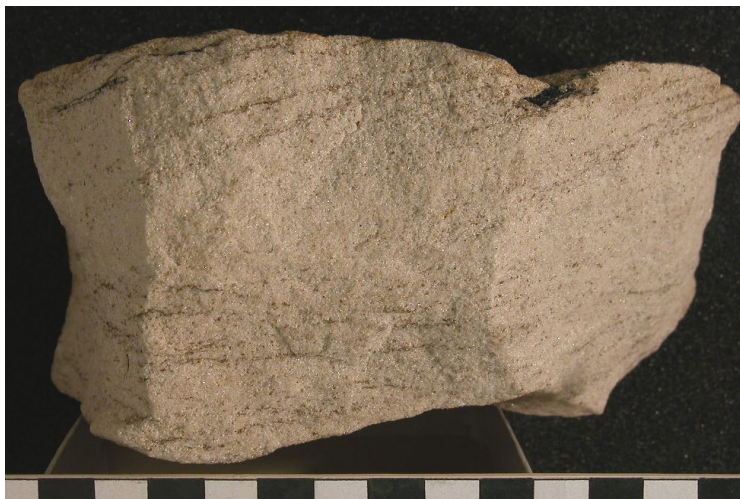
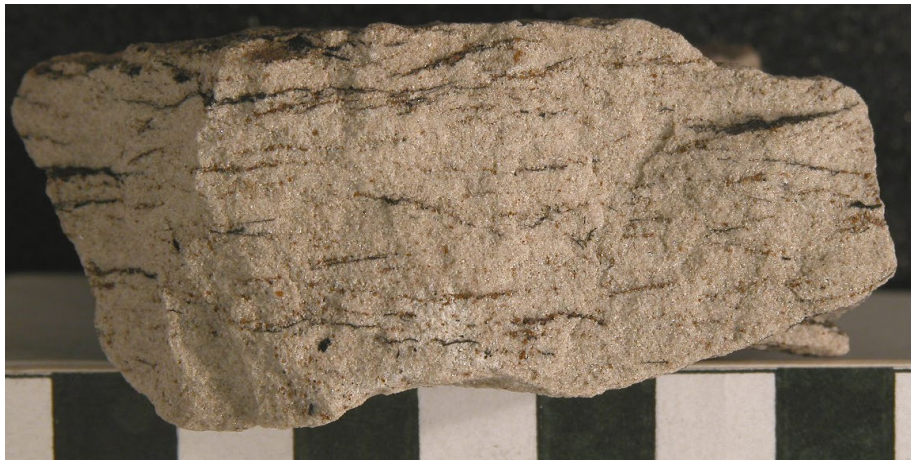


Photo 62. Top image: Sample of typical Hailes type sandstone from paving at Charlotte Square, showing the characteristic irregular dark ripple bedding laminae. Centre image: Sample of sandstone pavement from Calton Hill, showing the typical characteristics of Hailes type sandstone, in particular the presence of irregular dark coloured bedding planes. Bottom image: Typical 'Hailes type' sandstone from Craigmill quarry in Edinburgh, one of the quarries formerly producing Hailes sandstone used for paving in Edinburgh. The sample has the same characteristics as many samples of historic pavement collected during this study. The Craigmill quarry is now closed and infilled and there are no quarries operating in this area or producing this type of sandstone. Scale divisions are centimetres.

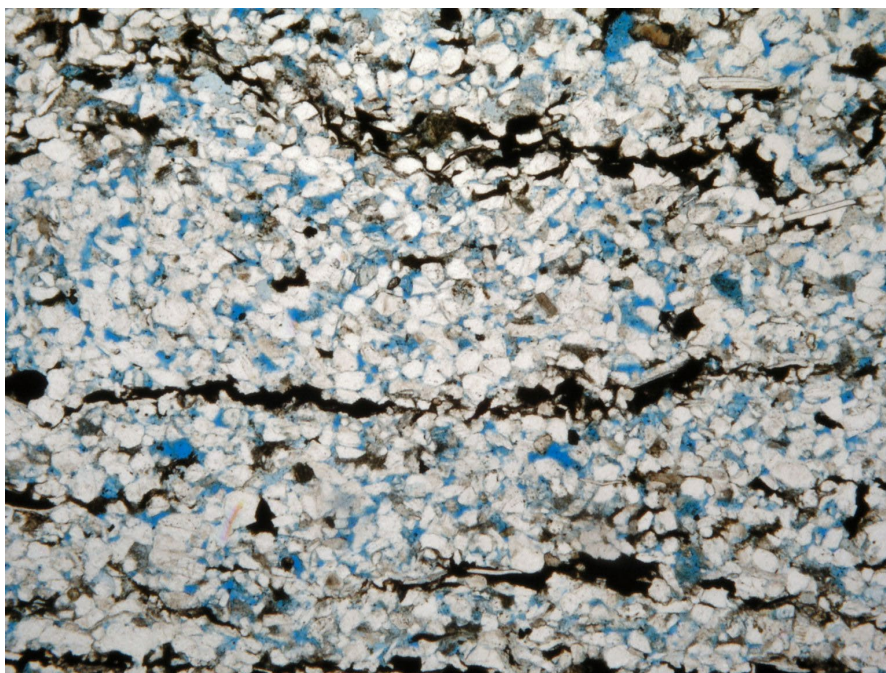
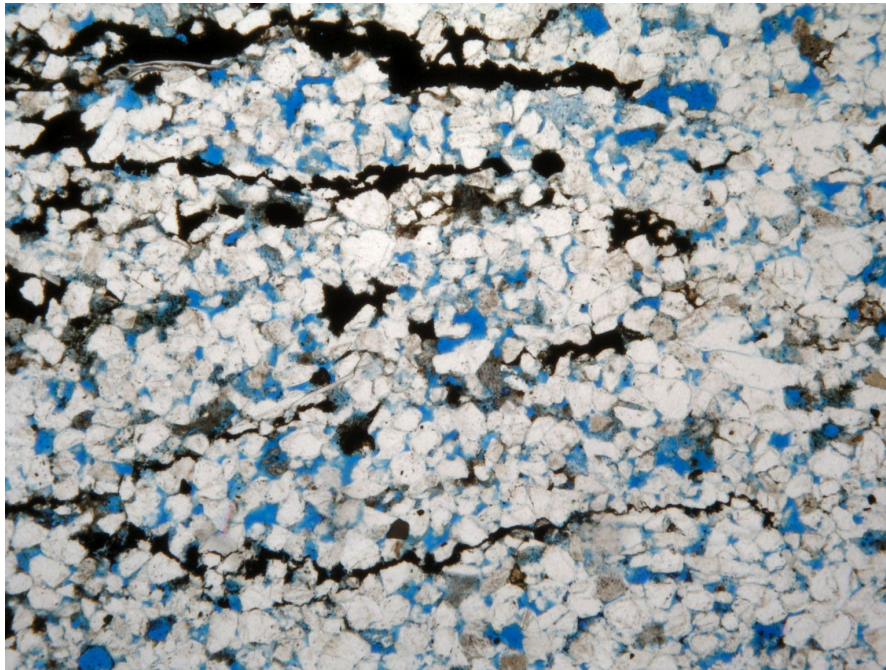


Photo 63. Microscopic thin section images of sample of pavement from Calton Hill (Top image) and sandstone from Hailes quarry, Edinburgh (Bottom image). Both show the same characteristics of fine grained quartz-rich nature (white grains) with high porosity (highlighted by blue dye) and characteristic dark bedding laminae concentrations of organic materials and iron oxide. Image c.3 mm across, plane polarised light; porosity highlighted by blue dye resin.

Craigleith type

Craigleith sandstone is typically a medium grained, highly quartz-rich sandstone with a pale colour, uniform texture and relatively open porosity (Photo 64). The compositional characteristics and well developed silica mineral cement make this a highly durable sandstone. It was one of the most favoured sandstone building stones used in Edinburgh, popular as freestone for ashlar frontages. Some varieties of Craigleith stone which had a more bedded texture may have not been considered suitable for ashlar work, and it is likely that these were utilised for other functions including paving. Towards the end of its life, the Craigleith quarry became an increasingly important producer of paving stone (Craig 1893).

Two samples of pavement from General Register House have petrographic characteristics typical of Craigleith sandstone, but with faint bedding defined by finer grained bands containing clay minerals (Photo 65). They have a typical medium grainsize and high open porosity. The two samples have a surface patina weathering to a variable orange-brown colour.



Photo 64. Cut section through sample of paving from General Register House showing typical ‘Craigleith type’ characteristics with very pale quartz-rich sandstone with medium grainsize and uniform texture. Note the top weathered surface with an orange-brown patina, distinctive of this type of stone, formed by weathering of microscopic iron oxide grains throughout the stone. BGS sample ED10186. Scale divisions are cm.

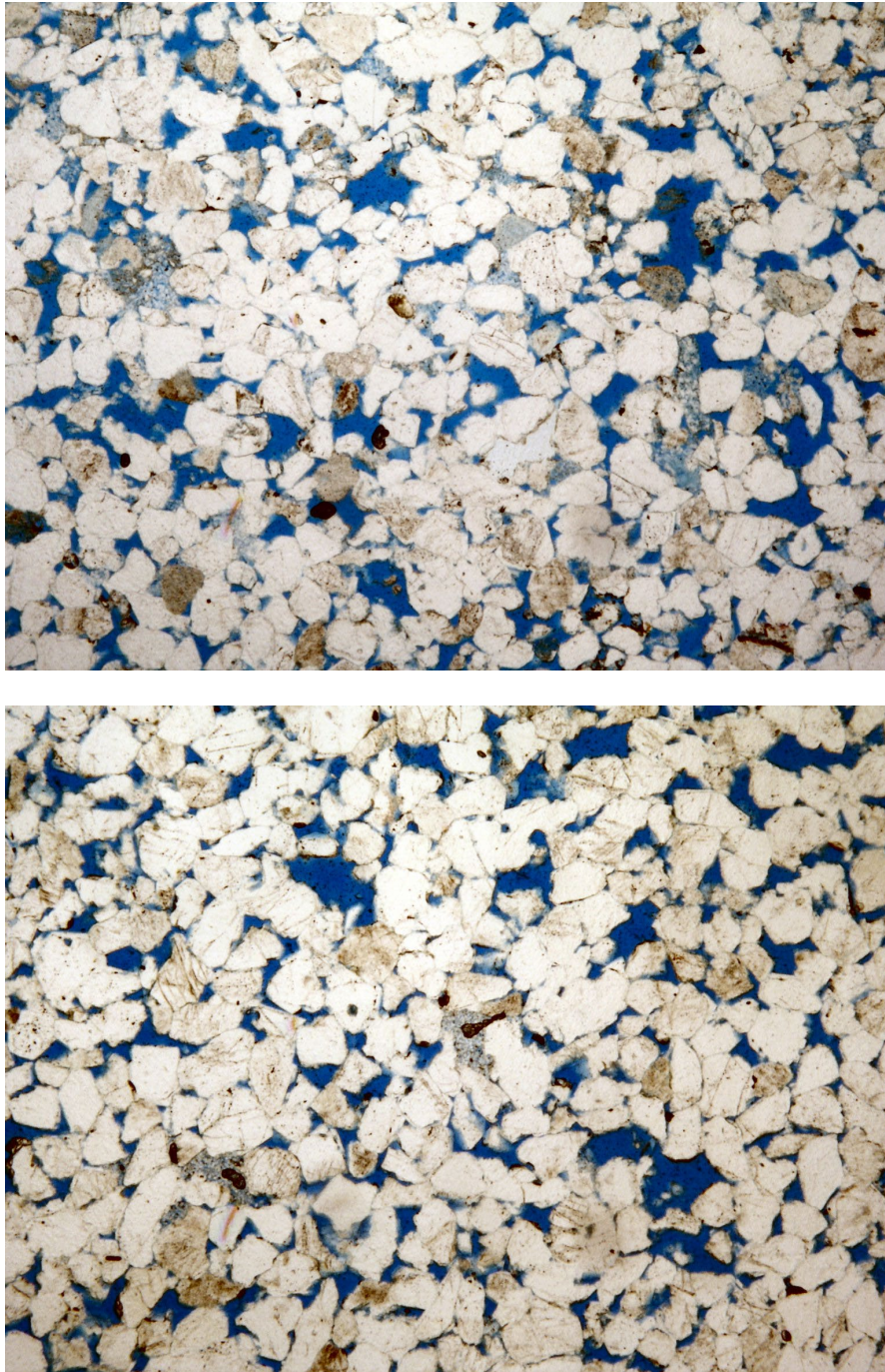


Photo 65. Microscopic thin section image of sample of pavement from Register House (Top image) and sandstone from Craighleith quarry, Edinburgh (Bottom image). Both are characterised by uniform medium grainsize, quartz-rich composition (white grains) and relatively high porosity. Image c.3 mm across, plane polarised light; porosity highlighted by blue dye resin.

Central Scotland type

Sandstones in this category are medium grained, quartz-rich, pale coloured sandstones with a relatively high and open porosity, although typically compact and well cemented. They differ from the Craigleith sandstone type in having a less quartz-rich composition, containing characteristic dark iron oxide grains scattered throughout, and fine grained clay minerals which locally infill the porosity. The iron oxide grains produce a distinctive orange-brown speckled appearance to the stone (Photo 66). Bedding laminae are commonly present, but variable and not prominent. Compared to Hailes sandstone they are coarser grained and more uniform with less bedding laminae. Samples from the large areas of pavement at Regent Road and Regent Terrace show these characteristics.

This sandstone is typical of Carboniferous sandstone from quarries to the west of Edinburgh and from the Central Belt of Scotland, in particular from the Stirling and Falkirk areas. The samples from Regent Road and Regent Terrace are similar to quarry specimens from Drumhead quarry (also known as Doghillock quarry) at Denny, near Falkirk. It is recorded that this quarry supplied paving stone to Stirling, and there is documentary evidence stating that paving stone from the Denny area was brought by canal into Edinburgh in the 1820s. It is likely that sandstone of this type was obtained from a number of quarries in the Central Belt and transported by canal to Edinburgh.

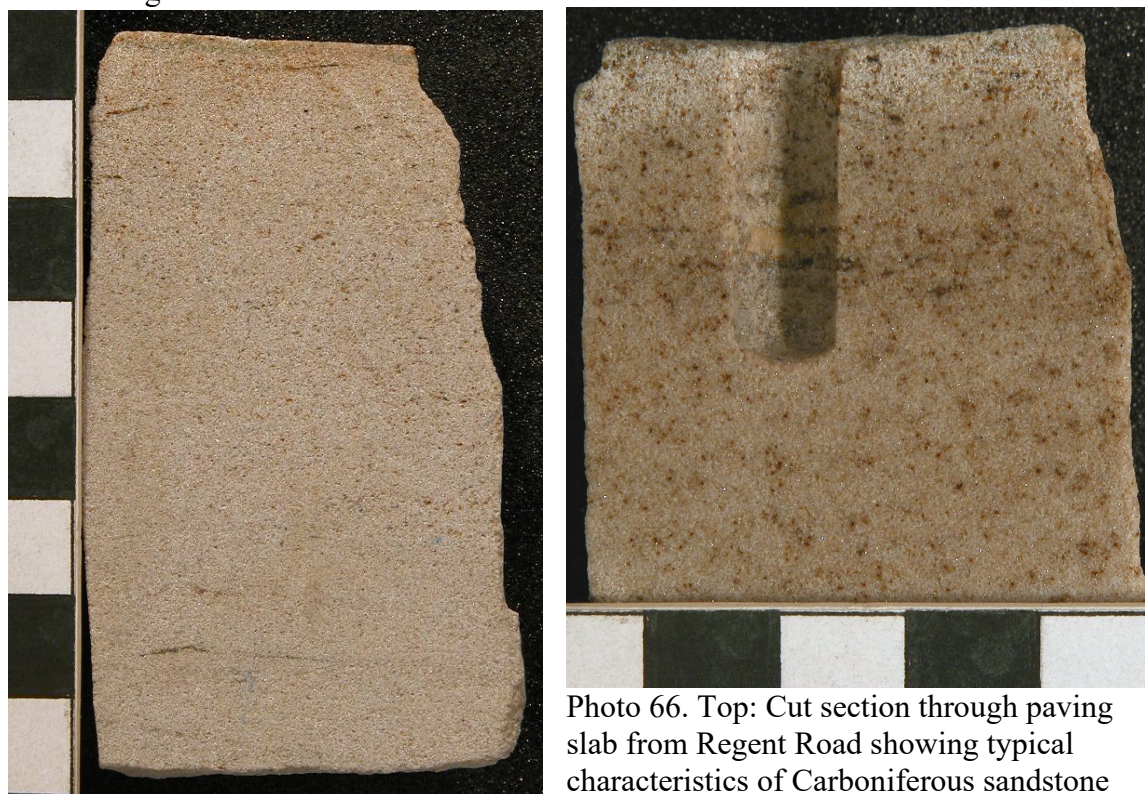


Photo 66. Top: Cut section through paving slab from Regent Road showing typical characteristics of Carboniferous sandstone

from the Scottish Central Belt with pale quartz-rich composition and medium grain size, with small iron oxide grains scattered throughout giving an orange-brown speckled appearance. Bedding is seen by faint dark laminae near base of sample. BGS sample ED10147. Bottom: Cut core from paving slab from Regent Terrace showing typical characteristics of Carboniferous sandstone from the Scottish Central Belt with strong orange-brown speckled appearance caused by iron oxide grains. Upper weathered part shows opaque white colour due to the alteration of clay minerals. BGS sample ED10146. Scale divisions are cm.

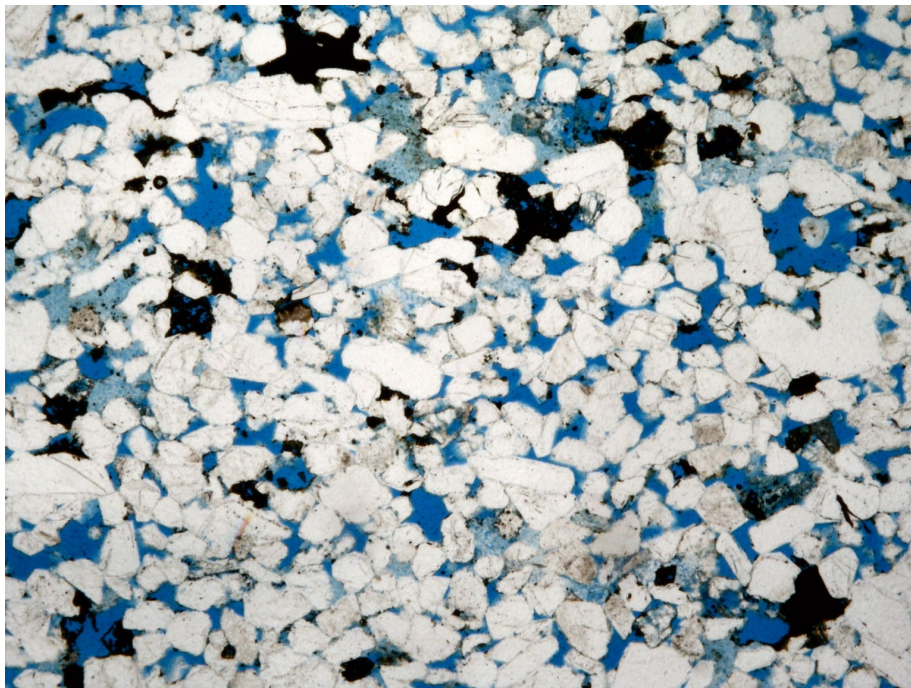
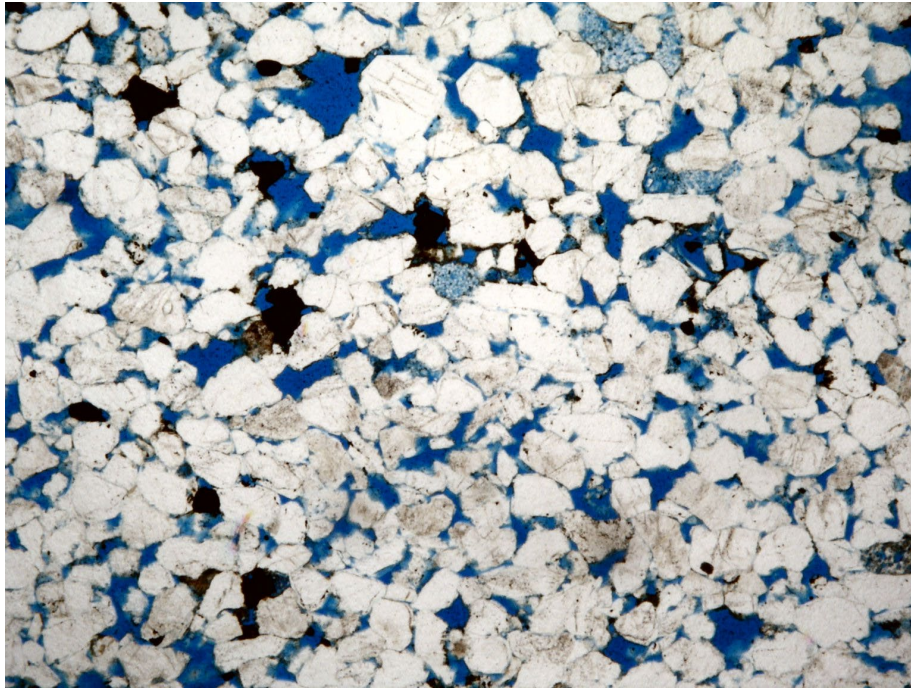


Photo 67. Microscopic thin section image of sample of pavement from Regent Terrace (Top image) and sandstone from Drumhead (Doghillock) quarry, near Denny (Bottom image), both showing almost identical medium to coarse grainsize, quartz-rich composition with high porosity and presence of dark iron oxide grains (black). Image c.3 mm across, plane polarised light; porosity highlighted by blue dye resin.

Angus type

Sandstone from Angus is distinct in character to the typical Carboniferous sandstones from Edinburgh and the Scottish Central Belt Hailes. It has a different geological age (Devonian) and formed under different geological conditions (deposited under mostly lacustrine i.e. lake sediments, as opposed to fluvial river sediments). These differences give the Angus sandstones a significantly different composition and texture, resulting in distinctive weathering characteristics when used as paving stone. In particular it has a fine grained uniform appearance, with a relatively dark colour and tight impervious texture.

Angus sandstone is typically fine to very fine grained, with a pale greenish-grey colour (Photo 68). It typically has a planar bedded texture consisting of parallel bedding laminae showing grainsize variation, with white mica concentrated along bedding surfaces. Ripple laminae are rarely present. Colour can vary, with red-brown varieties present depending on the iron oxide content. The stone is generally highly compact and microscopically is seen to consist of poorly sorted angular grains (contrasting with more rounded grains in Carboniferous sandstones) (Photo 69). These factors give it a very low porosity.



Photo 68. Samples of Angus sandstone paving from the Edinburgh New Town. Top and centre images are from General Register House (samples ED10194 & ED10189), showing a natural paving surface (top) and freshly broken surface (centre). Bottom image is from St Stephen's Place (sample ED10145) showing cut section through paving slab illustrating the bedded texture with faint parallel laminae. These samples are typical of 'Angus type' flagstone with a very fine grained compact texture, with grey green colour. Scale divisions are cm.



Photo 69. Microscopic thin section image of sample of pavement from Register House (Top image) and sandstone from Carmyllie quarry in Angus (Bottom image), both showing fine grained compact texture with little porosity, with a complex mineral composition seen by the abundance of dark and brown iron-bearing grains. Image c.3 mm across, plane polarised light; porosity highlighted by blue dye resin.

4.3 Discussion of results from the sample analysis

The samples collected from historical natural stone pavement in the Edinburgh New Town have been grouped, on geological grounds, into four distinct sandstone types, each reflecting the original quarry sources or areas of origin. The four types are Hailes, Craigleith, Central Scotland and Angus. Samples of Yorkshire sandstone and Caithness Flagstone were also identified, although these appear to be present as modern replacement paving, although some historic Caithness paving is observed (see discussion below).

In terms of historical paving stone, Hailes sandstone is by far the most common paving stone type present in the Edinburgh New Town, representing 80% of the sampled areas. Because of its high reputation, Craigleith sandstone may have been used for paving in special cases, for example as pavement around (the prestigious) General Register House. Stone from Angus appears to have been mostly used internally, for example as stairs, landings and internal flagstone.

It might be expected that the supply of paving stone types would have changed over time as transport systems improved, as has been found with sandstone for building (Hyslop & McMillan 2004). However there is no evidence to show that stone from further afield (e.g. from Angus and Caithness) became more common over time as the New Town developed (i.e. towards the end of the 19th century). This is likely to be due to the presence of Hailes quarry -a major 'industrial-scale' quarry specialising in high quality paving stone- so close to the Edinburgh market, which dominated the supply of paving throughout the major phases of development of the city. It is recorded that Hailes quarry was operating from the 17th century until the 1920's (McMillan et al 1999).

Analysis of the samples shows that the different sandstone types are quite distinct in terms of petrographic criteria such as colour, texture, porosity, mineral composition etc. These differences influence the way the stone types perform over time, in particular how they weather and wear when used as paving stone, giving each type a distinctive appearance. The characteristics of Hailes sandstone, in particular its bedded texture, gives it a very distinctive appearance compared to the other stone types.

4.4 Current supply of paving stone in the UK

All of the quarries in the Edinburgh area and Scottish Central Belt that historically supplied paving stone to Edinburgh are closed. The current paving stone industry in the United Kingdom is dominated by two areas, Yorkshire sandstone (or 'York Stone') and Caithness flagstone. In both these areas, a number of individual quarries produce stone of similar characteristics to that which has been traditionally marketed under these two generic names. Paving stones from Yorkshire and Caithness are distinctive, and different from each other. They are also significantly different from the four sandstone types used historically for paving in Edinburgh.

Caithness flagstone

Caithness flagstone is typically very fine grained with a dark grey colour. Technically it ranges from sandstone to siltstone with very fine grainsize down to mud grade. It has a very low porosity and a mineral composition unlike the Edinburgh and Central

Scotland sandstones traditionally used for paving in Edinburgh, giving it a quite different appearance (Photos 70 & 71). There is some evidence for the historical use of Caithness flagstone in the Edinburgh New Town e.g. small areas around New Register House and in North St David's Street, but its extent appears limited.

In recent decades, Caithness flagstone has been used for external pavement extensively in the Old Town of Edinburgh and in various pedestrian schemes in the New Town such as Castle Street and Elder Street (Photo 72). It is currently used ubiquitously for streetscape improvement schemes in towns and cities throughout the UK. Whilst Caithness flagstone is without doubt a very high quality paving material, it has geological characteristics that are markedly different from the historic paving stone types used in the Edinburgh New Town, resulting in a very different appearance and weathering characteristics.



Photo 70. Sample of Caithness flagstone from Spittal quarry near Halkirk, showing typical dark colour and fine grained texture, giving characteristic distinctive appearance. Natural riven surface.

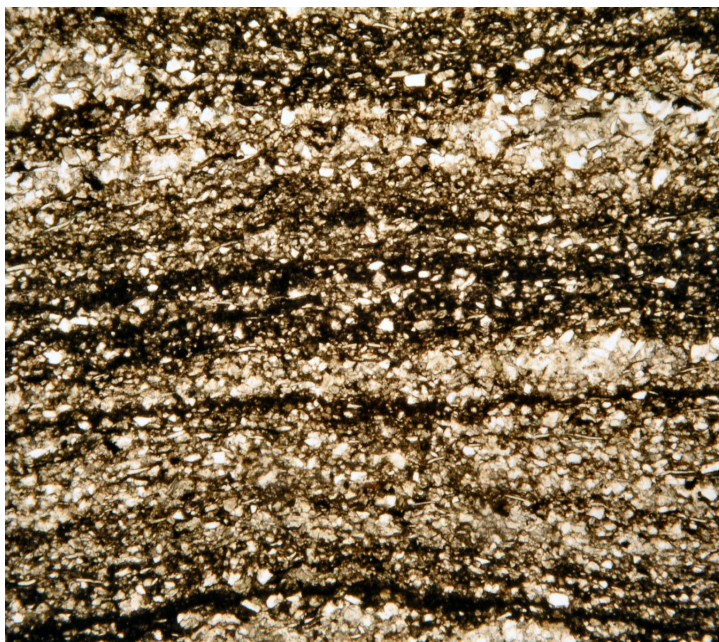


Photo 71. Microscopic thin section image of Caithness flagstone showing typical very fine grainsize, thinly bedded texture and lack of porosity. The dark material is mostly organic and iron-rich constituents. The petrographic characteristics contrast strongly with those of the historic paving types used in Edinburgh, resulting in Caithness flagstone having a very different appearance. Image c.3 mm across, plane polarised light; porosity highlighted by blue dye resin.

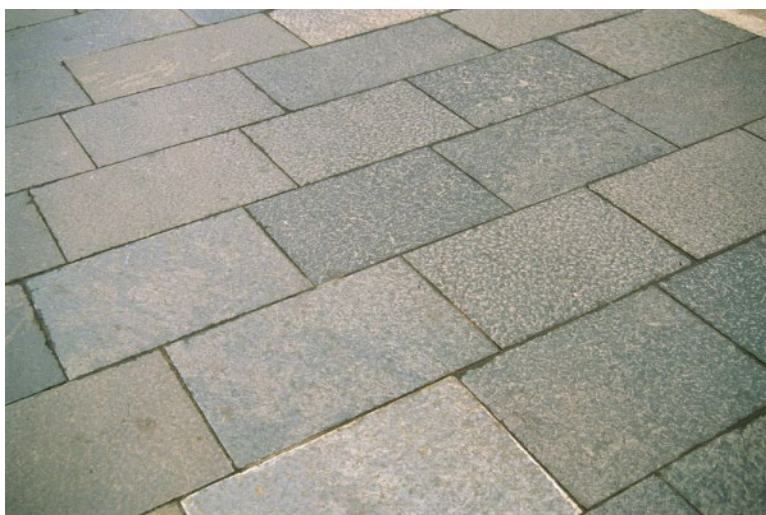


Photo 72. 'Modern' Caithness flagstone pavement, showing characteristic dark grey appearance, contrasting with the pale and orange-buff coloured historic Edinburgh sandstone pavement. Elder Street, Edinburgh.

Yorkshire sandstone

Like Caithness flagstone, Yorkshire sandstone is currently widely used for paving throughout the UK. It comes from a number of individual quarries, each producing stone of slightly different characteristics, but with an overall distinctive typical appearance. Although Yorkshire sandstone has a similar geological age and mode of formation to the sandstones of Edinburgh and the Scottish Central Belt, it has different compositional and textural characteristics. It typically contains a higher proportion of iron oxide producing a characteristic buff-brown-yellow colour (Photos 73 & 74), and it has a more variable composition (less quartz-rich with generally significantly higher clay mineral content). Compared to many Scottish Carboniferous sandstones, it is more compact with a lower porosity (Photo 75). In terms of appearance and weathering characteristics Yorkshire flagstone typically has a strong buff colour and uniform texture, commonly showing no bedding resulting in a uniform appearance.

These differences give Yorkshire flagstone a distinct appearance from the Edinburgh and Central Scotland sandstones, particularly in terms of its yellow-buff colour and uniform texture, contrasting with the variable red-brown patina and ripple-bedded appearance of the more local Edinburgh sandstones (Photo 76).

A few varieties of Yorkshire sandstone have certain characteristics that are more similar to sandstones from Edinburgh and the Scottish Central Belt and Angus flagstones. If carefully selected using petrographic criteria it can be possible to identify certain varieties of York sandstone which 'match' reasonably closely to historic flagstones used in Edinburgh. For example, some varieties of Woodkirk stone are a uniform, fine to medium grained, greenish-grey sandstone which can be similar to Angus flagstone. Scoutmoor sandstone commonly has a ripple-bedded texture with a variable colour from grey to orange-brown (due to variable oxidation of iron oxide grains) giving it a similar appearance to some Hailes type sandstones.

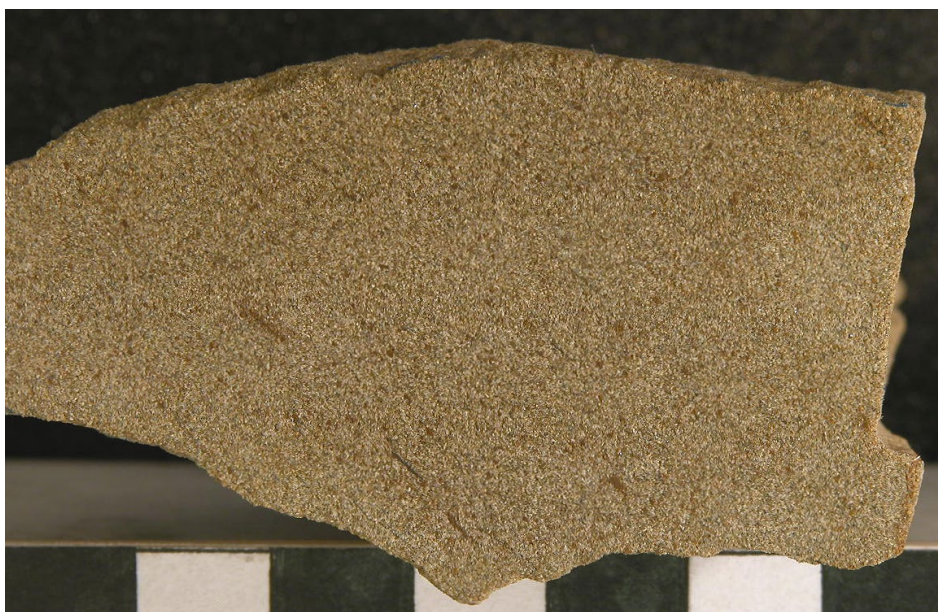


Photo 73. Cut section through 'modern' replacement Yorkshire Sandstone paving slab from Register House, showing typical medium grainsize and uniform texture, containing variable mineral composition with relatively common iron oxide grains giving a strongly speckled ('grainy') appearance and overall buff colour. BGS sample ED10188. Scale divisions are cm.



Photo 74. Sample of Crossland Hill York Stone, typical of many Yorkshire sandstones currently used for paving, showing typical buff colour and uniform appearance.

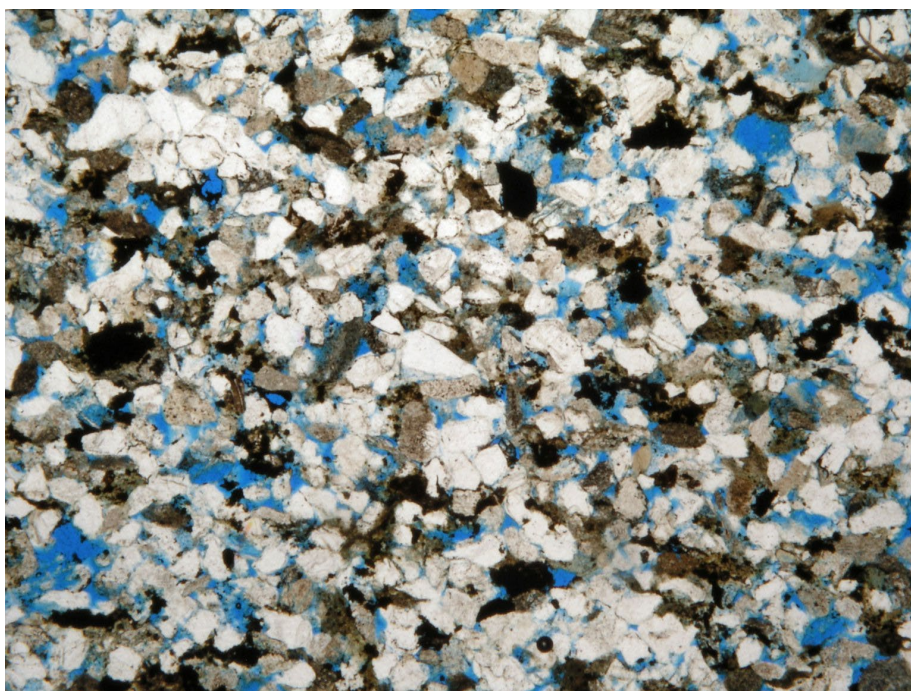


Photo 75. Microscopic thin section image of sample of pavement from Register House (Top image) and sandstone from Woodkirk quarry, near Leeds (Bottom image), both showing uniform fine to medium grainsize with moderate porosity and abundant brown iron-bearing minerals. Image c.3 mm across, plane polarised light; porosity highlighted by blue dye resin.

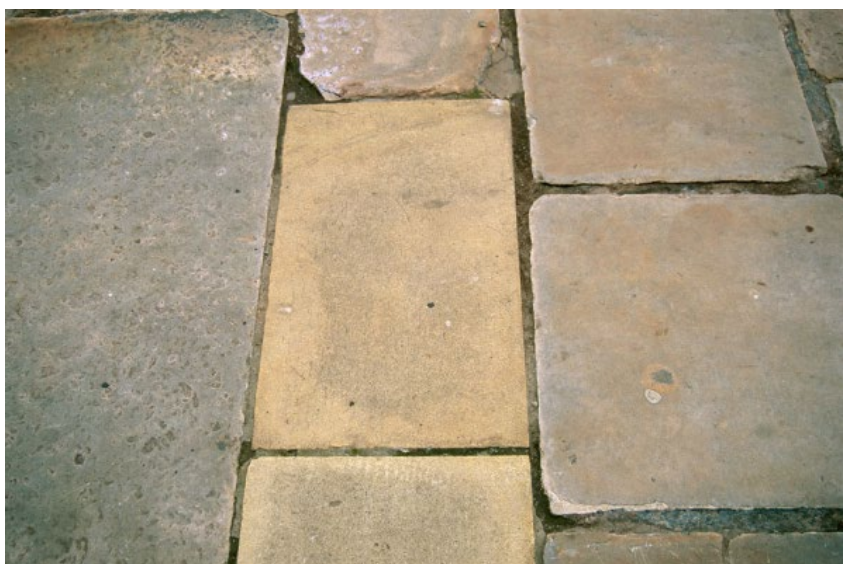


Photo 76. Small area of modern replacement paving in Charlotte Square, with two slabs of Yorkshire sandstone (centre of image) showing typical uniform strong yellow-buff appearance, contrasting with the original 'Hailes type' sandstone showing a more variable appearance ranging from grey to orange-brown colour.



Photo 77. Use of replacement Yorkshire sandstone as replacement steps adjacent to original 'Hailes type' sandstone paving. The typical uniform yellow-buff colour of the York stone contrast with the more variable and stronger coloured original paving slabs.

4.5 Future supply of matching stone for historic paving in the Edinburgh New Town.

The results of this study show that the external paving in the Edinburgh New Town was dominated by sandstone from Hailes quarry (or nearby quarries exploiting the same sandstone formation). The geological make-up of Hailes sandstone is such that it has a distinctive appearance, and it is quite different from most of the currently-available sandstone paving quarried in the UK today. All the original sandstone quarries in the Edinburgh area are closed. In order to obtain similar stone for repairs to historic pavement, and for new natural stone paving which resembles the historic pavement, either an substitute ‘matching’ stone type is required, or a new quarry needs to open (or reopen) in Hailes or similar sandstone.

Alternative (substitute) paving types resembling Hailes sandstone

Because of the highly distinctive nature of the Hailes sandstone it is very difficult to identify currently available sandstone types that could be considered as matching stone. Scout Moor sandstone, currently being produced in Lancashire, has some features that bear a resemblance to Hailes sandstone (Photo 78). It has a variable colour, from grey to orange-brown, typically varying within a single block. Secondly it typically has fine dark bedding laminae which produce a ‘contour effect’ on the upper surfaces (Photo 79). These features give Scout Moor sandstone a variability of appearance that resembles some features of Hailes sandstone, more than most other currently available paving stone types. It should be noted that the character of stone from a quarry can vary over time, and the above comments refer to current samples of Scout Moor. It is possible that other quarries may produce sandstone of similar characteristics.

Scoutmoor sandstone has been used recently for pavement in a number of localities in Edinburgh (e.g. Waverly Bridge and Cheyne Street). Despite the similarities, these areas still have a ‘modern’ appearance and appear different from historic paving, largely because of uniform slab size, or a limited number of slab sizes and course widths, plus uniform straight swan edges. Some Scoutmoor stone has a relatively uniform colour and texture compared to historic sandstones, and in order to replicate historical paving it is important to specify variability, both in terms of slab size and laying pattern as well as colour and texture. In general terms the regularity of modern paving, both in terms of slab size and appearance of the stone makes it unlikely to match well with the historical pavements.



Photo 78. Sample of Scout Moor sandstone showing sawn top surface with variable colour from grey to orange-brown, and ‘contour-effect’ texture caused by the presence of fine ripple bedding laminae. These characteristics are similar to those of Hailes type sandstone. Scale divisions are centimetres.



Photo 79. Modern natural stone pavement on Waverly Bridge, Edinburgh, typical of sandstone from Scout Moor quarry. This stone type has some similar characteristics to historic sandstone paving used in Edinburgh, in particular a variable colour from pale grey to orange-brown and the presence of bedding planes on the surface. The variability of slab sizes and course widths also helps to give this pavement a similar character to historic footpaths.

The potential for opening or reopening a quarry in Hailes or similar sandstone

The Hailes sandstone was produced mostly from Hailes and Redhall quarries on the southwest side of Edinburgh. Both these quarries are now infilled and close to or part of residential areas of the city. It is highly unlikely that any significant extraction of stone would be possible from either of these sites. Geologically, the Hailes sandstone is one of a number of sandstone units present within the West Lothian Oil Shale Formation. It occurs in two main outcrops (British Geological Survey 2003); a restricted area in southwest Edinburgh where it was worked at quarries at Hailes, Redhall and Baberton, and in a broad north-south belt stretching from Gyle to

Cramond (formerly worked at Craigiemill near Cramond Brig). Hailes sandstone was known to vary in character from quarry to quarry (McMillan et al. 1999).

Because of the proximity to Edinburgh it may not be possible to open a quarry in Hailes sandstone, although some of the outcrop occurs in rural areas along the western edge of the city. No modern resource assessment has been undertaken of the potential for obtaining future supplies of Hailes sandstone from these deposits. Alternatively, stone of similar characteristics may be present in several geologically similar sandstone units within Scottish Central Belt. The 'Central Scotland type' sandstone identified in this study and used as paving in Edinburgh has many characteristics similar to Hailes sandstone, and is likely to be present in a number of locations remote from built-up areas. With further investigation it may be possible to identify a number of former quarry sites which have similar stone and the potential to be reopened (e.g. Drumhead quarry, Denny; Photo 80). Alternatively a geological resource assessment exercise might identify new sites where quarries could be opened in similar sandstone. No such assessment of potential stone resources has been undertaken in modern times.



Photo 80. The former working face of Drumhead (Doghillock) quarry near Denny, typical of many of the now disused sandstone quarries which produced sandstone in Central Scotland. This quarry reputedly supplied paving stone to Stirling, and it is documented that paving sandstone from the Denny area was imported into Edinburgh by canal from the 1820s.

George Street Paving Test Panels

In early 2003 two ‘sample paving panels’ were laid on George Street in order to monitor the performance of a variety of currently available natural stone paving. The test areas are at Browns Restaurant on the north side (west end George Street), and the Standing Order public house on the south side (east end George Street). At both areas four types of stone were laid; three Yorkshire sandstones, Crossland Hill, Shire Hill and Scout Moor/Appleton, and Caithness Flagstone. Several courses of each stone type were laid. Additionally, at the Standing Order test panel some Angus Flagstone from the Carmyllie quarries was laid, following lobbying by the Scottish Stone Liaison Group.

Although not formally included in this project some general visual observations have been made of the test panels. At the time of this study all of the stone types appear to be performing well, no evidence of failure or damage to slabs. The Caithness Flagstone has a much darker appearance than the other stone types and is visually distinct compared to the others and to historic stone paving in the Edinburgh New Town. Both the Crossland Hill and Shirehill slabs have the typical appearance of Yorkshire sandstone, as described earlier i.e. strong buff colour with uniform texture and appearance (e.g. Photo 74). Only the Scout Moor/Appleton sandstone has a variable colour (mostly grey with variable orange-brown markings) and variable texture (ripple bedding giving a variable surface appearance) resembling historic sandstone paving. The Carmyllie flagstone has a variable colour from grey to dark purple, with a uniform fine grained texture.

It is understood that there are key requirements other than historical authenticity which are important for the selection of paving stone, e.g. strength characteristics, low moisture absorption/porosity, slip resistance, salt and frost resistance, requirement for cleaning, ease of removal of chewing gum etc. In comparison with historic sandstone paving the only one of the stone types in the test panel to have similar appearance (and future weathering characteristics) is the Scout Moor/Appleton stone. The Carmyllie stone used in the test panel is distinct to most historic external paving, and confirms the findings of this study, that Angus/Carmyllie stone was probably used largely for internal paving in the Edinburgh new Town.

4.6 Recommendations

In order to obtain supplies of paving sandstone similar in character to that used historically in the Edinburgh New Town it is considered necessary to pursue the two options outlined above:

- (i) To identify which currently operating quarries in the UK produce sandstones of similar characteristics to Hailes sandstone. Quarries such as Scout Moor quarry in Lancashire may be able to supply such alternative sandstones, although the consistency of product and continuity of supply would need to be determined.
- (ii) Undertake a geological assessment of sandstone resources in the Scottish Central Belt to identify former quarry sites or previously unexploited resources that have the potential to supply sandstone paving to Edinburgh. Such stone would have similar characteristics to the original historical sandstone paving used in the Edinburgh New Town, and a renewed source would ensure a long term local supply of historically authentic stone.

It is recommended that Scottish Stone Liaison Group is engaged to take forward these tasks, in order to involve the stone industry at an early stage in the process. It is also likely that a renewed source of sandstone paving stone would have a wider market than just Edinburgh, and other urban areas in Central Scotland e.g. Stirling, Falkirk etc. would also provide a demand for such traditional paving stone.

5. SUMMARY OF FINDINGS AND DISCUSSION

5.1 Summary of background issues

This project provides a documentation and analysis of the few remaining areas of original sandstone paving and related stone features on public footpaths in the New Town of Edinburgh. The objective of the study is to record the nature of the historic pavement in terms of both paving patterns (i.e. slab sizes and arrangement) and the types of sandstones used. The information on paving patterns is intended to provide data to assist the future specification of replacement natural stone pavement taking into consideration the character of historic footpaths in the city. The information relating to sandstone types is intended to ensure that future natural stone paving uses materials that accurately represent the original stone types used historically in the Edinburgh New Town.

Sandstone pavement is an important component of the historic fabric of the New Town of Edinburgh. Not only does stone contribute to the character of the buildings themselves, but it also adds to the overall historic built environment through its presence in streetscape materials, including roadways, footpaths and boundary walls. Edinburgh is predominantly a city of sandstone, directly reflecting the local geology in particular large deposits of Carboniferous quartz sandstones. Much of the sandstone used in the city was quarried locally, providing stone for building and paving. Whinstone was also extensively quarried from igneous rock outcrops in and around the city to provide durable stone, mostly used for road surfaces.

There is documentary evidence showing that stone was used for pavements and roadways at an early stage as part of the planned urban development in the Edinburgh New Town. The use of sandstone paving should therefore be seen as an integral part of the historic built environment in Edinburgh, and the retention and reinstatement of former sandstone pavements will help to complete the historical picture.

Virtually all of the original sandstone paving in the Edinburgh New Town was removed and replaced, predominantly with concrete slab, during the second half of the 20th century. It is estimated from the current research that less than 1% of the original stone pavement from public footpaths survives today. Most of these are small vestiges of original pavement have been fortuitously preserved as overlooked remnants in back lanes and cul de sacs that were never repaved. Additionally, some original paving has also been preserved in a small number of 'high status' localities, for example parts of Charlotte Square, Ann Street and the surroundings to General Register House.

5.2 Paving Patterns

Historic sandstone pavement was identified in eighteen sites from around the Edinburgh New Town. These vary from small, often-damaged remnants in back lanes to large areas of formal and near-complete sandstone pavement. Some of the localities show evidence of redressing of sandstone slabs (i.e. lifted, re-cut and re-laid) so that the original sizes and paving patterns are not preserved. Sandstone is also used for a number of additional related features such as kerb stones, mounting blocks, channelled gutter stones, lighting plinths and spur stones. Four sites where horonizing pavement (comprising split whinstone setts) is present have also been described.

A total of eighteen representative sections of paving were selected from thirteen of the sites in order to represent the original paving patterns (slab size etc.) in a range of situations. These were recorded as a series of measured sections, and drawn up to illustrate the paving patterns. The sandstone type at each locality was characterised using a pro forma description of the main geological criteria.

The eighteen locations where measured drawings were made can be divided into seven 'lanes' and six 'street' pavements. The lanes are Carlton Terrace, Wemyss Place (two sections), Gloucester Lane, Young Street (four sections), Thistle Street, Atholl Crescent and Lynedoch Place. The street pavements are Ann Street (two sections), Charlotte Square, Glenfinlas Street (east side), Regent Road, Regent Terrace and St Stephen Place.

The street pavement has slabs arranged in courses, with their long axes aligned perpendicular to the road direction. In all but one site (Ann Street) each course is made up of a single slab width, which varies between courses. The lanes show more variability, with three main paving styles: a single course of slabs with long axes aligned parallel to the roadway (with or without kerbstones); a single course of slabs with long axes aligned perpendicular to the roadway; and one lane has two courses of relatively square slabs laid in an off-set pattern. The various slab arrangements are shown as a series of measured drawings.

5.3 Paving Materials: the sandstone types used

A set of forty sandstone samples was collected from already damaged pavement and kerb at nineteen localities. The samples can be divided into five distinct types of sandstone, based on detailed geological examination. Of these, four are original historic paving stone and one is 'modern' replacement paving stone. The four types of historical sandstone identified are 'Hailes', 'Craigleith', 'Central Scotland' and 'Angus' types. The replacement paving stone is Yorkshire sandstone.

By far the most common type of sandstone paving is Hailes type, found at 84% of the sampled localities. Hailes sandstone was obtained from a series of local quarries on the western side of Edinburgh, with the principal quarry operating from the early 17th century until c.1920. Historical records indicate that Hailes stone was highly regarded as a material for paving (as well as for building purposes), and the combination of quality and proximity to the market ensured that Hailes was the dominant stone used for paving in the city. Craigleith sandstone from the local Craigleith quarry in Edinburgh, although mostly used for building, also provided some paving stone, and may have been favoured for paving and surrounds to prestigious public buildings such as Register House. Central Scotland type sandstone was used for paving in Edinburgh from the 1820s when canal transport became possible. It was probably sourced from numerous quarries to the west of the city as far as Lanarkshire and Stirlingshire. Paving stone from Angus (also known as Arbroath, Dundee or Carmyllie flagstone) was also used in Edinburgh, but appears mostly to have been for indoor use such as internal paving to entranceways, steps, landings etc.

Hailes, Craigleith and Central Scotland type sandstones are all geologically of Carboniferous age and formed in a similar geological environment, giving them broadly similar characteristics and properties. Sandstone from Angus is Devonian in age with a different geological origin, providing a distinct appearance and character.

Hailes stone is particularly distinctive, containing abundant thin variable bedding laminae (ripple cross bedding) defined by accumulations of dark iron oxide, carbonaceous debris and mica. These impart a ripple bedded texture, giving a 'contour' effect and variable reddish-orange colouration where iron oxide concentrations are present on worn surfaces. The bedded nature also gives the surfaces a natural non-slip property. Craigleith sandstone can be bedded, but tends to be more uniform and paler in colour. Sandstone paving from Central Scotland shares some characteristics with Hailes sandstone, with some varieties containing bedding planes and concentrations of darker minerals, giving a variable appearance.

5.4 Current and future supply of paving stone

All of the quarries that supplied the four types of historic sandstone paving to Edinburgh New Town are closed. The current supply of natural sandstone paving in the UK is dominated by Yorkshire sandstone and Caithness Flagstone. In general, neither type has similar characteristics to the historic paving types. Caithness Flagstone and Yorkshire sandstone are the most commonly used 'modern' replacement sandstone types in Edinburgh today. They have been used in areas of historic paving to replace missing slabs, and on a larger scale (mostly in parts of the Edinburgh Old Town) for areas of new natural stone paving. Caithness Flagstone is geologically quite distinct from the four types of historic paving identified from the New Town, and consequently quite different in appearance and weathering characteristics. Yorkshire sandstone, although having a similar geological age and mode of origin as the historical sandstone types, has a different mineral composition and a much more uniform texture, resulting in a different appearance commonly with a strong yellow-buff colour. There are however a number of sandstone quarries in the north of England which do have some similarity in terms of variability of texture and colour to Hailes and Central Scotland sandstones. In addition, 'Yorkshire sandstone' is a generic term used for a number of quarries and sandstone varieties, and it is possible that some currently produced sandstones have characteristics which are more similar to the historic Edinburgh sandstone paving stones.

In order to ensure the future supply of sandstone paving which has similar characteristics to historic material in Edinburgh, two approaches are suggested. Firstly, in the short term it may be possible to identify specific varieties of Yorkshire (or northern England) sandstone that have reasonably similar geological characteristics to the historic material. This would provide an alternative substitute stone type for 'immediate' use. The best way of ensuring future supplies of suitable stone consistently for the longer term would be to re-establish supplies of 'local' stone from the Edinburgh and Central Scotland areas by reopening former quarries or opening new quarries in similar geological strata. It is recommended that a resource assessment is undertaken in the Scottish Central Belt in order to document the historic paving stone quarries and their potential for reopening, as well as an assessment of the presence of similar adjacent geological strata with potential to supply stone similar to the historical paving types. In the case of Hailes sandstone, the particular sandstone unit is known to outcrop as a narrow strip on the western outskirts of Edinburgh, and whilst most of the former quarry sites are now adjacent to urban development, there may be some areas where quarrying would be possible.

5.5 Skills and related issues

This study does not consider the skills required for the extraction, processing and laying of natural stone paving. There is currently a general shortage of a skilled workforce for stone masonry, and it may be that specialist training is necessary if new sandstone pavement is to be produced using historic patterns and materials (for example the laying of slabs or variable size contrasts with the uniformity of modern pavements). The particular example of horonized whinstone pavement (section 3.2) is a case where specialist skills are unlikely to be available today. In addition, the use of a correct substrate (for example the use of traditional materials such as lime rather than cement) may be crucial, as seen by the poor quality of existing repairs (e.g. Photo 58). It may be necessary for a specialist investigation of the foundations of historic pavements in order to understand these aspects and to define a specification for the laying of historic paving. Organisations such as the Scottish Stone Liaison Group and the National Heritage Training Group have a skills remit, and are currently active in enhancing the stone masonry workforce.

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REFERENCES

- Alvares, I.K.A. 2005. Causeways of Edinburgh –A case study of the development of streets and paving in the Old Town and James Craig’s New Town in the Seventeenth and Eighteenth Century. Unpublished MSc dissertation, Edinburgh College of Art.
- British Geological Survey 2003. Edinburgh, Scotland Sheet 32. Bedrock. 1:50,000. (Keyworth, Nottingham: British Geological Survey).
- Craig, G. 1893. Building stones used in Edinburgh: their geological sources, relative durability and other characteristics. Transactions of the Edinburgh Geological Society, 6, 266-68.
- Edinburgh City Council. 2006. The Edinburgh Standards for Streets.
www.edinburgh.gov.uk/CEC/CityDevelopment/PlanningandStrategy/EdinburghStandardsforStreets
- Haynes, N. 2006. A scoping study for historical research of paving materials in the First New Town of Edinburgh. Unpublished report prepared for Edinburgh World Heritage and the City of Edinburgh Council, November 2006.
- Hutton, G. 2002. Scotland’s Millennium Canals. Stenlake Publishing.
- Hyslop, E.K. & McMillan, A.A. 2004. Replacement sandstone in the Edinburgh World Heritage Site: problems of source and supply. 10th International Congress on Deterioration and Conservation of Stone. ICOMOS Stockholm. 777-784.
- Leary, E. 1986. The building sandstones of the British Isles. Building Research Establishment Report. Garston, UK.
- McMillan, A.A., Gillanders, R.J. & Fairhurst, J.A. 1999. Building Stones of Edinburgh. Edinburgh Geological Society.
- Smith, G. 1835. Account of the quarries of sandstone in the Edinburgh and Glasgow districts and the principal slate quarries in Scotland. Prize Essays and Transactions of the Highland and Agricultural Society of Scotland (New Series), 4, 81-97.
- Youngson, A.J. 1993. The making of classical Edinburgh. Edinburgh University Press.

APPENDIX 1

LOCATION MAPS OF AREAS OF HISTORIC STONE PAVEMENT IN THE EDINBURGH NEW TOWN

Locations of areas of historic sandstone pavement, whinstone horonizing and specific individual sandstone features (e.g. mounting blocks, spur stones) surveyed in this study are shown on the following maps.

Colours used to identify different elements are:

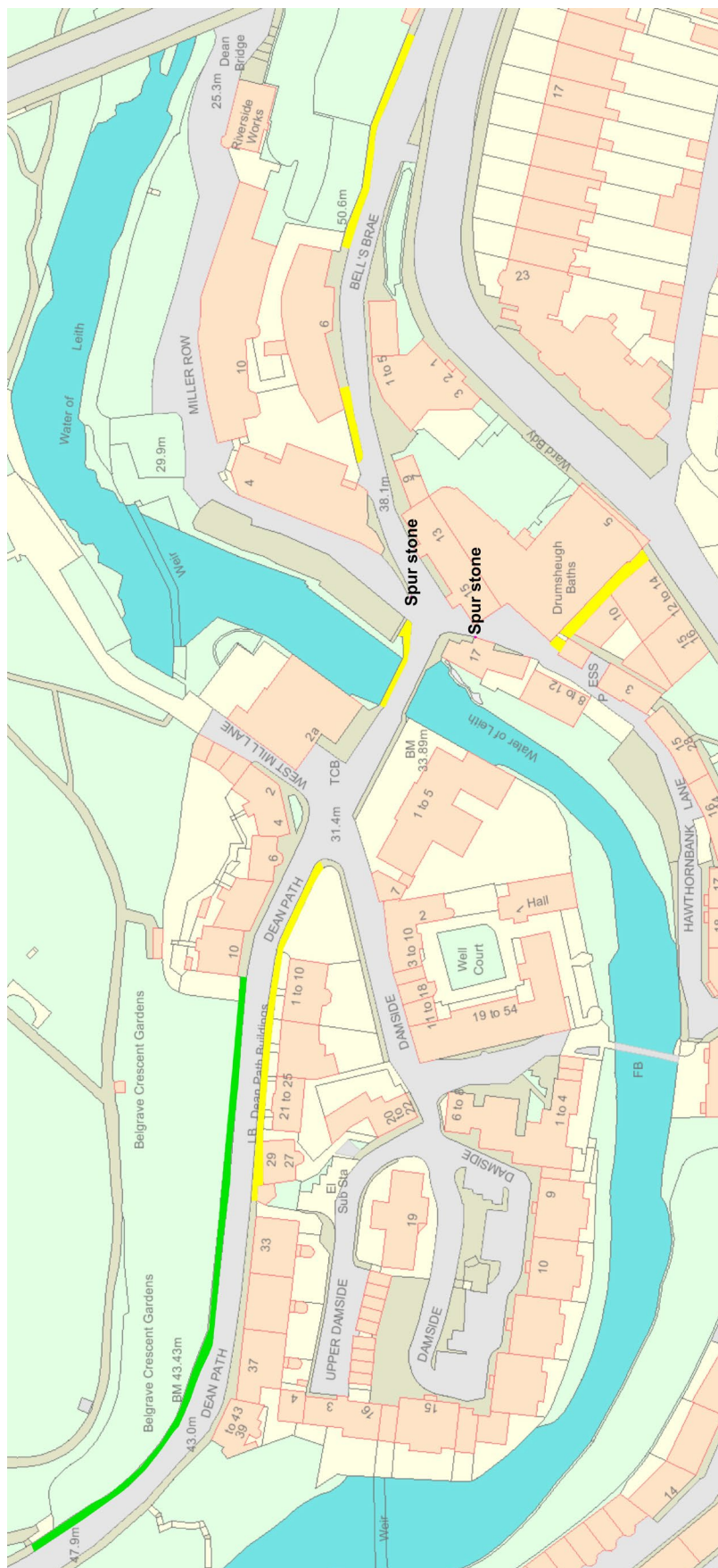
Yellow = sandstone pavement

Green = whinstone horonizing

Red = spur stones, isolated blocks (including mounting blocks), sandstone kerbs.



Map 1. Ann Street area



Map 2. Bell's Brae & Dean Bridge area



Map 3. Lynedoch Place Lane



Map 4. Atholl Crescent & Coates Crescent area, including Atholl Crescent Lane

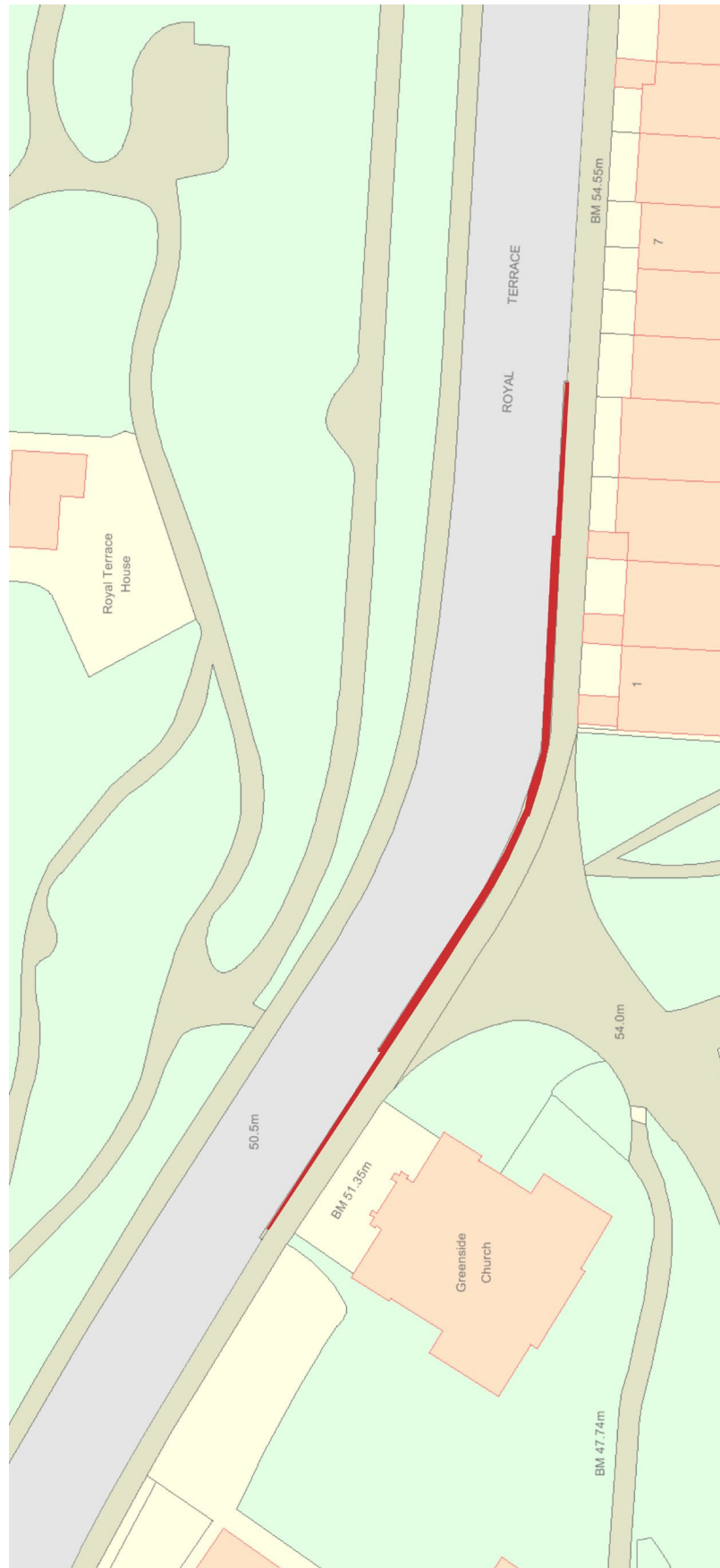


Map 5. Thistle Street Lanes



Map 6. Thistle Street Lanes

Map 7. Hill Street Lanes and Young Street Lanes



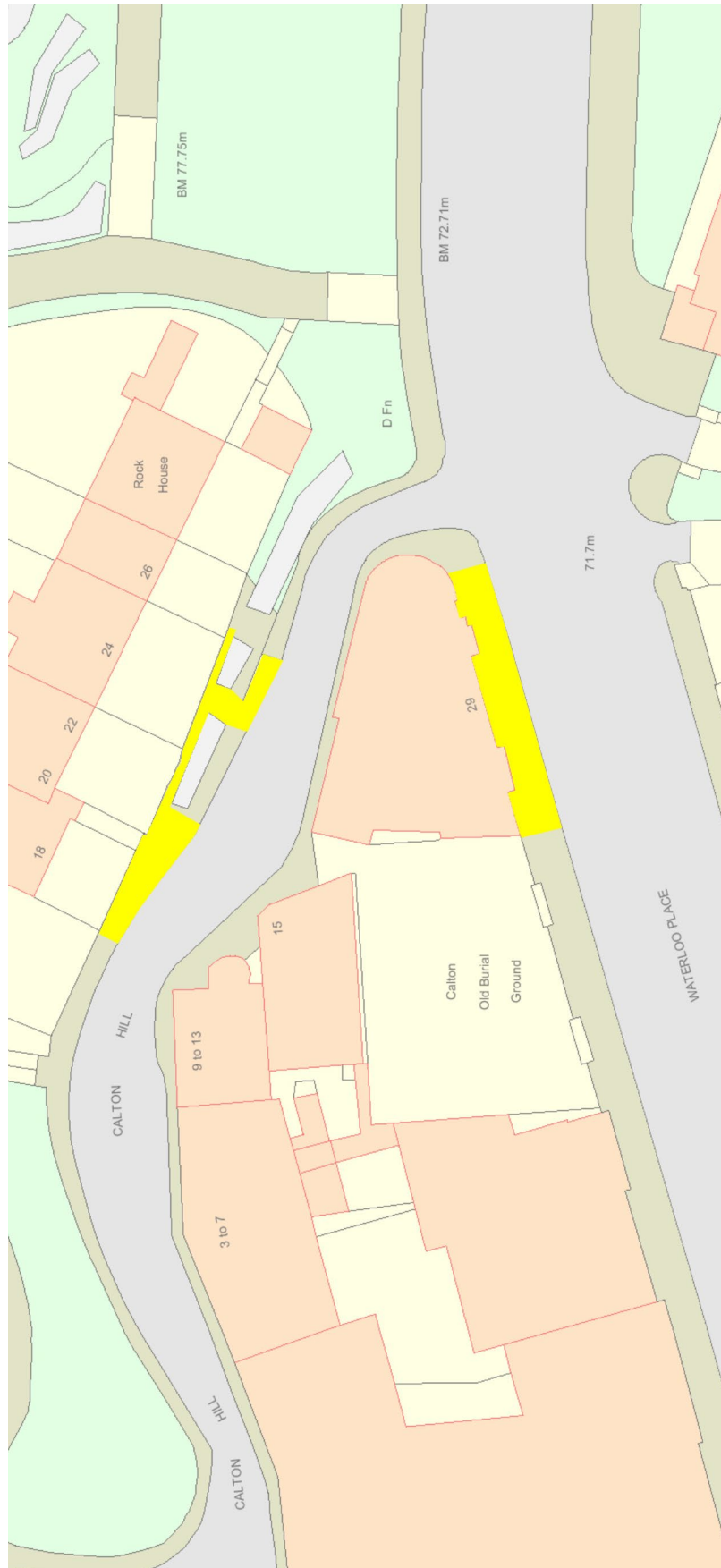
Map 8. Royal Terrace



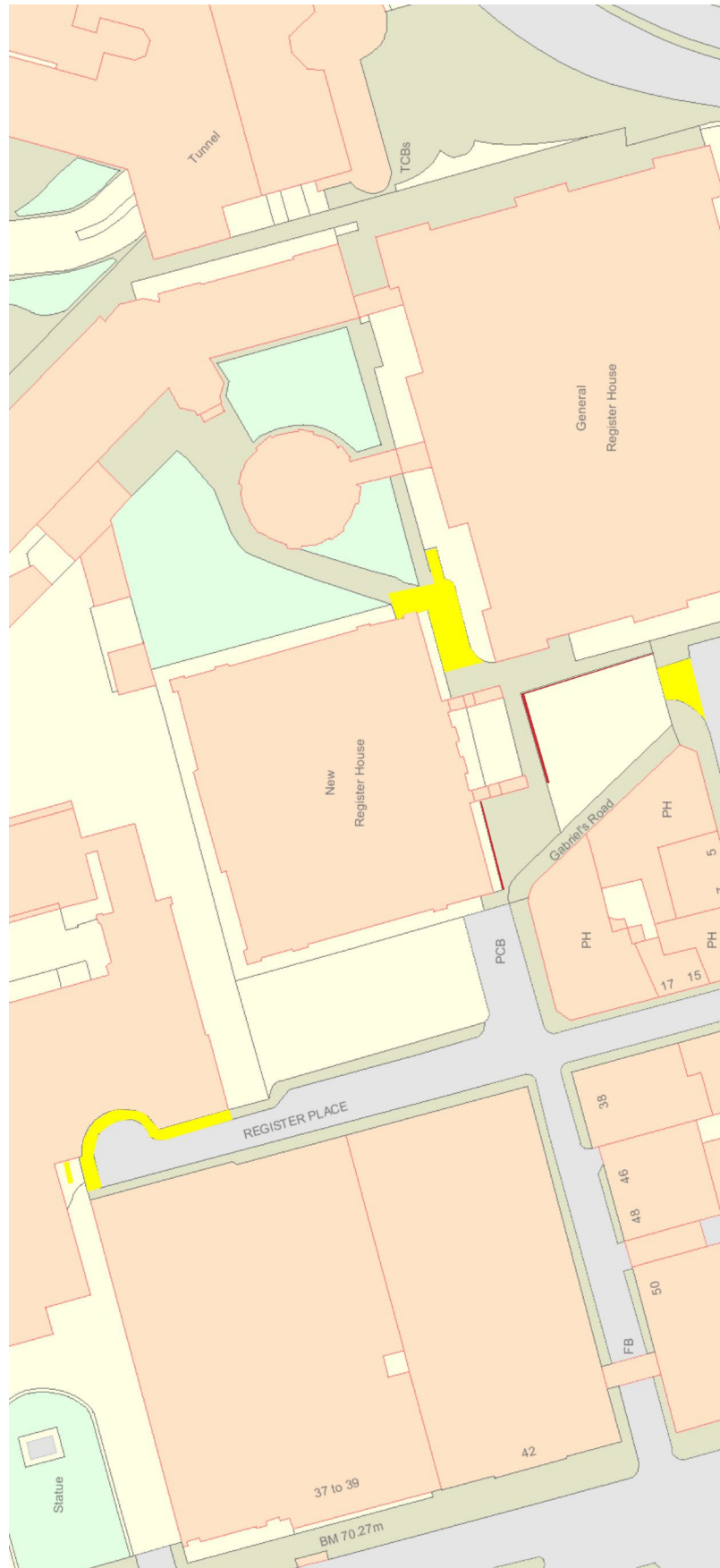
Map 9. Carlton Terrace area



Map 10. Regent Terrace and Regent Road



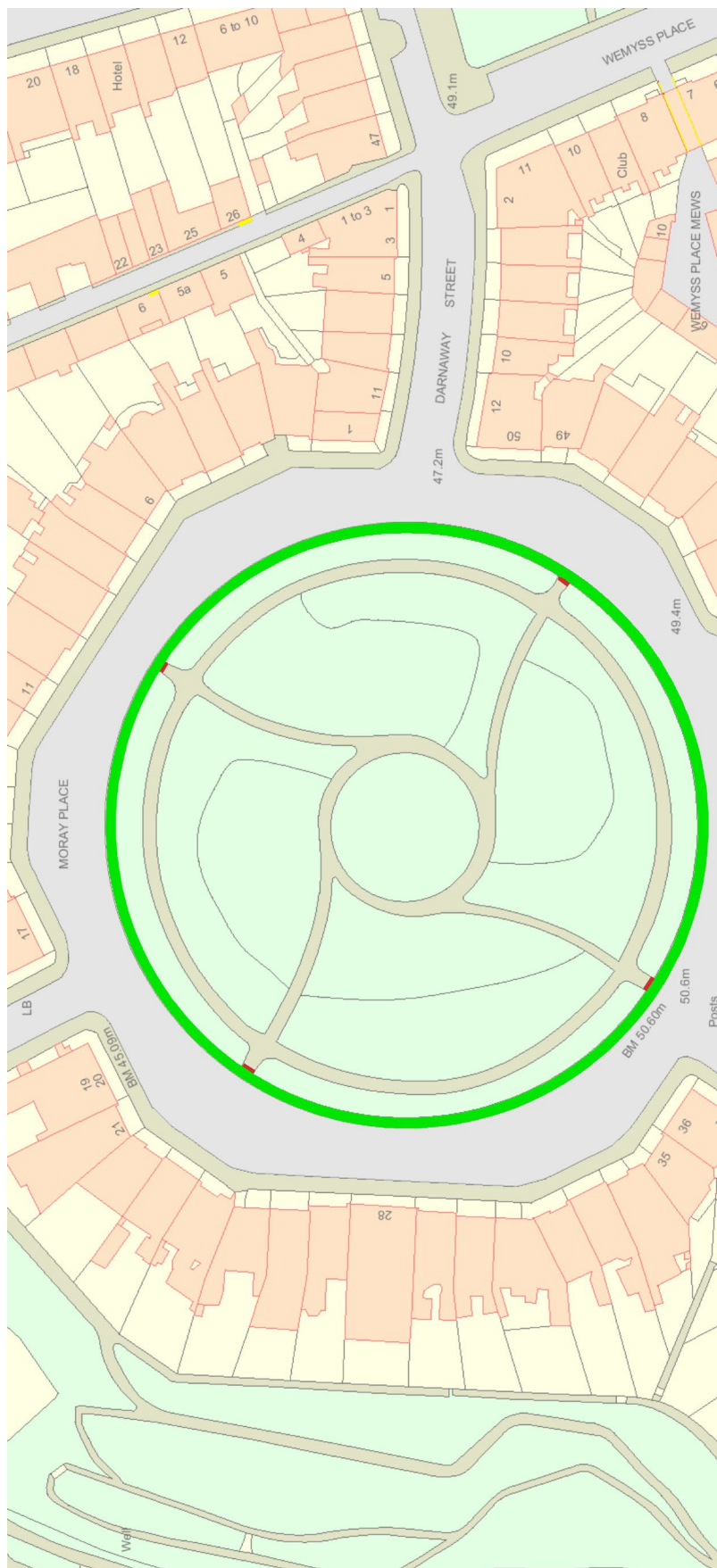
Map 11. Waterloo Place and Carlton Hill area



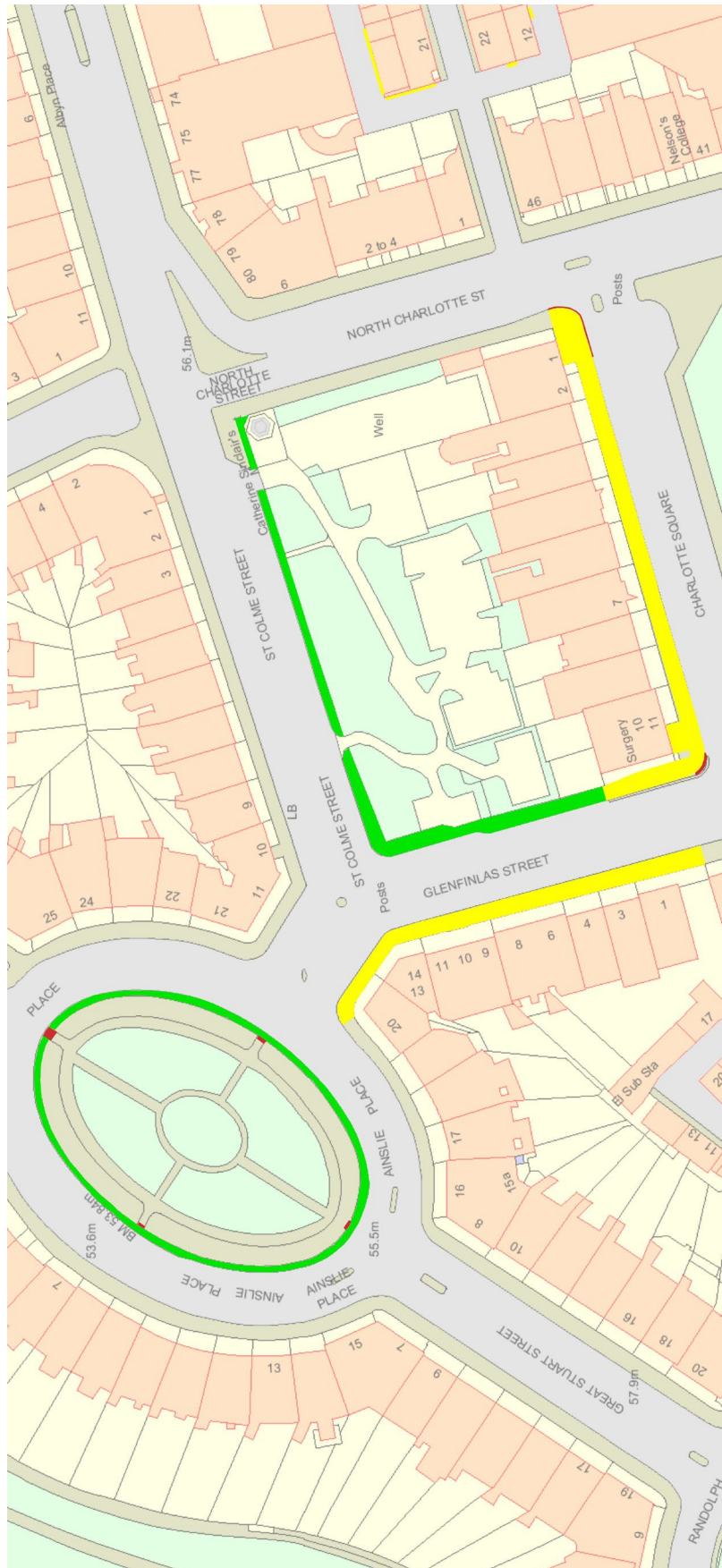
Map 12. Register House



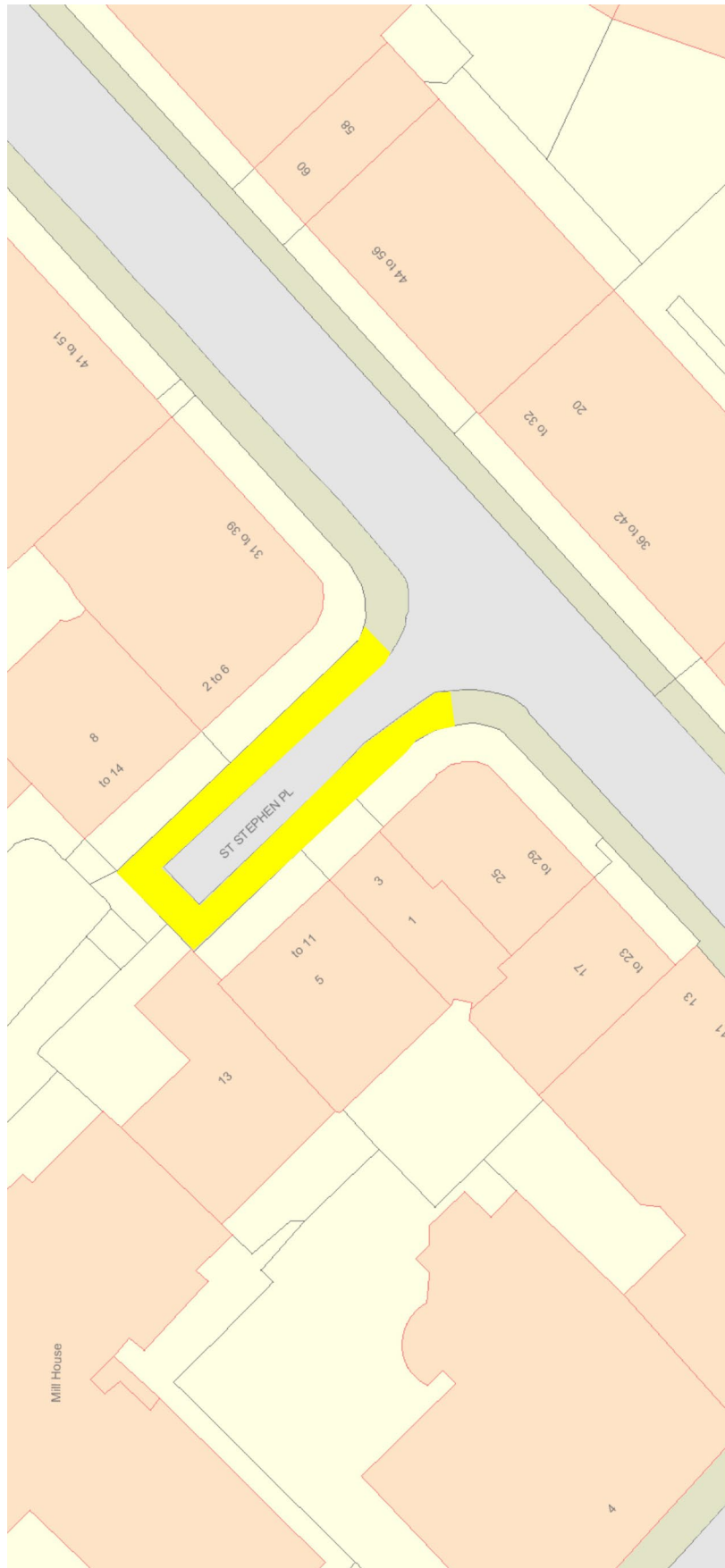
Map 13. Gloucester Lane



Map 14. Wemyss Place



Map 15. Charlotte Square and Glenfinlas Street



Map 16. St Stephen Place

APPENDIX 2

DATA SHEETS FROM STREET SURVEYS OF HISTORIC PAVING

The following pro forma data sheets are designed to provide systematic recording of field observations of in situ sandstone pavement for the main localities described in the study. The details recorded for each area comprise the macroscopic geological characteristics of the stone type (colour and colour variation, grainsize, description of internal mineral characteristics and texture). The paving pattern is shown as a series of tick boxes to record the details of courses (orientation, width and variation). Details of edges, joints and slab thicknesses are also given, plus comments on the overall condition of the pavement and the presence and types of repairs and replacement stone. Associated features such as stone kerbs, setted streets etc. are also noted. Observations of grainsize are recorded in microns, using the standard classification, i.e. Fine sand (<250 micron), Medium sand (250-500 micron) and Coarse sand (500-1000 micron). Colour variation and range was determined in situ using a Munsell Colour Chart.

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: *9 Ann Street (SW side)*

Site No: *1 (measured section 1; Fig. 2)*

Date: *11/9/06*

Surveyor: *EKH/SLH*

Weather: *dry, cloudy bright*

General description of paving/features: *Large variations in block size, mostly grey-brown colour, with smooth ripple surfaces.*

Colour description (incl. variations): *Range from grey-brown to orange-brown. Most blocks grey-brown.*

Munsell Colour/Range: *Most common blocks fairly uniform grey-brown 10YR 6/3 to 5/7 dull yellow orange to greyish yellow brown. Less common (more rippled) blocks wider range from grey-red/brown 5Y7/1 light grey to 5YR4/4 dull reddish brown.*

Grain Size: *Mostly fine to medium sand c.250, though some fine 187 and medium 375 present. More red-brown blocks finer grained.*

Mineral Composition/Observations: *Mostly quartz-rich, some medium grained sandy blocks have large muscovite several mm's size.*

Surface Texture: Natural Internal (smooth/ripple bedded etc): *Smooth mostly, some with ripple marks or contour effect from bedding laminae, but not rough*

Secondary Surface: Smooth ☒ (worn) ☐ Rough
☒ Other: *Generally worn smooth.*

Features visible in section: *Not seen*

Paving Pattern: ☒ Coursed (see below) ☐ Uncoursed
☐ Random ☐ Other

Course width:

Blocks per course:

Block widths:

☐ Regular

☐ Single

☐ = Course width

☒ Irregular

☒ Multiple

☒ Mixed widths within course

Course alignment to kerb: ☒ Perpendicular

☐ Parallel

Flagstone edge characteristics (straight/rough/irregular etc): *Some irregular straight, rough in detail even where overall straight.*

Joint width: *Highly variable as irregular block edge; 5-25 mm, most 10-20 mm.*

Jointing materials: *Many recessed infilled with soil, some blocks have grey cement.*

Block thickness/Laying details: *Not seen.*

Evidence of surface tooling: *None generally seen but rare blocks have diagonal fine broaching used to achieve flat surfaces.*

General condition (broken flags, etc.): *Some broken and some missing corners.*

Replacement Stone (materials/quantity): *None seen*

Evidence of repairs: ☐ Tar infilling ☐ Cement patch ☐ Sawn edges ☐ Saw damage
☒ Other: *None seen.*

Kerb material: *Whinstone.*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *Gutter is 3 rows of whinstone setts parallel to pavement direction. Setted street.*

Paved area recorded on map number: Map 1

Sample/s: ED10148/10164/10175/10176

Photographs: Photos 3 to 6

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: *17 Ann Street (SW side)*

Site No: *1 (measured section 2; Fig. 3)*

Date: *11/9/06*

Surveyor: *EKH/SLH*

Weather: *dry, cloudy bright*

General description of paving/features: *Multiple size and small size blocks with multiple blocks per course. Generally smooth surface with faint ripple bedding and overall greyish brown colour.*

Colour description (incl. variations): *Mostly grey to grey orange buff.*

Munsell Colour/Range: *Less common more variable blocks 2YR4/4 reddish brown to 10YR7/2 dull yellow orange. Blocks more commonly a uniform grey brown 10YR6/1 brownish grey to 10YR 5/3 dull yellowish brown.*

Grain Size: *Mostly fine to medium sand c.250.*

Mineral Composition/Observations: *Quartz grains and iron rich finer grained surfaces. No mica apparent.*

Surface Texture: Natural Internal (smooth/ripple bedded etc): *Common ripple surfaces but worn smooth.*

Secondary Surface: Smooth ☒ Worn smooth ☐ Rough ☐ .

Features visible in section: *Not seen.*

Paving Pattern: ☒ Coursed (see below) ☐ Uncoursed

☐ Random ☐ Other

Course width:

Blocks per course:

Block widths:

☐ Regular

☐ Single

☐ = Course width

☒ Irregular

☒ Multiple

☒ Mixed widths within course

Course alignment to kerb: ☒ Perpendicular

☐ Parallel

Flagstone edge characteristics (straight/rough/irregular etc): *Overall straight, but irregular edges.*

Joint width: *10-35 mm, mostly 15-20 mm.*

Jointing materials: *Not seen, recessed and soil-filled.*

Block thickness/Laying details: *Not seen.*

Evidence of surface tooling: *None seen on most of pavement, though sloped corner at south end has broad broached ribbing as anti-slip measure.*

General condition (broken flags, etc.): *Occasional cracked flags seen, broken corners common.*

Replacement Stone (materials/quantity): *None seen; adjacent areas re-laid at entrance gates to properties for utility installation etc.*

Evidence of repairs: ☐ Tar infilling ☐ Cement patch ☐ Sawn edges ☐ Saw damage
☒ Other: *None.*

Kerb material: *Whinstone.*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *Gutter is 3 rows of whinstone setts parallel to pavement direction. Setted street.*

Paved area recorded on map number: Map 1

Sample/s: ED10148/10164/10175/10176

Photographs: Photos 3 to 6

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: *Lynedoch Place Lane*

Site No: *3 (Fig. 4)*

Date: *29/9/06*

Surveyor: *EKH/SLH*

Weather: *Wet after rain, dull*

General description of paving/features: *Surveyed area on W side near entrance where c.20 m of single slab paving with no kerb. Single slab entire width of pavement, much variation in size of slab.*

Colour description (incl. variations): *Strong red-orange brown colour varying to pale buff brown.*

Munsell Colour/Range: *Very pale where fresh 2.5Y8/1 to reddish brown 7.5YR5/3 where weathered.*

Grain Size: *Fine to medium.*

Mineral Composition/Observations: *Generally uniform siliceous with abundant dark ripple laminae with concentrated carbonaceous material and fine grained white mica.*

Surface Texture: Natural Internal (smooth/ripple bedded etc): *Common ripples and mild contour weathering, slightly pitted.*

Secondary Surface: Smooth ☒ (worn) Rough ☐ Other:

Features visible in section: *Not seen.*

Paving Pattern: ☐ Coursed (see below) ☐ Uncoursed
☐ Random ☒ Other: *Single slabs, length parallel to pavement*

Course width:

☐ Regular

☒ Irregular

Blocks per course:

☒ Single

☐ Multiple

Block widths:

☒ = Course width

☐ Mixed widths within course

Course alignment to kerb: ☐ Perpendicular

☒ Parallel

Flagstone edge characteristics (straight/rough/irregular etc): Rounded outer edge to road
(originally rounded –not worn)

Joint width: *Generally small <10 mm*

Jointing materials: *Appear unfilled*

Block thickness/Laying details: *Minimum 70mm thickness*

Evidence of surface tooling: *Worn smooth*

General condition (broken flags, etc.): *Few broken and some missing corners.*

Replacement Stone (materials/quantity):

Evidence of repairs: ☐ Tar infilling ☒ Cement patch ☐ Sawn edges ☐ Saw damage
☐ *Some cement used around utility installation and bollards etc*

Kerb material: *None*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *No kerb, thin whin
gutter stone and whin setts.*

Paved area recorded on map number: Map 3

Sample/s: ED10153/10161

Photographs: Photos 11-12

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: *Atholl Crescent Lane (W end, W side)* **Site No:** *4 (Fig. 5)*

Date: *29/9/06*

Surveyor: *EKH/SLH*

Weather: *Dull, rain*

General description of paving/features: *Only c.10m metres remaining. Single layer of flags with sandstone kerbs.*

Colour description (incl. variations): *Buff-brown varying pale to reddish.*

Munsell Colour/Range:

Grain Size: *Fine- to medium-grained.*

Mineral Composition/Observations: *White mica on bedding surfaces.*

Surface Texture: Natural Internal (smooth/ripple bedded etc): *Most have rippled texture with finely pitted surface.*

Secondary Surface: Smooth ☒ (worn) Rough ☐ Other:

Features visible in section: *Not seen.*

Paving Pattern: ☒ coursed (see below) ☐ Uncoursed
☐ Random ☐ Other

Course width:

☐ Regular

☒ Irregular

Blocks per course:

☒ Single

☐ Multiple

Block widths:

☒ = Course width

☐ Mixed widths within course

Course alignment to kerb: ☐ Perpendicular

☒ Parallel

Flagstone edge characteristics (straight/rough/irregular etc): *Straight, though variable in detail.*

Joint width: *5-15 mm.*

Jointing materials: *Grey cement, much now detached.*

Block thickness/Laying details: *Not seen.*

Evidence of surface tooling: *None seen.*

General condition (broken flags, etc.): *Several blocks cracked.*

Replacement Stone (materials/quantity): *None seen.*

Evidence of repairs: ☒ Tar infilling ☒ Cement patch ☐ Sawn edges ☐ Saw damage
☐ Other

Kerb material: *Edge bedded sandstone, coarse broaching along length with droved margins.*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *Whin setted edging with
whin setted street.*

Paved area recorded on map number: Map 4

Sample/s: n/a

Photographs: n/a

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: *Thistle Street NE Lane*

Site No: *5 (Fig 6)*

Date: *29/9/06*

Surveyor: *EKH/SLH*

Weather: *dull after rain*

General description of paving/features: *Approx. 20 metres of sandstone paving survives. Single slab with broad sandstone kerb*

Colour description (incl. variations): *Dull purple brown grey.*

Munsell Colour/Range: *Commonly 2.5Y6/2 to 5/3.*

Grain Size: *Generally fine grained.*

Mineral Composition/Observations: *Siliceous with black carbonaceous flakes and large white mica scattered throughout.*

Surface Texture: Natural Internal (smooth/ripple bedded etc): *Kerbs have ripple bedded texture with contour effect, flags are smoother*

Secondary Surface: Smooth ☒ (worn) ☐ Other

Features visible in section: *not seen*

Paving Pattern: ☐ coursed (see below) ☐ Uncoursed
☐ Random ☒ Other: single slabs per course

Course width:

☐ Regular
☒ Irregular

Blocks per course:

☒ Single
☐ Multiple

Block widths:

☒ = Course width
☐ Mixed widths within course

Course alignment to kerb: ☐ Perpendicular ☒ Parallel

Flagstone edge characteristics (straight/rough/irregular etc): *straight, though variable in detail*

Joint width: *3-15 mm*

Jointing materials: *open*

Block thickness/Laying details: *not seen*

Evidence of surface tooling: ☒ *remnants of coarse broaching perpendicular to paving direction*

General condition (broken flags, etc.) *Some cracked*

Replacement Stone (materials/quantity): *none*

Evidence of repairs: ☒ Tar infilling ☐ Cement patch ☐ Sawn edges ☐ Saw damage
☐ Other

Kerb material: *sandstone, broad, same stone type as slabs*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *concave whin gutter stone with whin setts. Caithness slab present to west, much is badly broken*

Paved area recorded on map number: *Maps 5 & 6*

Sample/s: *ED10167/10173*

Photographs: *Photos 16-17*

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: *Carlton Terrace Lane (E side)*

Site No: *9 (Fig. 11)*

Date: *29/9/06*

Surveyor: *EKH/SLH*

Weather: *sun after rain*

General description of paving/features: *E side surveyed, here more rippled and pitted surface than on W side which is smoother and more uniform. Also E side has preserved coarse broaching. W side worn to concave shape (though some more rippled blocks are less worn)*

Colour description (incl. variations): *Grey-buff to reddish-brown buff. Mostly pale grey*

Munsell Colour/Range:

Grain Size: *Fine to medium*

Mineral Composition/Observations: *Irregular orange Fe oxide grains. Common black carbonaceous fragments on rippled surfaces with large muscovite*

Surface Texture: Natural Internal (smooth/ripple bedded etc): *Almost all blocks have rippled surface worn to give 'contour effect'*

Secondary Surface: Smooth ☐ Rough ☐

Other ☒ *occasional blocks have coarser ripples*

Features visible in section: *not seen. Laminae*

Paving Pattern: ☐ Coursed (see below) ☐ Uncoursed
☐ Random ☒ Other single block per course

Course width:	Blocks per course:	Block widths:
☐ Regular	☒ Single	☒ = Course width
☒ Irregular	☐ Multiple	☐ Mixed widths within course

Course alignment to kerb: ☒ Perpendicular ☐ Parallel

Flagstone edge characteristics (straight/rough/irregular etc): *Straight overall with variable in detail*

Joint width: *very small, generally 4-5 mm*

Jointing materials: *open*

Block thickness/Laying details: 60-80 mm thick, seen in several places

Evidence of surface tooling: ☒ Coarse broaching along length of slabs with finely droved margin at outer (road) end

General condition (broken flags, etc.) *Some cracked (c.30%)*

Replacement Stone (materials/quantity):

Evidence of repairs: ☒ Tar infilling ☒ Cement patch ☐ Sawn edges ☐ Saw damage
☐ Other

Kerb material: *missing, replaced by concrete*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *Concave whinstone gutter stone with whin setts*

Paved area recorded on map number: *Map 9*

Sample/s: *ED10169*

Photographs: *Photos 23-25*

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: *Regent Terrace*

Site No: *10 (Fig. 12)*

Date: *29/9/06*

Surveyor: *EKH/SLH*

Weather: *sun after rain*

General description of paving/features: *Part of long continuous section starting at junction with Regent Road, running continuously to first house on Regent Terrace. The flagstones are distinct from that on Regent Road (presumably different development), stone appears more uniform, in better condition and weathering to darker colour. Relatively uniform sizes.*

Colour description (incl. variations): *Relatively dark, uniform, normally buff reddish-brown or patches within blocks which are strong red-brown to buff. Strong red-brown colour around margins up to 40mm from edge.*

Munsell Colour/Range: *Fresh stone is pale 10YR8/2, weathering to reddish brown 7.5YR5/3. Darker grey in strongly rippled parts.*

Grain Size: *medium grained, uniform*

Mineral Composition/Observations: *Speckled with orange-brown Fe grains (large) and aligned large muscovite. Also black carbonaceous fragments.*

Surface Texture: Natural Internal (smooth/ripple bedded etc): *Most natural smooth uniform with minor contours where worn through thin parallel laminae. Small proportion of slabs (7 of 30) have ripple surfaces with complex contour pattern and some pitting*

Secondary Surface: Smooth ☒ (worn) ☐ Other

Features visible in section: *not seen*

Paving Pattern: ☒ Coursed (see below) ☐ Uncoursed
☐ Random ☐ Other

Course width:

☐ Regular

☒ Irregular

Blocks per course:

☐ Single

☒ Multiple

Block widths:

☒ = Course width

☐ Mixed widths within course

Course alignment to kerb: ☒ Perpendicular

☐ Parallel

Flagstone edge characteristics (straight/rough/irregular etc): *Relatively straight edges and corners. Straight but variable in details with natural edge.*

Joint width: *15-35 mm*

Jointing materials: *recent grey cement, mostly receded*

Block thickness/Laying details: *not seen*

Evidence of surface tooling: *All worn smooth although rare broaching is preserved at inner wall both parallel and perpendicular to course direction.*

General condition (broken flags, etc.): *Several blocks cracked*

Replacement Stone (materials/quantity): *none*

Evidence of repairs: ☐ Tar infilling ☐ Cement patch ☐ Sawn edges ☐ Saw damage
☐ Other ☒ None

Kerb material: *Large sandstone kerbs, of same stone type as flags. Minimum 230mm thickness*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *Road is whin setts with sandstone gutter stones (though not present along entire length of sandstone paved area).*

Paved area recorded on map number: *Map 10*

Sample/s: *ED10146/10156*

Photographs: *Photo 26*

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: *Regent Road*

Site No: *11 (Fig. 13)*

Date: *8/9/06*

Surveyor: *EKH/SLH*

Weather: *Dry, strong sun*

General description of paving/features: *Large area running into Regent Terrace (which has different sandstone type). Fairly uniform, dominantly red-brown colour, smooth surface, common ripple bedding features on surfaces. Rare linear features and coarser ripples*

Colour description (incl. variations): *Overall much orange-brown, ranging to stronger reddish-brown on most blocks. Varies to pale grey-brown within blocks*

Munsell Colour/Range: *Red-brown 2.5 4/3 dull reddish-brown to greys 10YR 6/1 brownish-grey, tending to lightest 10YR 6/1. Some less worn edges are darker red to 2.5YR 3/6 dark reddish brown.*

Grain Size: *Fine to medium 250 (red-brown) to 375 (grey)*

Mineral Composition/Observations: *Quartz-rich, well sorted. Possibly some small white mica*

Surface Texture: Natural Internal (smooth/ripple bedded etc): *Many blocks show faint rippled texture; surface generally smooth, not pitted. Rare blocks linear features. Many are smooth*

Secondary Surface:

Smooth

☒

Rough

☐

Other: *occasional blocks have coarser ripples*

Features visible in section: *coarse ripple laminae*

Paving Pattern:

☒

Coursed (see below)

☐

Uncoursed

☐

Random

☐

Other

Course width:

Blocks per course:

Block widths:

☐

Regular

☐

Single

☐

= Course width

☒

Irregular

☒

Multiple

☐

Mixed widths within course

Course alignment to kerb:

☒

Perpendicular

☐

Parallel

Flagstone edge characteristics (straight/rough/irregular etc): *Overall straight but slightly irregular in detail. Occasional larger irregularities (possible damage)*

Joint width: *8-23 mm (mostly 10-20 mm)*

Jointing materials: *pale cement filling joints and damage edges/corners*

Block thickness/Laying details: *minimum 8cm (though most obscured)*

Evidence of surface tooling: ☒ *Preserved on unworn areas by building edge. Tooling is coarse broaching with fine perpendicular droving*

General condition (broken flags, etc.) *Measured area good, some damage with cracks to adjacent blocks*

Replacement Stone (materials/quantity): *none*

Evidence of repairs: ☐ Tar infilling ☐ Cement patch ☒ Sawn edges ☐ Saw damage
☒ Other *large part of adjacent area recently re-laid*

Kerb material: *sandstone with similar colour. Broached along length on top, and side tooling*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *Gutter block is same material. Smooth surface*

Paved area recorded on map number: *Map 10*

Sample/s: *ED10147*

Photographs: *Photos 27 to 30*

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: *Gloucester Lane*

Site No: *14 (Fig. 14)*

Date: *11/9/06*

Surveyor: *EKH/SLH*

Weather: *dry cloudy bright*

General description of paving/features: Generally single length, regular coursed single slab to kerb

Colour description (incl. variations): *Generally uniform grey-buff orange. Grey where most worn, orange-buff where least. Soiled black at untrodden edges.*

Munsell Colour/Range: *2.5Y6/1 yellowish grey to 10YR 5/3 dull yellowish brown 10YR6/4 dull yellow orange*

Grain Size: *Generally uniform fine to medium c.250. Common muscovite flakes up to c.1 mm on surfaces*

Mineral Composition/Observations: *Abundant large white mica and black carbonaceous flakes aligned along bedding, with some of former concentrated into laminae. Common orange iron oxide grains scattered throughout.*

Surface Texture: Natural Internal (smooth/ripple bedded etc): *Smooth, some blocks show ripple laminae on surface*

Secondary Surface: Smooth ☒
Other ☐

Rough ☐

Features visible in section: *not seen*

Paving Pattern: ☒ Coursed (see below) ☐ Uncoursed
 ☐ Random ☐ Other

Course width:

Blocks per course:

Block widths:

☒ Regular

☒ Single

☒ = Course width

☐ Irregular

☐ Multiple

☐ Mixed widths within course

Course alignment to kerb:

☒

Perpendicular

☐

Parallel

Flagstone edge characteristics (straight/rough/irregular etc): *straight, with minor irregularities.
relatively precise joints*

Joint width: *Unusually narrow/precise 4mm-10mm (most 5-8mm)*

Jointing materials: *white cement pointing, much missing. Many joints empty or with soil*

Block thickness/Laying details: *not seen*

Evidence of surface tooling: ☒ *several blocks show broad broached ribbing perpendicular to
pavement length*

General condition (broken flags, etc.) *Only c.30% slabs remain, several are cracked and some
have broken corners. Several slabs (c.10) have been cut for utility installation and are partially
cement*

Replacement Stone (materials/quantity): *none*

Evidence of repairs: ☐ Tar infilling ☒ Cement patch ☐ Sawn edges ☐ Saw damage
☒ Other: *missing slabs replaced by cement or concrete slab*

Kerb material: *whinstone*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *channelled whinstone
gutter; whin setts*

Paved area recorded on map number: *Map 13*

Sample/s: *ED10149/10171*

Photographs: *Photos 40-42*

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: *Charlotte Square (Nos. 4 to 5)*

Site No: *16 (Fig. 17)*

Date: *8/9/06*

Surveyor: *EKH/SLH*

Weather: *dry, strong sun*

General description of paving/features: *Complete section of sandstone pavement on north side of square, with mounting blocks and sloping kerb slabs. Sandstone kerbs at corners. Highly variable slab size with larger slabs adjacent to property entrances. Most appears original, with minor repairs.*

Colour description (incl. variations): *Grey and orange-grey buff with orange-brown patches within blocks*

Munsell Colour/Range: *2.5Y 7/1 to 2.5Y 6/1 light grey to yellowish grey (varies within blocks)*

7.5YR6/3 to 5YR5/6 dull brown to bright reddish brown (varies within blocks)

Grain Size: *Fine to medium sand 250-375*

Mineral Composition/Observations: *Quartz-rich well sorted with little white mica*

Surface Texture: *Natural Internal (smooth/ripple bedded etc): Some blocks smooth, but most shallow pitted due to ripple bedding. Rare blocks with linear ripple arrangements.*

Secondary Surface: Smooth ☒ (worn) ☐ Rough

Other: ☒ *Smooth worn surface over common shallow pitting*

Features visible in section: *Irregular non-continuous thin dark ripple laminae, sparse in some blocks intense in others. Black carbonaceous layers in laminae.*

Paving Pattern: ☒ Coursed (see below) ☐ Uncoursed

☐ Random ☐ Other

Course width:

Blocks per course:

Block widths:

☐ Regular

☐ Single

☒ = Course width

☒ Irregular

☒ Multiple

☐ Mixed widths within course

Course alignment to kerb:



Perpendicular



Parallel

Flagstone edge characteristics (straight/rough/irregular etc): *Overall straight, but commonly rough in detail*

Joint width: *mostly 14-40mm generally highly variable*

Jointing materials: *cement, multiple generations receded*

Block thickness/Laying details: *Slabs exposed at NE corner repair works: mostly 7-10 mm, up to 12 mm; varies within a block.*

Evidence of surface tooling: Generally none, occasional block shows crude parallel tooling, often diagonal.

General condition (broken flags, etc.) *Some missing corners and damage to edges and some cracked blocks*

Replacement Stone (materials/quantity): ☒ *minor replacement with occasional blocks of concrete paving, Yorkshire sandstone, red sandstone, Caithness flagstone*

Evidence of repairs: ☒ Tar infilling ☒ Cement patch ☐ Sawn edges ☐ Saw damage
☒ Other *Repairs generally minor and partial*

Kerb material: *Sandstone c.140mm deep laid on same base as flags; most has ripple bedding and reddish colour identical to paving slabs, some is uniform sandstone with no bedding and paler colour. Large sloping kerb flags are 60-100mm deep (same as flags) laid on a sand layer, identical stone to flags.*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *Mounting blocks are single stones >210mm thick with broad rounded corners to front and vertical droved sides*

Paved area recorded on map number: *Map 15*

Sample/s: *ED10152/10155/10158/10160/10166*

Photographs: *Photos 46 to 48*

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: *Glenfinlas Street (E side)*

Site No: *17 (Fig. 18)*

Date: *11/9/06*

Surveyor: *EKH/SLH*

Weather: *dry, dull cloud*

General description of paving/features: *This pavement section chosen as it is original and has uniform course widths and slab sizes distinct from Charlotte Square. Tooling is preserved on less worn slabs adjacent to wall on inside of pavement.*

Colour description (incl. variations): *Generally buff-orange, with some grey-buff and some stronger orange red.*

Munsell Colour/Range: *Orange-red blocks 5YR 4/4 dull reddish brown. Grey blocks 10YR7/1 light grey. Common variable block range in one block from the above to brownish grey 10YR6/1 to dull brown 7.5YR5/3*

Grain Size: *Mostly fine to medium 250-375, commonly medium c.375*

Mineral Composition/Observations: *Generally uniform quartz grains, common small muscovite aligned < 1mm but not concentrated.*

Surface Texture: Natural Internal (smooth/ripple bedded etc): *Typically smooth with common rippled surfaces though not uneven.*

Secondary Surface: Smooth ☒ (worn) Rough ☐ Other:

Features visible in section: *Not seen. Kerbstone shows strong ripple lamination on some blocks with concentrated mica in some laminae and Fe oxide giving strong red colour where weathered.*

Paving Pattern: ☒ Coursed (see below) ☐ Uncoursed
☐ Random ☐ Other

Course width:

Blocks per course:

Block widths:

☐ Regular

☐ Single

☒ = Course width

☒ Irregular

☒ Multiple

☐ Mixed widths within course

Course alignment to kerb:

☒

Perpendicular

☐

Parallel

Flagstone edge characteristics (straight/rough/irregular etc): *Straight but rough irregular edges.*

Joint width: *7-30 mm, much variety between blocks.*

Jointing materials: *Light grey cement, broken with parts missing.*

Block thickness/Laying details: *Not seen.*

Evidence of surface tooling: *Broad broached ribbing preserved on inner edge by wall where not worn – indicates pavement is original. Tooling mostly aligned perpendicular to slope*

General condition (broken flags, etc.): *Good, with rare cracks and few broken corners. Some blocks wearing at edges showing decay of softer stones.*

Replacement Stone (materials/quantity): *Rare, some red sandstone and York stone.*

Evidence of repairs: ☐ Tar infilling ☒ Cement patch ☐ Sawn edges ☐ Saw damage

☒

Other: *Minor cement repairs broken corners etc.*

Kerb material: *Same sandstone as paving flags.*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *Channelled whinstone gutter. Whinstone setts. Broad band of cement between gutter and kerb appears to represent substitute replacement for an extra kerb step.*

Paved area recorded on map number: Map 15

Sample/s: ED10159

Photographs: Photo 49

**EDINBURGH NEW TOWN FLAGSTONE PAVING STUDY:
HISTORIC PAVING SURVEY FORM**

Location: 4-8 St Stephen Place (NE side)

Site No: 18 (Fig. 19)

Date 11/9/06

Surveyor: EKH/SLH

Weather: Dry, cloudy bright

General description of paving/features: *Variable block size with mixture of original block and replaced blocks which appear to have been redressed/cut down to size. Probably all re-laid with new coursing pattern.*

Colour description (incl. variations): *Variable from grey-buff to orange-buff to strong red-brown. Grey to red-brown often present in individual slabs. Other slabs more uniform buff-orange.*

Munsell Colour/Range: *A few blocks uniform red-brown 2.5YR5/4 TO 4/4 (dull reddish brown). others variable 5YR 5/3 (dull reddish brown) to 10YR (light grey). Many blocks are more uniform 10YR 6/2-6/3 brownish grey to greyish yellow brown.*

Grain Size: *Fine to medium 187-375, ripple surfaces some 375*

Mineral Composition/Observations: *Mostly quartz-rich, red-brown bands commonly finer grained iron-rich patina. Some ripple beds coarser with common muscovite up to c.1mm.*

Surface Texture: Natural Internal (smooth/ripple bedded etc): *Common rough irregular coarse rippled surfaces, though some blocks smooth. Rare have linear bedded surfaces.*

Secondary Surface: Smooth ☒ (worn) Rough ☐ Other: *Many blocks worn smooth, but most have coarse ripple marks.*

Features visible in section: *Not seen.*

Paving Pattern:

☒

Coursed (see below)

☐

Uncoursed

☐

Random

☐

Other

Course width:

Blocks per course:

Block widths:

☐

Regular

☐

Single

☒

= Course width

☒

Irregular

☒

Multiple

☐

Mixed widths within course

Course alignment to kerb:

☒

Perpendicular

☐

Parallel

Flagstone edge characteristics (straight/rough/irregular etc): Many blocks recently cut (typically trimmed on one side) but many are original. Straight with irregular edge detail.

Joint width: 10-25 mm, typically 10-20 mm

Jointing materials: *Pale cement.*

Block thickness/Laying details: *Not seen.*

Evidence of surface tooling: *Occasional blocks show parallel broaching probably done to achieve smooth surface.*

General condition (broken flags, etc.): *Few broken and some missing corners.*

Replacement Stone (materials/quantity): *Several slabs of 'recent' Caithness flagstone.*

Evidence of repairs: ☐ Tar infilling ☐ Cement patch ☐ Sawn edges ☐ Saw damage
☒ *None, some cement used around utility installation and bollards etc.*

Kerb material: *Whinstone.*

Other features (horonizing/mounting blocks/spur stones/kerb steps etc.): *Tarmac road. Mostly concrete steps to adjacent housing.*

Paved area recorded on map number: Map 16

Sample/s: ED10145/10177

Photographs: Photos 50 to 53