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The hydrogeology of the Leicester district (geological sheet 156)

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The hydrogeology of the Leicester district (1:50,000 scale geological sheet 156)

CS Cheney

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Parent Body

Natural Environment Research Council, Polaris House, North Star Avenue, Swindon, Wiltshire SN2 1EU

☎ 01793-411500 Fax 01793-411501
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1 Introduction

This report forms part of the 1:10,000 scale resurvey of the Leicester geological sheet which will result in the publication of a revised 1:50,000 scale map and two reports: a Sheet Description, available from BGS by print-on-demand, and a Sheet Explanation, the latter an abridged version of the Sheet Description published as a booklet to accompany the folded 1:50 000 scale map. The content of this report will form the basis of the hydrogeological input to the Sheet Description and Sheet Explanation.

The minimum elevation of the study area is about 42 m, in the valley of the River Soar near Montsorrel in the north west of the district. A topographic divide trends generally south westward, running approximately from Ranksborough Hill [SK 824 114], via Watborough Hill [SK 767 059], Tilton-on-the-Hill [SK 744 057], about 1 km to the east of Billesdon [SK 730 028] and Rolleston [SK 731004] to Carlton Curlieu [SP694 973]. A maximum elevation of over 210 m occurs on this divide between Tilton and Billsdon.

The greater part of the district lies to the west of the divide within the catchment of the River Soar, itself a tributary of the River Trent. The northern section drains to the north via minor tributaries of the Rivers Eye and Wreake, which flow westward (just outside the district) and then south westward to join the River Soar to the south of Cossington. The River Soar and its tributaries drain the whole of the western half of the district in a generally northerly direction. Tributaries of the River Sence drain the south central section of the district, with the River Sence flowing westward to join the River Soar in the south-west corner of the district near Whetstone.

To the east of the watershed, the area is drained in a south easterly direction by tributaries of the River Welland, notably the River Gwash, the River Chater and the Eye Brook.

The mean annual rainfall ranges from a minimum of about 630 mm in the Wreak valley on the northern fringe of the area, to more than 700 mm over the higher ground to the west of Montsorrel in the north-west of the district, as well as the more elevated areas around Cold Overton and between Billesdon and Whatborough Hill in the east (Meteorological Office, 1977). The mean (1971 to 2000) annual evapotranspiration for the central part of the district is about 515 mm (data derived using MORECS data (Thompson and others, 1981)).

2 Water supply

Prior to the 19th century, the city of Leicester and other urban centres in the district were dependant on shallow wells, springs and surface watercourses for their water supplies. Leicester developed on the gravelly river terraces associated with the River Soar valley, which provided a dry site where water was readily available from shallow wells. Most of the supply was obtained from public draw wells, one of which (the Plancke or Klanche well) was located near the top of the present Cank Street (Richardson 1931). These sources were highly prone to contamination and the supplies often became unfit for consumption.

In 1847 a private water company was formed to provide the city with a potable water supply. Surface water impoundments were constructed to source the supply. Thornton reservoir (located to the west of the district), together with the associated treatment plant and supply mains, had been constructed by 1854. This was followed by Cropston and Swithland reservoirs, both located in the north-west of the district, in 1866 and 1896 respectively. Additional reservoirs were constructed farther north, under the auspices of the Derwent Valley Water Board, during the first half of the 1900s to provide additional water supplies to Leicester, Nottingham, Sheffield and Derby. Increasing demand, due to continuing industrial expansion and rising population, outstripped Leicester's portion of the supply from these sources by the mid 1950s, prompting the formation of the River Dove Water Board to secure additional supplies. Currently over 92% of the water supplied to Leicester and the surrounding area originates from the rivers Dove and Derwent (which drain southwards from the Derbyshire Peak District) (www.stwater.co.uk) and has been the responsibility of Severn Trent Water since 1989.

Groundwater abstraction licence and water use data for the Mercia Mudstone Group, Lias Group and Superficial Deposits minor aquifers are shown in Table 1. These data have been derived from a listing of abstraction licence data provided by the Environment Agency in 1999. The original listing does not differentiate between the wells and boreholes that penetrate each of these three minor aquifers. It has, therefore, been necessary to correlate the abstractions with specific borehole or well records held in the BGS National Water Well Archive in order to define from which aquifer the abstraction is occurring. Where it has not been possible to make such a correlation, the location of abstractions with regard to the underlying geology was used to designate the most probable aquifer. Surface water abstraction licence data, (for the categories used for groundwater use), has been included in Table 1 for comparative purposes.

Of the three aquifers, the greatest abstraction, (although not particularly large in terms of total quantity), is from the Mercia Mudstone Group. Groundwater from this source is of particular importance to the industrial sector, with abstractions concentrated in the vicinity of Leicester. The relatively small scale use of this aquifer for agricultural and private supply purposes is probably a reflection of the proximity of the Mercia Mudstone outcrop to urban areas that are well served by water mains supplies.

The Lias Group aquifer is of particular importance to the agricultural sector with a large number of small licensed abstractions (average about 1100 m^3/a), for general agricultural and domestic use.

Little groundwater from the Superficial Deposits is abstracted in the district despite its widespread distribution along the valley of the River Soar. The two agricultural supplies obtained from the Superficial Deposits are in fact from River Terrace Deposits (River Gravels), whilst the abstraction used for mineral washing from River Soar alluvium (alluvial deposits) may include some contribution from the underlying Mercia Mudstone Group aquifer.

Table 1 **Licensed water use in the Leicester district** (derived from data provided by the Environment Agency in 1999).

	Private Water Supply		Agriculture				Industrial						TOTALS	
			General		Spray Irrigation		Process		Circulated Cooling		Mineral Washing			
	m^3/a	No.	m^3/a	No.	m^3/a	No.	m^3/a	No.	m^3/a	No.	m^3/a	No.	m^3/a	(No)
Superficial Deposits	-	-	6,515	1	6,315	1	-	-	-	-	6,049	1	**18,879**	**(3)**
Lias Group	2364	2	48,567	44	69,307	1	3,600	1	-	-	-	-	**123,838**	**(48)**
Mercia Mudstone Group	545	1	16,400	9	53,804	8	553,184	6	851,239	5	-	-	**1,475,172**	**(29)**
TOTALS	**2,909**	**3**	**71,482**	**54**	**129,426**	**10**	**556,784**	**7**	**851,239**	**5**	**6,049**	**1**	**1,617,889**	**(80)**
Surface Waters	51,925	4	568	1	313,310	17	2,355,687	9	249,348	2	-	-	**2,970,838**	**(33)**

3 Geology

The lithostratigraphy present within the Leicester district is presented in Table 2.

Table 2 The stratigraphy of the Leicester district

QUATERNARY	HOLOCENE		Alluvium, etc, head, slip
QUATERNARY	PLEISTOCENE		Slope Terrace Deposits (head) River Terrace Deposits All Tills, Rotherby Clay, Wigston Sand & Gravel, Glaciofluvial & Glaciolacustrine Deposits Bytham Sands and Gravels.
JURASSIC	MIDDLE JURASSIC	Inferior Oolite Group	Northampton Sand Formation (~15+).; ferruginous sandstone.
JURASSIC	LOWER JURASSIC	Lias Group	Whitby Mudstone Formation (~55m); mudstones Marlstone Rock Formation (0-10m); calcareous ironstone. Dyrham Formation (15-25m); mudstones; minor siltstones and sandstones. Charmouth Mudstone Formation (110-125m); mudstones and thin limestones. Blue Lias Formation (115-130m); mudstone with thin limestones.
TRIASSIC	UPPER	Penarth Group	Lilstock Formation: Cotham Member (4-8m); silty, calcareous mudstones Westbury Formation (3-4m); dark grey to black mudstones and siltstones
TRIASSIC	UPPER / MIDDLE	Mercia Mudstone Group	Blue Anchor Formation (c. 8m); dolomitic mudstones and siltstones Cropwell Bishop Formation (40-50m); red mudstones and siltstones with gypsum Hollygate Sandstone Mbr. (up to 12 m); medium to coarse sandstone and mudstone Edwalton Formation (40-50m); red gypsiferous mudstones and siltstones, locally dolomitic Cotgrave Sandstone Mbr (c.1-2m); medium to fine grained sandstone Gunthorpe Formation (~60-80m); as for Edwalton Formation Sneinton Formation (2-20m); interbedded mudstone, siltstone and sandstone.
TRIASSIC	MIDDLE	Sherwood Sandstone Gp.	Bromsgrove Sandstone Formation (0-35m); sandstone with mudstone interbedded
ORDOVICIAN		Mountsorrel Complex	Granodiorite, minor diorite and gabbro
PRECAMBRIAN		Charnian Supergroup	Brand Group; slate with conglomerate, grit and quartzite Maplewell Group; volcanoiclastic sandstones, siltstones and mudstones, cleaved and metamorphosed

The Lias Group crops out across much of the central and eastern portion of the district; small outliers of the Northampton Sand Formation occur on a few of the higher hilltops.

Mercia Mudstone Group strata crop out in the west of the district. The basal Sneinton Formation (formerly the Keuper Water Stones), although present in a stratigraphic borehole located some 1.5 km to the west of the district at Leicester Forest East [SK 5246 0282] and several boreholes in the vicinity of Leicester, may be absent in some parts of the district.

Sherwood Sandstone Group rocks are present at considerable depth beneath the Mercia Mudstone Group and have only been penetrated by two boreholes drilled for water supply purposes, and three investigation boreholes. The geological logs (indicating the presence of interbedded sandstones with mudstones) suggest that only the Bromsgrove Sandstone Formation is likely to be present at thicknesses of up to 35 m. The Sherwood Sandstone Group is absent from north western parts of the district where the Mercia Mudstone directly overlies elevated parts of the pre-Cambrian basement.

4 Hydrogeology

4.1 ORDOVICIAN AND PRECAMBRIAN

These well-indurated rocks possess little or no primary permeability or porosity. Limited quantities of groundwater are only likely to occur within and move through joints and fractures in these rocks, and yields are dependent on wells and boreholes intersecting such water bearing fractures. Usable quantities of groundwater would not appear to be obtainable from these rocks in the Leicester district.

4.2 SHERWOOD SANDSTONE GROUP

The Sherwood Sandstone Group is the most important aquifer in the English Midland, of England but only a limited thickness of the sandstones are present at considerable depth beneath the Leicester district, the nearest outcrop being located over 6 km to the north-west. Where present, the Sherwood Sandstone aquifer is likely to be confined by the overlying Mercia Mudstone Group.

Thicker sandstone horizons occur in the basal part of the Mercia Mudstone sequence (the Sneinton Formation), where the groundwater is commonly in hydraulic continuity with the underlying Sherwood Sandstone aquifer. The Sneinton Formation consists of mudstones together with siltstones and sandstones and often forms a localised minor aquifer in its own right. This basal unit of the group was formerly known as the Keuper Waterstones, reputedly due to their similarity in appearance to watered silk rather than their water bearing properties (Downing et al., 1970). In practice, few (if any) boreholes solely utilise this basal unit, most continuing to greater depth to penetrate the underlying Sherwood Sandstone aquifer, as is the case for the two water supply boreholes that penetrate the Sneinton Formation in the district. In consequence, the Sneinton Formation is discussed in conjunction with the Sherwood Sandstone Group in this section.

Of the two water supply boreholes in the district that penetrated the Sneinton Formation and underlying Sherwood Sandstone Group aquifer, neither borehole record contains any significant hydrogeological information for these horizons. The first borehole was drilled in 1892 in Knighton Fields Lane [SK 5922 0197]; it penetrated the Mercia Mudstone Group (including the Hollygate Sandstone, Cotgrave Sandstone and Plains skerry) to a depth of 169 m below surface, then entered approximately 30 m of Sneinton Formation and Sherwood Sandstone Group aquifer, before terminating in probable Ordovician mudrocks at a total depth of 251 m. No casing details were provided but it is probable that the sandstone beds within the Mercia Mudstone contributed to the total yield of the borehole. The borehole was tested at 27.3 m^3/h (7.5 l/s) for a water level drawdown of only 1.7 m but a much larger production yield of almost 136 m^3/h (38 l/s) was reported in 1949. The water quality was also reported to have been good. This combination of very high yield and good quality water may indicate that a substantial proportion of the total yield originated from the Sneinton/Sherwood Sandstone aquifer.

The second borehole, drilled in 1997 in Nansen Road, Leicester [SK 6104 0401], penetrated the whole of the Mercia Mudstone sequence above a 30 to 40 m thickness of Sneinton Formation/Sherwood Sandstone Group aquifer. Water strikes were reported at depths of 11.5 m (in the Mercia Mudstone) and at 243 m (in the Sherwood Sandstone). The second strike appears to have provided a yield of almost 2.5 m^3/h (0.7 l/s) but nothing was reported regarding the quality of that water. This 'test' borehole was backfilled on completion.

Although three other investigation boreholes were drilled to the north-east of Leicester, encountering over 30 m of sandstones beneath 160 to almost 200 m of Mercia Mudstone strata, none of the available records provide any hydrogeological information.

4.3 MERCIA MUDSTONE GROUP

4.3.1 General

The Mercia Mudstone Group, (formerly the Keuper Marl), has traditionally been regarded as weakly permeable and at best a poor aquifer. The group has, therefore, been most commonly referred to in the context of forming a confining upper limit to the underlying Sherwood Sandstone Group aquifer. While effectively a non-aquifer in many areas, limited quantities of groundwater suitable for domestic or small-scale agricultural use are commonly obtainable (Jones and others 2000). In the Leicester district, the Mercia Mudstone Group provides higher yields than any of the other potential aquifers; the largest yields being obtained from boreholes that penetrate the Hollygate Sandstone Member (of the Edwalton Formation).

The Mercia Mudstone Group consists predominantly of effectively impermeable mudstones interbedded with occasional thin impersistent siltstones and sandstones (skerries). The arenaceous beds (‘skerries’) are present, to a varying degree, throughout most of the mudstone sequence except the uppermost Blue Anchor Formation (Jones and others 2000). The skerries are laterally most persistent and attain greatest thickness, in excess of 10m, in the Hollygate Sandstone Member. With the exception of the latter and the Cotgrave Sandstone Member, the arenaceous beds are generally thin (often less than 1m thick) but have a strong dolomitic cementation and thus can often contain and transmit limited quantities of groundwater through fractures. These beds commonly constitute only a small proportion of the nominal saturated depth of boreholes and wells; however, they confer a very large proportion of the yield, with the mudstones contributing little or nothing. Groundwater contained within the dolomitic siltstones and sandstones is generally confined by the overlying mudstones. In situ rising head and packer tests in investigation boreholes drilled along the line of a tunnel near Leicester provided values of coefficient of permeability ranging from $3x10^{-10}$ m/s to 10^{-5} m/s. The very low values were thought to be associated with the mudstones and the higher ones with the ‘skerries’ (Atkinson et al 2003).

The thin arenaceous beds commonly possess a very small outcrop area and recharge is, therefore, limited; some are laterally impersistent and are totally enclosed within the mudstones. Under such circumstances recharge is limited to that which moves slowly through the mudstones; storage is therefore likely to be rapidly depleted on pumping and yields can decline dramatically with time as pumping depletes storage within the water-bearing horizons. Failure to penetrate a dolomitic bed, or intersecting one that is only poorly fractured (not an uncommon event), results in a dry or very low yielding borehole.

Thicker sandstone horizons are more common in the basal part of the sequence (Sneinton Formation), where the groundwater is sometimes in hydraulic continuity with the underlying Sherwood Sandstone aquifer. In consequence, the Sneinton formation has been discussed in conjunction with the Sherwood Sandstone Group in Section 4.2.

4.3.2 Cropwell Bishop Formation

Yields from the Cropwell Bishop Formation generally range up to 1.6 m^3/h (0.45 l/s) but there are also a number of records indicating that 'very little water' was obtained. Exceptionally, a yield of 4.6 m^3/h (1.3 l/s) was obtained from a borehole in Friday Street, Leicester [SK 5866 0530]. A similar yield (4.5 m^3/h) was also obtained from a well with a borehole drilled through its base that penetrated the Cropwell Bishop Formation at Ratcliffe College, Cossington [SK 6251 1503] but half of this yield was reported to be derived from the original well dug in the overlying glacial sands and gravels.

4.3.3 Hollygate Sandstone Member (Edwalton Formation)

Yields obtained from the Hollygate Sandstone Member commonly range from less than 5 m^3/h to 45 m^3/h (about 1.5 to 12.5 l/s) for drawdowns (where recorded) that only rarely exceed 10 m. Virtually all of these relatively high yielding boreholes are located within the Leicester urban area and were drilled to supply groundwater for industrial purposes. Smaller yields were obtained from a number of boreholes but in many of these cases the Hollygate Sandstone Member was not fully saturated. A test yield of over 50 m^3/h for a drawdown of only 1.6 m was obtained from a borehole located at the Union Works, Leicester [SK 5902 0639], whilst pumping rates of over 90 m^3/h were recorded for boreholes located in Leicester at the Beaumanor Brewery [SK 5880 0713] and Ash Street [SK 6024 0539], although both were originally tested at considerably lower rates. This wide variation in yields and associated drawdowns in boreholes where the Hollygate Sandstone Member is fully saturated is likely to be a reflection of differences in the degree of fracturing present. The Hollygate Sandstone Member subcrops beneath the alluvial and River Terrace deposits beneath a small part of the valley of the River Soar [SK578 050] west of central Leicester and there, the aquifer is likely to be in hydraulic continuity with both the superficial deposits and the river channel. The sandstone aquifer therefore has the potential to be recharged by the river, although its continuity is disrupted by north west and north trending faulting. Where such recharge does occur, the aquifer could be capable of sustaining the relatively high yields produced from local boreholes constructed in the Leicester urban area, although several high yielding boreholes located in close proximity may exceed the capacity of the sandstone to sustain yields.

4.3.4 Edwalton and Gunthorpe Formations

The few boreholes that only penetrate the Edwalton Formation mudrocks or the Gunthorpe Formation produced little or no water. The three boreholes known to have penetrated the intervening Cotgrave Sandstone Member (defining the base of the Edwalton Formation) in the district produced yields of the order of 3.5 m^3/h (1 l/s), although the resulting water level drawdowns are not recorded.

4.3.5 Groundwater Quality

Fox-Strangways (1903) considered that although considerable amounts of water could be obtained from the Mercia Mudstone Group, this water was too hard for domestic use due to the quantity of gypsum present in the mudstones.

Few partial chemical analyses are available for boreholes or wells that penetrate the Mercia Mudstone Group in the district but comments contained on drilling records often indicate that the water was hard or very hard and occasionally that it was unfit for drinking.

The very limited information available suggests that groundwater mineralisation may increase with borehole depth. Total dissolved solids concentrations range from about 700 mg/l in a borehole of about 40 m depth, to 2600 mg/l in a 60 m borehole. Total hardness ranges from over 300 mg/l to 2600 (as $CaCO_3$), much of this being permanent, with associated sulphate concentrations of between 163 and 1260 mg/l. Recorded chloride concentrations range from about 40 to 120 mg/l, again showing some correlation with borehole depth.

4.4 LIAS GROUP

4.4.1 General

The Lias is a minor multi-layered aquifer in which the subordinate limestones and sandstones, including ferruginous sandstones (ironstones), constitute the aquifer horizons. The overlying and underlying strata are generally impermeable clays, mudstones or shales that effectively isolate the individual aquifer horizons. The aquifer horizons are relatively thin, rarely extend over large areas and may be laterally discontinuous over distances of kilometres or less. Since the aquifer units are relatively thin, faults with quite limited displacements may split an aquifer into separate, hydraulically isolated compartments. Faults may also juxtapose different aquifer horizons placing them in hydraulic continuity.

Intergranular permeabilities are generally low in the limestones and water movement takes place through fractures. The fractures are often irregularly distributed in a vertical and horizontal sense, but can extend for significant distances and may result in relatively high yields where interconnected. Fracture development in the sandstones, friable sands, and ironstones is likely to be less pronounced than in the limestones and primary porosity may play a greater role in water storage and transport. Controls on permeability are likely to be more closely linked to the degree of induration and grain size distribution.

4.4.2 Blue Lias and Charmouth Mudstone Formations

The Blue Lias Formation and Charmouth Mudstone Formations (formerly the Lower Lias) consist of impermeable mudstones with thin water bearing limestone bands that constitute a multilayered aquifer. Intergranular permeabilities are generally low in the limestones and water movement takes place through fractures that have often been enlarged by solution. Yields are very variable, being dependent on whether or not a borehole intersects an interconnected system of water-filled openings.

The thin limestone aquifer horizons generally only have small outcrop areas and in consequence recharge is limited. The limestone aquifer horizons are characterised by relatively high secondary permeabilities but since they are generally thin, transmissivities are relatively low, as are storage coefficients. Water resources are in consequence limited, with both yields and water levels often falling significantly after only a few hours pumping as storage is depleted. Where formations are highly fissured pumping can affect sources some distance away.

Recorded yields obtained from the Blue Lias and Charmouth mudstones generally range between 0.7 and 3 m^3/h (0.2 to 0.8 l/s) for highly variable amounts of water level drawdown in response to pumping. Higher yields of about 4 m^3/h (1.1 l/s) occur in the vicinity of Illston-on-the-Hill [SP 707 993] and range from about 4.4 to 6.8 m^3/h (1.2 to 1.9 l/s) in the area to the south west and south east of Twyford [SK 730 100]. However there are also numerous records of very low yielding and effectively dry boreholes elsewhere in the district.

4.4.3 Dyrham Formation and Marlstone Rock Formation

Few water boreholes penetrate the Marlstone Rock Formation without continuing deeper to also penetrate the underlying Dyrham Formation. It is therefore only rarely possible to define the separate contributions from each formation to the total yield obtained from these boreholes but it is probable that the greater part of the total is, in most cases, likely to be from the Marlstone Rock.

The Dyrham Formation, formerly the Middle Lias silts and clays, comprises muddy, fine-grained sands and sandy mudstones. The Marlstone Rock comprises a calcareous ironstone. Generally it is a ferruginous, bioclastic somewhat sandy limestone, commonly conglomeratic at the base, where it rests on the Dyrham Formation.

A number of villages (such as Pickwell, Somerby, East Norton, Goadby, Launde, Loddington and Withcote) are located on the outcrop of the Marlstone Rock, their position having originally been determined by the availability of usable water supplies derived from this formation (Richardson 1931). Recorded borehole yields range from about 1.1 to 3.6 m^3/h (0.3 to 1 l/s), with lower yields being recorded where the Marlstone Rock is only partially saturated. In contrast to the Blue Lias and Charmouth Mudstone formations records of very low yielding boreholes are comparatively rare and there are no effectively dry boreholes. Springs commonly issue from the base of the Marlstone Rock and a particularly large yield of 9.5 m^3/h (2.6 l/s) is recorded as issuing from such a spring near Somersby [SK 7776 0996], which formerly provided the supply for that village. Similarly small springs often occur at the base of the Dyrham Formation at its boundary with the underlying mudstones.

4.4.4 Whitby Mudstone Formation

Mudstones predominate in this formation, with a few thin limestone beds that could act as aquifer horizons. In addition outcrops are commonly located in relatively elevated locations, on the crest of hills in the district, and consequently groundwater is likely to drain rapidly from the more permeable horizons that are present. Virtually all boreholes that penetrate this formation continue also to penetrate the underlying Marlstone Rock and Dyrham formations, from which water supplies are obtained. Fox-Strangways (1903) considered this horizon to provide the poorest supply of any formation in the district, and only very low yields (at best) have been obtained from boreholes solely penetrating it. Springs that formerly provided a supply to the village of Cold Overton [at SK 8130 1187] yielded up to a maximum of 3.8 m^3/h (1 l/s) (early in the year) but had been known to decline to as little as 0.5 m^3/h (0.13 l/s), presumably following a period of particularly low rainfall.

4.4.5 Groundwater Quality

There are many boreholes and wells in the Leicester district that provide water supplies of usable quality from the Blue Lias and Charmouth mudstones, although even partial chemical analyses of these groundwaters are rare. The quality of water from the Lias limestones is generally good but hard, with calcium and bicarbonate ions likely to predominate.

Fox-Strangways (1903) and Richardson (1931) considered that the scant water supplies available from the limestones and shales of the Blue Lias and Charmouth mudstones (formerly the Lower Lias) at depth was likely to be hard, liable to be brackish or saline and to commonly contain hydrogen sulphide due to the break down of pyrites. The few adverse comments regarding water quality on the vast majority of boreholes and wells penetrating the Lias in the district would imply that, in general, water of usable quality has been obtained. The presence of poor quality water was, however, recorded in two boreholes near Ashby Folville, with one [at SK 7147 1177] simply noting ‘salty water’ and another [at SK 7084

1468] noting an unpleasant odour. High salinity was indicated at New York Farm, South Croxton [SK 6627 1049] where a chloride ion concentration of 220 mg/l was recorded, whilst at Borrough Court near Marefield [SK 7425 0080] it was noted that the water was highly corrosive to the pipes. There does not appear to be any particular correlation these instances of inferior quality water and borehole depths, the latter being highly variable.

The quality of water from the Marlstone Rock is generally good but hard and often ferruginous. Fox-Strangways (1903) indicated that groundwater from the Marlstone Rock was liable to contain elevated concentrations of iron, sometimes rendering it unsuitable for domestic use. As in the case of the Blue Lias and Charmouth mudstones, numerous boreholes and wells have been drilled and used to provide small-scale supplies from the Dyrham Formation and Marlstone Rock Formation but adverse comments regarding water quality are rare, suggesting that, in general, water of usable quality has been obtained.

4.5 INFERIOR OOLITE/NORTHAMPTON SAND FORMATION

The Northampton Sand Formation constitutes the basal unit of the Inferior Oolite Group throughout most of the East Midlands. Within the Leicester district the formation only occurs as small outliers located on the crest of hills. In consequence any recharge that enters these rocks rapidly drains through them and the formation does not constitute a viable aquifer within the district.

4.6 SUPERFICIAL DEPOSITS

The original water supply for Leicester was provided from shallow wells sunk in the alluvium and gravel river terraces associated with the River Soar. These wells would, however, have been relatively low yielding and highly prone to contamination from surface pollution. In addition, groundwater contained in the superficial deposits was most probably in hydraulic continuity with the River Soar and its tributaries and many of the wells would have been prone to dry up during prolonged periods without rainfall. These wells were abandoned as the city expanded and turned to more reliable potable sources of surface water to provide public supplies.

Few sources exist in the district that have obtained water supplies solely from the superficial deposits. There are, however, numerous records of shallow wells, presumably dug in the superficial deposits, that were later deepened by drilling a borehole through their floor into the underlying Mercia Mudstone or Lias rocks. The superficial deposits were commonly cased out, with water supplies being obtained from the underlying strata. This type of construction was also followed for many of the more recently drilled boreholes that penetrate appreciable thicknesses of superficial deposits, indicating that only small unusable quantities of groundwater were obtainable from these deposits.

The till (boulder clay) deposits are effectively impermeable but limited supplies have been obtained where lenses of sand and gravel occur within them. Limited supplies of water have also been obtained from glaciofluvial sand and gravel deposits. A number of wells drawing water from these deposits formerly provided supplies for individual villages in the district, but were abandoned as water mains were extended to provide supplies to the more rural areas. Archive records indicate that water levels and yields of many of these wells declined during prolonged dry periods and in some cases, the supply was not sufficient to meet demand.

Little water quality information is available for groundwaters from the superficial deposits but it is probable that the waters are generally of usable quality. These groundwaters are however highly prone to contamination from surface pollution, as is confirmed by comments on the records for few of the wells.

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