

WILLOW GROVE, BURY

PHASE 1: PRELIMINARY RISK ASSESSMENT

Job Number: LKC 23 1019

Date: March 2023

Client: Shape Consulting Engineers



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1 Introduction

LK Consult Ltd (LKC) has been commissioned to carry out a Phase 1 Preliminary Risk Assessment (PRA) for Willow Grove, Bury.

In accordance with current guidance (including LCRM¹ and the National Planning Policy Framework (NPPF)²), the PRA will include a site reconnaissance, site history, geology, hydrogeology, hydrology, mineral search and a landfill search. Information gathered from the desk study and site reconnaissance will be used to develop a contamination conceptual model for the site.

In addition, the information gathered will be used to identify potential geotechnical constraints associated with the redevelopment of the site.

Based on the findings of this report, an appropriate site investigation can be derived, if required.

Site details are provided in Table 1-1. Figure 1 shows the site location and boundary. Figure 2 shows the proposed development plan.

Site Location	To the southwest of the Maxwell Street and Willow Street Junction, Bury. Centred at approximate National Grid Reference 381800E 411040N.
Approximate Area	3700m ² .
Topography	98-99 metres Above Ordnance Datum (AOD). Site is approximately level.
Current Site Use	Residential apartments in the north of the site with retaining wall to the south (approximately 2.0m) Commercial units, storage units and car parking across the remaining of site.
Purpose of Report	Pre-planning.
Proposed Development	Residential apartments with soft landscaping.

Table 1-1: Summary of site details

¹ Land Contamination Risk Management (LCRM) <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

² "National Planning Policy Framework." The Ministry of Housing, Communities and Local Government. Published March 2012, Updated July 2021.

2 Historical Review

In compiling the site history, LKC consulted Envirocheck historical mapping (Appendix A).

Table 2-1 summarises features on site. Table 2-2 summarises potentially contaminative land uses within approximately 50m and potentially infilled features within approximate 250m.

Site Features	Location on Site	Dates Present		Comments
		From	To	
Site Undeveloped	Whole Site	1851	1938	Site developed by 1956 mapping.
Field Boundary	SE	1891	1931	No longer shown on 1937 mapping. Potentially infilled.
Commercial Buildings	N, NE, S, SW	1956	present	6no. buildings on 1956 mapping. Building in SW no longer present by 1959 mapping. Change of layout by 1959 mapping including additional building in centre of site. Building in southwest of site no longer present by 1999 mapping, potentially demolished. Additional building present by 2000 aerial photo. Change of layout by 2006 mapping, evidence building in the north demolished and built over with residential building.
Domestic Garages	W	1985	2000	Not annotated on 1999 mapping. No longer annotated by 2003 mapping.
Residential Building	N	2006	present	

Table 2-1: Summary of site features. Dates based on available historical map editions.

Surrounding Area Features	Distance (m)	Direction	Dates Present		Comments
			From	To	
Willow Street	2	E	1938	present	
Allotment Gardens	38	NE	1960	present	
2no. Wells	142	NE	1891	1931	No longer annotated by 1937 mapping. Potentially infilled.
	237	S	1851	only	No longer present by 1893 mapping. Potentially infilled.
Pond	168	S	1851	1930	Annotated as marsh land by 1930 mapping. No longer annotated by 1931 mapping. Potentially infilled.
Pits o'th Moor	192	NW	1851	only	No longer annotated by 1891 mapping. Potentially infilled.

Table 2-2: Summary of potentially contaminative features within 50m and potentially infilled features with 250m. Dates are based on available historical map editions.

3 Environmental Setting

A summary of environmental settings is presented in Table 3-1, based on a review of available environmental data.

Categories (data sources)		Details
Geology ^{1, 2}	Artificial	- No BGS recorded artificial.
	Superficial	- Till (diamicton).
	Bedrock	- Pennine Lower Coal Measures.
	BGS Logs (<50m)	- None.
Hydro-geology ¹	Aquifer Designation	- Superficial - Bedrock
	Source Protection Zone (SPZ)	- Secondary Undifferentiated Aquifer. - Secondary A Aquifer.
	Groundwater Abstractions (100m)	- Site not within an SPZ.
	Surface Water Courses (100m)	- None.
Hydrology ¹	Flooding risk	- No risk of flooding from river or seas without defences. - Potential for Groundwater Flooding to Occur at Surface.
	Surface Water Abstractions (100m)	- None.
	Discharge Consents (onsite)	- None.
	Pollution Incidents (onsite)	- None.
Minerals & Mining ^{1,3}	Coal Mining	- Within a Coal Reporting Area. - Not within a Development High Risk Area.
	Surface Mineral Extractions (250m)	- None.
	Cheshire Brine Compensation District	- Not within Compensation District.
	Non-Coal Mining Area	- No Hazard.
Ground Stability ¹	Collapsible Ground	- Very low hazard.
	Compressible Ground	- No hazard.
	Ground Dissolution	- No hazard.
	Landslide	- Very low hazard.
	Running Sand	- Very low hazard.
Landfill Sites (250m) ¹	Shrinking / Swelling Clay	- Very low hazard.
	Known / Registered	- None.
	Potentially Infilled Land (non-water and water), based on Envirocheck Report	- 3no. features: 25m NE, 53m S and 181m SE.
Radon Potential ¹	Potentially infilled sites, based on LKC historical review	- 1no. features on site: See Table 2-1. - 4no. features within 250m Table 2-2.
		- <1% of homes above Action Level. No protective measures are necessary in the construction of new dwellings or extensions.
Designated Sites (50m) ¹		- None.
Contemporary Trade Directory (50m) ¹		- None.
Fuel Station Entries (50m) ¹		- None.
Unexploded Ordnance Risk (UXO) – Zetica Risk Map	Zetica Risk Map ⁴	- Bomb Risk: Low. - Strategic Targets: None identified within 100m.

Table 3-1: Summary of the environmental setting.

Notes: Distance in brackets is the distance from site that features are included. Where no distance given, features relate to on site only.

Data Sources:

1 Envirocheck Report (Appendix A & B)

2 BGS GeoIndex <http://mapapps2.bgs.ac.uk/geoindex/home.html>

3 The Coal Authority Web Mapping Services (WMS) /

Interactive Map Viewer <http://coal.decc.gov.uk/en/coal/cms/publications/data/map/map.aspx>

4 Zetica UXO Unexploded Bomb Risk Map (Appendix C)

4 Site Reconnaissance

A site reconnaissance was carried out on 13th March 2023. The buildings on site were inaccessible during the site visit. No hand dug trial holes were undertaken due to proposed development area being hardstood; and at different ground level to remainder of site.

Relevant features identified on site are summarised below:

- Residential apartment block with soft landscaping in the north of site.
- Residential car park in the west of site, including garden area with shrubs and seating area. Tarmac noted to be in good condition with no evidence of spillages or leakages.
- Commercial units (Leisure Services Central Production Unit) with associated parking in the southeast; including 2no. garage units. Tarmac noted to be in good condition with some evidence of scarring from possible services.
- 1no. commercial unit built from brick, the remaining 2no. units noted to be metal frames with metal panelling.
- Southeast of site noted to be approximately 1.50m below remaining site level.
- Retaining wall (approximately 2m high) present the south of residential apartments in north of site. Visually in good condition with weepholes present for drainage; no cracks, bulging or damage noted in the brickwork.
- 2no. padlocked double access gates on Willow Street entrance (key required).
- Overhead BT cables noted to enter site from the eastern boundary.
- Several drainage manholes noted across site, with 1no. located within site entrance in southeast corner.
- Vehicle access to site off Willow Street.
- No evidence of fuel/oil storage on site during reconnaissance.
- No ACM noted on current on site buildings.
- No evidence of contamination identified, however did not have access inside on site units.

The surrounding area comprises residential buildings.

Relevant photographs are provided in Plate 4-1.

	
Photograph 1: View of site from north, including residential apartment block.	Photograph 2: View of site from eastern boundary.

	
Photograph 3: Double gated entrance with padlock on eastern boundary	Photograph 4: Existing commercial units on site.
	
Photograph 5: Retaining wall to south of residential block.	Photograph 6: View of southeast corner of site, from car park in west. Ground levels differ by approximately 1.50m.

Plate 4-1: Site photographs.



Plate 4-2: Plan showing site walkover features.

5 Preliminary Conceptual Model

5.1 Introduction

The aim of the conceptual model is to provide a preliminary assessment of the likelihood of a pollutant linkage for each potential combination of contaminant, pathway and receptor. A conceptual model can be used to make an informed decision on the contamination risks associated with the site and whether further site investigation work is required.

The Sections below are therefore divided into potential contaminant, potential pathway and potential receptor as described in LCRM³, on the premise that, if there is no pollutant linkage, then there will be no risk to the receptor. The final Section provides an assessment of the potential pollutant linkages that may still be present on the site if redevelopment were to occur.

5.2 Potential Contaminants

Potential viable contamination sources are detailed in Table 5-1. These are split into onsite sources, offsite sources and underlying geology.

Potential Source	Contaminants
On Site	
Shallow Made Ground below some or all of site (e.g. former buildings)	- Potentially infilled field boundaries are likely to have been excavated upon development of site, therefore not considered significant source. - Assuming predominantly reworked natural soils with possible demolition rubble, ash and clinker: Asbestos, heavy metals, sulphates, PAHs⁴. - Not expected to be a significant source of gas given anticipated depth and nature of Made Ground.
Demolished buildings	- Asbestos Containing Material (ACM).
Car park	- Assuming hardstood surface and no signs of spills / leaks on the site surface: No significant contamination source anticipated.
Residential property	- Assuming no demolition has occurred: No significant contamination source anticipated.
Commercial buildings	- No significant contamination source anticipated given site history. - No evidence of tanks/fuel storage on site. - Demolished buildings: ACM.
Domestic Garages	- No significant spillages/leakages anticipated due to domestic use. - Has since been developed for residential use in the north; remedial measures anticipated within north of site.

Table 5-1: Potential contamination sources.

³ Land Contamination Risk Management (LCRM) <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

⁴ Defra (2002). "Potential Contaminants for the Assessment of Land". R&D Publication CLR 8.

Surrounding Area	
Surrounding land uses (allotments)	- Not expected to be a significant source due to immobility of metals and PAHs in ash and clinker.
Surrounding area	- No significant contamination sources within influencing distance of the site.
Offsite potentially infilled features within 250m	- Given size, distance and age of features, there is not considered to be a significant source of hazardous gas.
Underlying Geology	
Underlying Pennine Lower Coal Measures	- Ground Gas (principally carbon dioxide and methane).
Superficial / Bedrock	- Glacial Till over Pennine Lower Coal Measures. - No significant contamination sources identified.

Table 5-1 (continued): Potential contamination sources.

5.3 Potential Receptors

Potential receptors are detailed in Table 5-2.

Receptors	
Human Health	- Future site users (including residents, visitors and site workers). - Offsite land users.
Controlled Waters	- Secondary Undifferentiated Aquifer (superficial). - Secondary A Aquifer (bedrock). - No surface water within influencing distance.
Buildings.	
Potable water pipes.	

Table 5-2: Potential receptors.

5.4 Potential Pathways

Potential pathways are detailed in Table 5-3.

Pathways		
Soil	Human Health ⁵ (residential land use: apartments with shared landscaping)	- Ingestion of soil. - Ingestion of soil-derived indoor dust. - Dermal contact with soil. - Dermal contact with soil-derived indoor dust. - Inhalation of soil-derived outdoor dust. - Inhalation of soil-derived indoor dust. - Inhalation of vapours outside. - Inhalation of vapours inside.
		- Omitted as no private gardens: ingestion of contaminated home-grown produce and ingestion of soil attached to home-grown produce.
		- Windblown dust and fibres to adjacent receptors.
		- Direct contact with receptors (services).
Water		- Surface run-off over impermeable surface.
		- Site is predominantly hardstood; therefore, infiltration is likely to be limited.
Water and Gas		- Migration through potentially permeable strata and preferential pathways. - Superficial (Till) likely to be low permeability. - Bedrock (mudstone, siltstone, sandstone) likely to be variably permeable. - Preferential pathways: services.
Gas		- Migration into buildings (e.g. via services) and accumulation of gases in confined spaces (potentially causing explosion if methane is present).

Table 5-3: Potential pathways.

⁵ EA (2008). "Updated Technical Background to the CLEA Model". Science Report – SC050021/SR3.

5.5 Preliminary Contamination Conceptual Model

The Preliminary Contamination Conceptual Model is illustrated in Table 5-4 and has identified five generic potential pollutant linkages.

Each linkage is described along with an assessment of the risk based upon guidance on probabilities and consequences outlined in CIRIA C552⁶.

In order to assess the potential risk for each pollutant linkage, an assessment of the magnitude of the potential consequence (severity) of the risk occurring and the magnitude of the probability (likelihood) of the risk occurring has been considered and classified. This is based on the guidance provided in CIRIA C552 and further details including a risk matrix is provided in Appendix D.

Where LKC identified a low to very low risk, targeted or low density intrusive investigation work, a watching brief (during construction work) or no investigation work will be recommended. This will be dependent on the nature of the site and the proposed development.

Where the risk falls into the moderate/low risk, LKC will undertake an assessment to establish what category the pollutant linkage will fall into (i.e. moderate or low risk will be chosen).

Where LKC identifies a moderate or higher risk, intrusive investigation work or precautionary remedial measures will be recommended.

Due to the minor consequence associated with the phytotoxic effect to flora (i.e. loss of plants in a landscaping scheme), the overall risk for the majority of sites will be very low to low. Where soils contain significant concentrations of heavy metals, in general there will other pollutant linkages (i.e. the risk to human health) that will trigger the requirement for remediation (e.g. a clean environmental cover system). As such the risk to flora associated with phytotoxic contaminants will not be considered further.

The risk to buildings associated with elevated sulphate will be considered as part of the geotechnical assessment and will not be included in the contamination risk assessment.

It should be noted that there may be risk from short term exposure from contaminated soil to site workers. The Preliminary Contamination Conceptual Model deals with long term exposure to key receptors. Acute risks can be easily mitigated by good environmental management of the site during site works. Standard health and safety precautions (as per HSE guidance⁷) should be adopted by all workers involved with site enabling and construction works. Therefore, this receptor is not considered in the contamination conceptual model.

⁶ CIRIA (2001). "Contaminated Land Risk Assessment: A Guide to Good Practice". C552.

⁷ HSE (1991). "Protection of Workers and the General Public During Development of Contaminated Land". London HMSO.

PL	Pathway	Receptor	Contaminants of Concern (CoC)	Probability	Consequence	Risk	Recommendations
1	- Dermal contact. - Inhalation of soil, fibres and dust. - Ingestion of soils, dust - Windblown dust.	- Future site users. - Offsite receptors.	- ACM. - Heavy metals. - PAHs.	Likely (given site history, site conditions and proposed end use)	Medium	Moderate	Intrusive investigation required. Soil analysis of CoC, subject to ground conditions encountered. Pre-Demolition and Major Refurbishment Asbestos Survey recommended.
			- Petroleum hydrocarbons.	Low likelihood (given site history, site conditions and proposed end use)	Medium	Moderate / Low (moderate assumed until ground conditions confirmed)	Intrusive investigation required. Soil analysis of CoC, subject to ground conditions encountered.
2	- Inhalation of vapours. - Migration via permeable strata and preferential pathways.	- Future site users. - Offsite receptors.	- Volatile contaminants (TPHCWG, SVOC, VOCs).	Low likelihood (given site history, site conditions and proposed end use)	Medium	Moderate / Low (moderate assumed until ground conditions confirmed)	Intrusive investigation required, to include PID testing. Soil analysis of CoC, subject to ground conditions encountered and PID testing.
3	- Inhalation of gas. - Migration via permeable strata and preferential pathways. - Explosion in confined spaces.	- Future site users. - Buildings. - Offsite land users.	- Ground / hazardous gas (carbon dioxide, methane).	Unlikely (given limited no viable gas source and limited pathway)	Severe	Moderate / Low (moderate risk assumed until depth of made ground confirmed)	Intrusive investigation to confirm ground conditions. If significant gas source and pathway identified, gas monitoring or gas protection measures required.
4	- Surface run-off. - Migration via permeable strata and preferential pathways. - Perched waters migration.	- Groundwater (Secondary A Aquifer, Secondary Undifferentiated Aquifer).	- Mobile contaminants such as metals, PAHs, hydrocarbons, VOCs, SVOCs	Low Likelihood (only limited mobile contamination anticipated, with limited pathway)	Medium	Moderate / Low (moderate assumed until ground conditions confirmed)	Intrusive investigation required. Groundwater sampling, subject to ground conditions encountered. Analysis of CoC.
5	- Ingestion of tainted water supply.	- Future site users. - Water pipes.	- Organic contaminants such as petroleum hydrocarbons, naphthalene, VOCs.	Low Likelihood (although some contamination may be present, significant contamination not expected at pipeline depth)	Medium	Moderate / Low (moderate risk assumed until ground conditions confirmed)	Intrusive investigation required. Soil analysis of CoC, subject to ground conditions encountered.

Table 5-4: Preliminary Contamination Conceptual Model.

Notes: PL = Pollutant Linkage. Contaminant of Concern (CoC) - See Table 5-1 for contamination sources. Site conditions based on observations during site reconnaissance.

6 Preliminary Geotechnical Risk Assessment

Table 6-1 summarises the possible geotechnical constraints of the site, based on the site history, environmental settings and site reconnaissance. Investigation work will be required to confirm the risks and provide a detailed geotechnical assessment and foundation design.

Coal Mining	Site is not within a Development High Risk Area. No further assessment required.
Slope Stability	Site is relatively flat. No significant slope stability risk anticipated. No further assessment required.
Retaining Wall	Retaining wall identified on site to the south side of the existing residential apartments. Approximately 2.0m in height. Visually in good condition with weepholes present for drainage; no cracks, bulging or damage noted in the brickwork.
Envirocheck Ground Stability Hazards	No to low hazard identified. No further action required.
Made Ground	Unknown depth and constituent of made ground across the site. Initial information indicates relatively shallow made ground. Possible in-ground structures from previous developments. Unlikely to be a suitable founding strata unless engineering work is undertaken.
Superficial	Unknown strength of soils for foundation design. Clay anticipated below the site.
Bedrock	Unknown depth to bedrock.
Groundwater	Unknown depth and variability of groundwater. Shallow / fluctuating groundwater can affect the strength of the soil, particularly in granular ground. Shallow groundwater can also affect construction works.
Plasticity	Plasticity of clay deposits should be confirmed, particularly where trees are present or proposed, to identify the shrink / swell risk. Clay recorded on site.
Sulphate	Unknown sulphate content of the made ground and natural.
Road / Pavement Design	Unknown CBR values for footpath and road design.

Table 6-1: Summary of geotechnical constraints.

7 Summary Conclusions and Recommendations

7.1 Summary Conclusions

Table 7-1 summarises the site details, historical review, environmental settings and site reconnaissance.

Current Site Use	Residential apartments in the north of the site. Commercial units, storage units and car parking across the remaining of site.
Proposed Development	Residential apartments with soft landscaping.
Main Historical Features	Onsite: Field boundary, Unannotated Buildings, Residential Building, Domestic Garages. Surrounding Area: Willow Street, Allotment Gardens, Wells, Pond, Pit.
Geology / Hydrogeology	Artificial: No BGS recorded artificial. Superficial: Glacial Till (clay). Secondary Undifferentiated Aquifer. Bedrock: Pennine Lower Coal Measures (mudstone, siltstone, sandstone). Secondary A Aquifer.
Landfills / Infilled ground	No recorded landfills. Potentially infilled ground identified.
Site walkover	Residential apartments in the north with associated car park in the west of site; commercial units with car parking in the southeast of site; manholes and overhead services noted on site (BT, water, drainage, gas); the southeast of site noted to be 1.50mbgl below ground level of the remainder of site.

Table 7-1: Summary of site details, historical review, environmental settings and site reconnaissance.

A preliminary contamination conceptual model has been produced by LKC, which is summarised in Table 7-2.

Pollutant Linkage		Risk	Recommendations
PL1: Contaminants posing a risk to future site users via dermal contact, ingestion and inhalation (of soil, dust, fibres and home-grown produce).	ACM, heavy metals, PAHs	Moderate	Intrusive investigation required. Soil analysis of CoC, subject to ground conditions encountered. Pre-Demolition and Major Refurbishment Asbestos Survey is undertaken prior to demolition
	Petroleum hydrocarbons	Moderate / Low	Intrusive investigation required. Soil analysis of CoC, subject to ground conditions encountered.
PL2: Volatile contaminants (TPHCWG, SVOC, VOCs) posing a risk to future site users via the inhalation of vapours.		Moderate / Low	Intrusive investigation required, to include PID testing. Soil analysis of CoC, subject to ground conditions encountered and PID testing.
PL3: Gas (carbon dioxide and methane) posing a risk to buildings and future site users via the migration of gas into building causing explosion and asphyxiation.		Moderate / Low	Intrusive investigation to confirm ground conditions. If significant gas source and pathway identified, gas monitoring or gas protection measures required.
PL4: Mobile contamination (metals, PAHs, hydrocarbons, VOCs, SVOCs) posing a risk to controlled waters via the migration through permeable strata.		Moderate / Low	Intrusive investigation required. Groundwater sampling, subject to ground conditions encountered. Analysis of CoC.
PL5: Organic contaminants (as petroleum hydrocarbons, naphthalene, VOCs) posing a risk to water pipes.		Moderate / Low	Intrusive investigation required. Soil analysis of CoC, subject to ground conditions encountered.

Table 7-2: Summary risk table.

Where moderate / low risk had been identified, the assumed risk is shown in bold.

A preliminary geotechnical assessment has been carried out by LKC. Table 7-3 summarises the geotechnical constraints.

Coal Mining	Site is not within a Development High Risk Area. No further assessment required.
Slope Stability	Site is relatively flat. No significant slope stability risk anticipated. No further assessment required.
Retaining Wall	Retaining wall identified on site to the south side of the existing residential apartments. Approximately 2.0m in height. Noted to be in good condition. No further assessment required.
Made Ground	Unknown depth and constituent of made ground across the site. Initial information indicates relatively shallow made ground. Possible in-ground structures from previous developments. Unlikely to be a suitable founding strata unless engineering work is undertaken.
Superficial	Unknown strength of soils for foundation design. Clay anticipated below the site.
Bedrock	Unknown depth to bedrock.
Groundwater	Unknown depth and variability of groundwater. Shallow / fluctuating groundwater can affect the strength of the soil, particularly in granular ground. Shallow groundwater can also affect construction works.
Plasticity	Plasticity of clay deposits should be confirmed, particularly where trees are present or proposed, to identify the shrink / swell risk. Clay recorded on site.
Sulphate	Unknown sulphate content of the made ground and natural.
Road / Pavement Design	Unknown CBR values for footpath and road design.

Table 7-3: Summary of geotechnical constraints.

7.2 Recommendations

Recommendations are provided in Table 7-4.

Contamination status	There is sufficient information on the potential contaminative status of the site to allow conditional approval of a planning application, based on the proposed end use detailed in the PRA.
Further assessment recommendations	Phase 2 intrusive investigation required. Phase 2 investigation to be carried out in line with current guidance, including BS10175 ⁸ , BS5930 ⁹ CIRIA C665 ¹⁰ , RB17 ¹¹ and BS8485 ¹² . Either 'exploratory investigation': 1 sample per 25-50m square centres. Or 'detailed investigation': 1 sample per 10-25m square centres. Plus targeted investigation locations in areas of concern (contamination and geotechnical). To be agreed with the local authority.
Type of investigation work	Boreholes.
PL 1, 2, 5	Intrusive investigation work recommended to confirm ground conditions across the site. Testing of contaminants of concern based on preliminary conceptual model and field observations (PID tests and visual / olfactory evidence).
PL 3	Intrusive investigation to confirm ground conditions. If significant gas source and pathway identified, gas monitoring required. Gas monitoring: monitoring wells to be installed in boreholes, monitoring frequency and period subject to anticipated risk. Precautionary gas protection measures: type of measures to be determined once ground conditions established.
PL 4	Groundwater sampling, subject to ground conditions encountered. Groundwater samples to be collected from monitoring wells and tested for contaminants of concern based on preliminary conceptual model and ground conditions encountered.
Reporting	Information from the above can be used to carry out a contamination and geotechnical assessment and provide a remediation strategy for the site.

Table 7-4: Recommendations.

⁸ British Standard (2017). "Investigation of Potentially Contaminated Sites – Code of Practice". BS10175:2017.

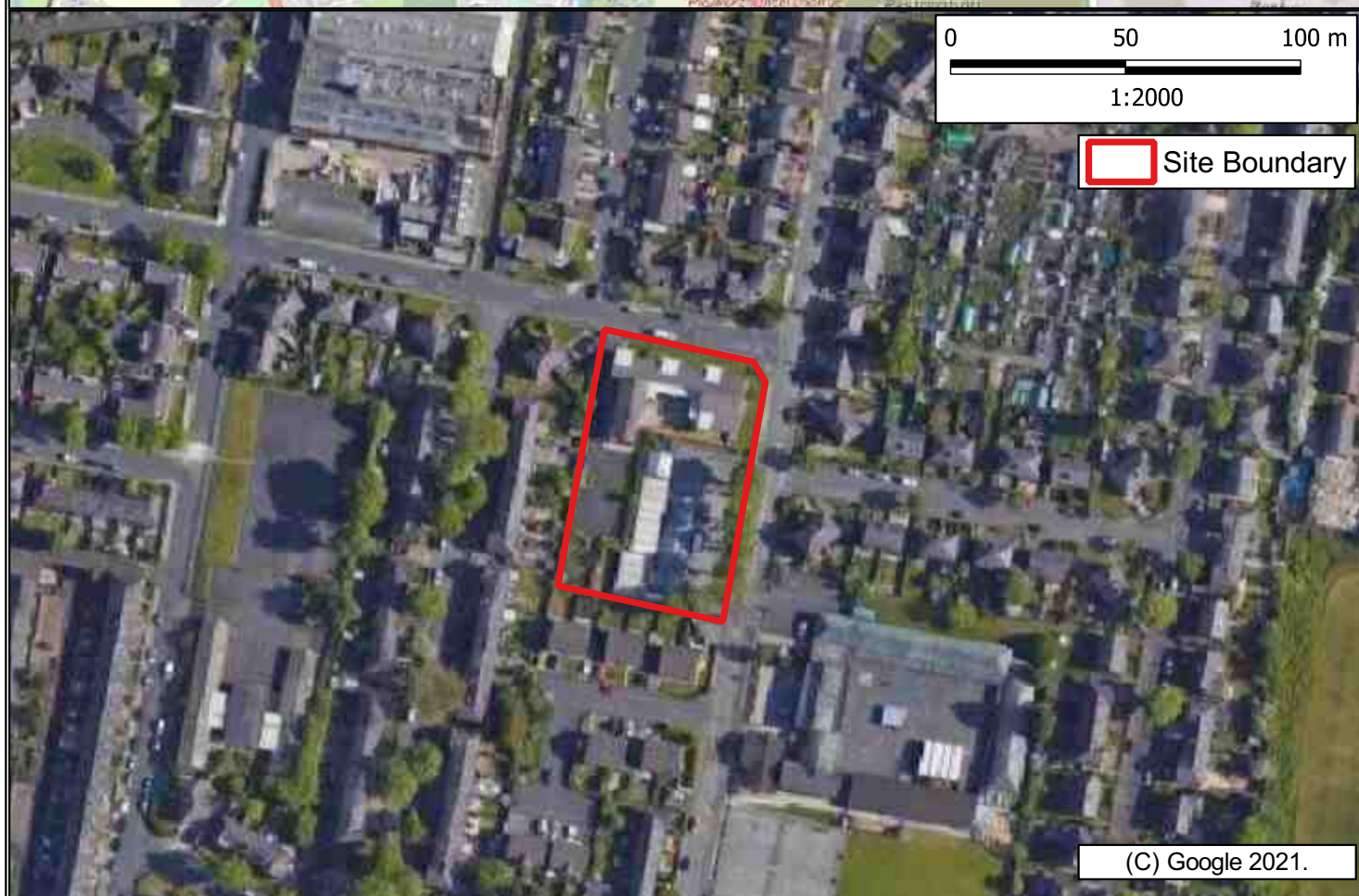
⁹ British Standard (2015). "Code of Practice for Ground Investigations". BS5930:2015.

¹⁰ CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings". CIRIA C665.

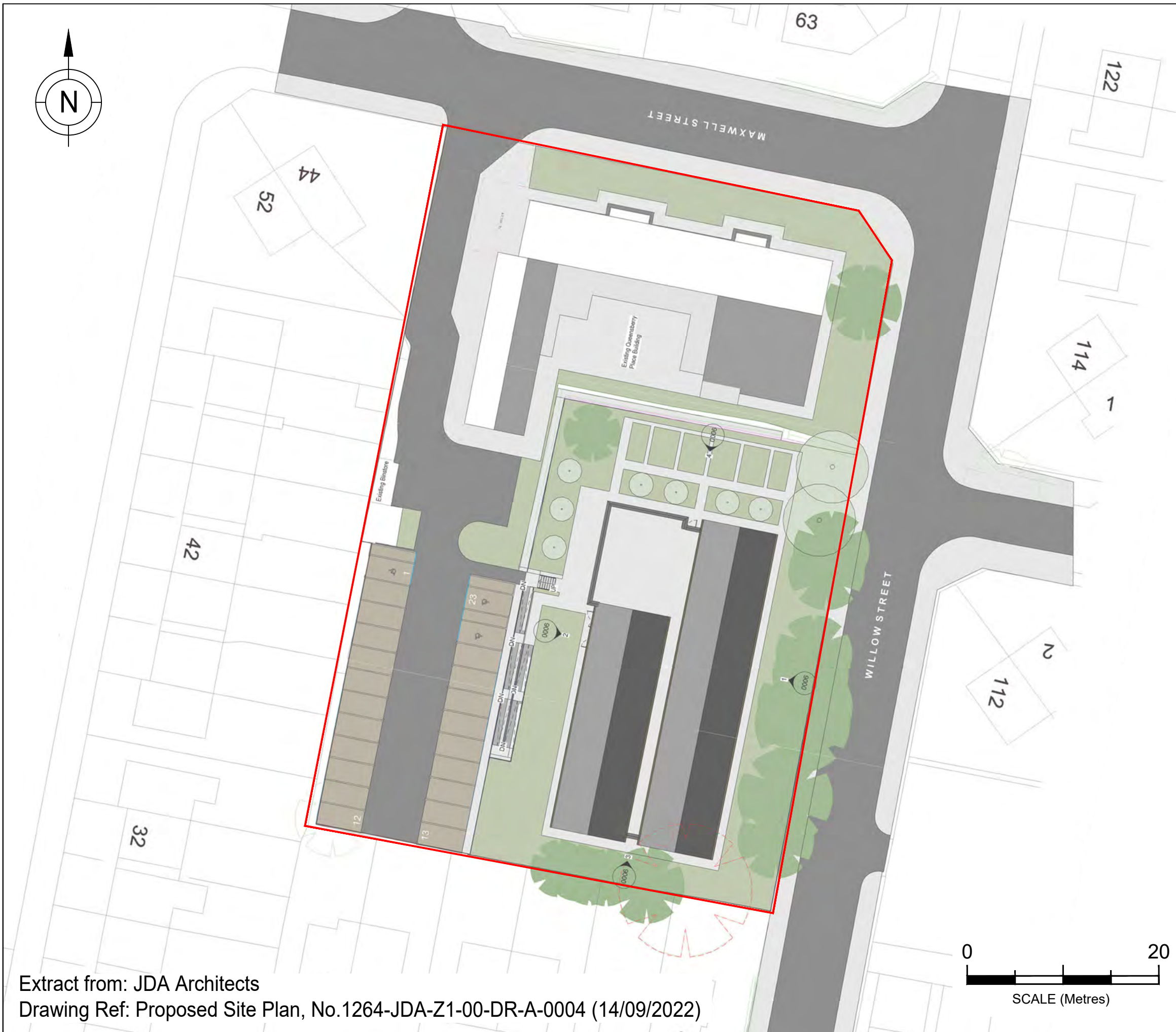
¹¹ CL:AIRE Research Bulletin RB17 (November 2012) "A Pragmatic Approach to Ground Gas Risk Assessment".

¹² BSI (2015). "Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings". BS8485:2015.

Figures



Client: Shape Consulting Engineers				Title: Site Location & Boundary Plan		
Site: Willow Grove, Bury				Scale (see scale bar): 1:20,000 & 1:2,000 @ A4		
Job No.: LKC 23 1019	Drawn By: RW	Checked By: BRH	Drawn: March 2023	Figure: 1	Revision:	



KEY



Site Boundary

Proposed Tree Amendments



Tree to be retained



Tree planted as part of the proposal



Tree to be removed

Note: See landscaping proposal for full details

Proposed Boundary Treatment Details



1100mm Metal Railing



1800mm Timber Fence

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.



Client:
Shape Consulting Engineers

Site:
Willow Grove, Bury

Title:
Proposed Development Plan

Job No.:	Scale (See Scale Bar):	Figure:	Revision:
LKC 23 1019	See Scale Bar	2	
Drawn By:	Checked By:	Drawn:	
AC	BR	Mar 2023	

Appendix A

Historical Maps

Historical Mapping Legends

Ordnance Survey County Series 1:10,560

	Gravel Pit		Sand Pit		Other Pits
	Quarry		Shingle		Orchard
	Osiers		Reeds		Marsh
	Mixed Wood		Deciduous		Brushwood
	Fir		Furze		Rough Pasture
	Arrow denotes flow of water		Trigonometrical Station		
	Site of Antiquities		Bench Mark		
	Pump, Guide Post, Signal Post		Well, Spring, Boundary Post		
	285 Surface Level				
	Sketched Contour		Instrumental Contour		
	Main Roads		Minor Roads		
	Sunken Road		Raised Road		
	Road over Railway		Railway over River		
	Railway over Road		Level Crossing		
	Road over River or Canal		Road over Stream		
	Road over Stream				
	County Boundary (Geographical)				
	County & Civil Parish Boundary				
	Administrative County & Civil Parish Boundary				
	County Borough Boundary (England)				
	County Burgh Boundary (Scotland)				
	Rural District Boundary				
	Civil Parish Boundary				

Ordnance Survey Plan 1:10,000

	Chalk Pit, Clay Pit or Quarry		Gravel Pit
	Sand Pit		Disused Pit or Quarry
	Refuse or Slag Heap		Lake, Loch or Pond
	Dunes		Boulders
	Coniferous Trees		Non-Coniferous Trees
	Orchard		Scrub
	Bracken		Heath
	Marsh		Reeds
	Building		Glasshouse
	Sloping Masonry		Pylon
	Cutting		Embankment
	Road Under		Road Over
	Level Crossing		Foot Bridge
	Standard Gauge Multiple Track		Standard Gauge Single Track
	Siding, Tramway or Mineral Line		Narrow Gauge
	Geographical County		Administrative County, County Borough or County of City
	Municipal Borough, Urban or Rural District, Burgh or District Council		Borough, Burgh or County Constituency
	Civil Parish		
	BP, BS		Ch
	CH		F E Sta
	FB		Fn
	GP		MP
	MS		Pol Sta
	PO		PC
	PH		SB
	Spr		TCB
	TCP		W
	Police Station		Post Office
	Public Convenience		Public House
	Signal Box		Spring
	Telephone Call Box		Telephone Call Post
	Well		

1:10,000 Raster Mapping

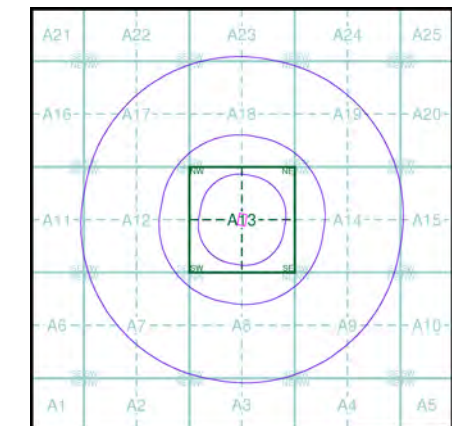
	Gravel Pit		Refuse tip or slag heap
	Rock		Rock (scattered)
	Boulders		Boulders (scattered)
	Shingle		Mud
	Sand		Sand Pit
	Slopes		Top of cliff
	General detail		Underground detail
	Overhead detail		Narrow gauge railway
	Multi-track railway		Single track railway
	County boundary (England only)		Civil, parish or community boundary
	District, Unitary, Metropolitan, London Borough boundary		Constituency boundary
	Area of wooded vegetation		Non-coniferous trees
	Non-coniferous trees (scattered)		Coniferous trees
	Coniferous trees (scattered)		Positioned tree
	Orchard		Coppice or Osiers
	Rough Grassland		Heath
	Scrub		Marsh, Salt Marsh or Reeds
	Water feature		Flow arrows
	Mean high water (springs)		Mean low water (springs)
	Telephone line (where shown)		Electricity transmission line (with poles)
	Bench mark (where shown)		Triangulation station
	Point feature (e.g. Guide Post or Mile Stone)		Pylon, flare stack or lighting tower
	Site of (antiquity)		Glasshouse
	General Building		Important Building



Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Lancashire And Furness	1:10,560	1851	3
Lancashire And Furness	1:10,560	1894	4
Lancashire And Furness	1:10,560	1910 - 1911	5
Lancashire And Furness	1:10,560	1931	6
Lancashire And Furness	1:10,560	1938 - 1939	7
Ordnance Survey Plan	1:10,000	1955 - 1956	8
Ordnance Survey Plan	1:10,000	1965 - 1967	9
Ordnance Survey Plan	1:10,000	1974	10
Manchester	1:25,000	1975	11
Ordnance Survey Plan	1:10,000	1983 - 1984	12
10K Raster Mapping	1:10,000	1999	13
10K Raster Mapping	1:10,000	2006	14
VectorMap Local	1:10,000	2022	15

Historical Map - Slice A



Order Details

Order Number: 307891304_1_1
 Customer Ref: LKC 23 1019
 National Grid Reference: 381800, 411040
 Slice: A
 Site Area (Ha): 0.37
 Search Buffer (m): 1000

Site Details

Willow Street, Maxwell Street, Bury, BL9 7PY

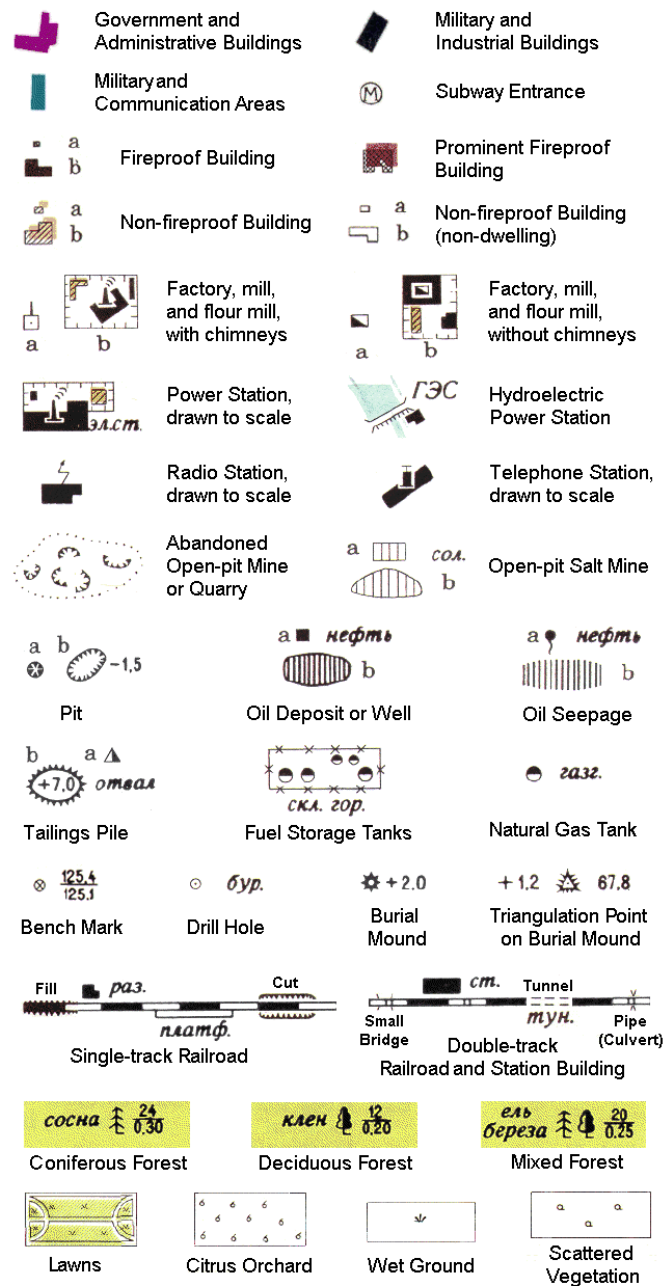


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Russian Military Mapping Legends

1:5,000 and 1:10,000 mapping

a. Not drawn to scale b. Drawn to scale



243.8 Values for prominent elevations

186.0 Numbers for spot elevations, depth soundings, contour lines, etc.

0.2 Velocity of the current, width of river bed, depth of river

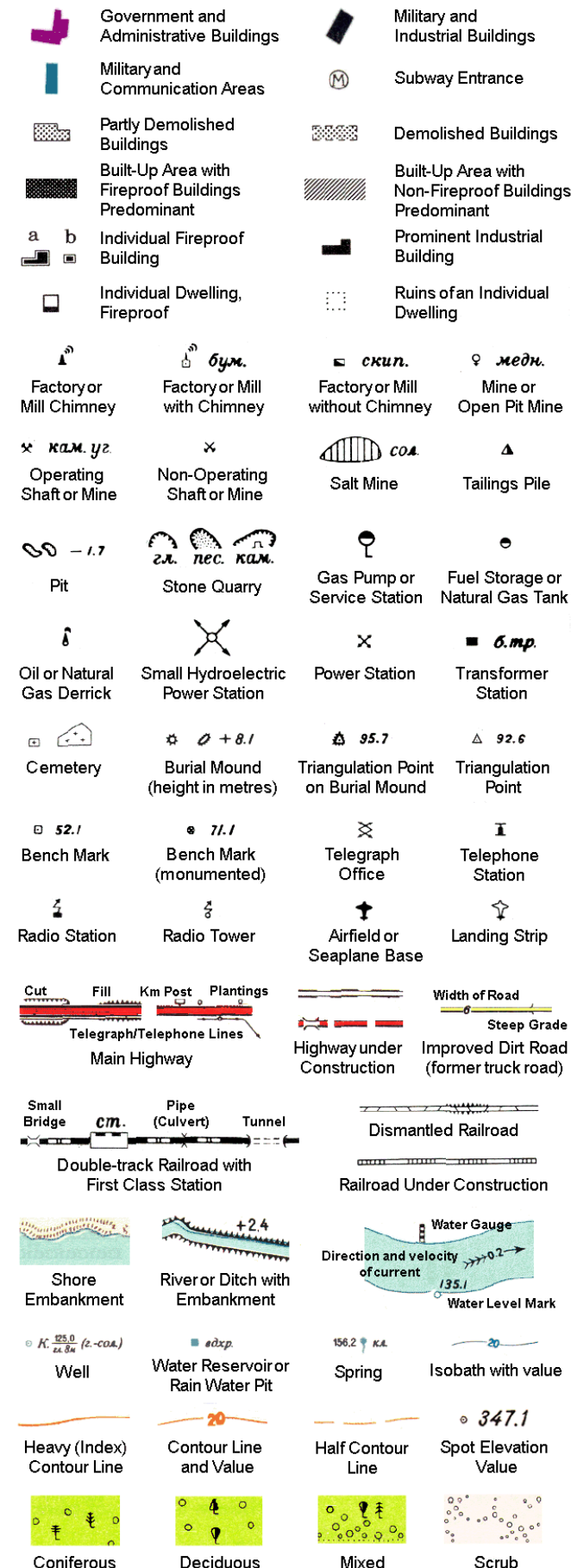
180/12 Fractional terms: length and capacity of bridges; depth of fords and condition of the river bottom; height of forest and the diameter of trees

Russian Alphabet (For reference and phonetic interpretation of map text)

А а (A)	З з (Z)	П п (P)	Ч ч (CH)
Б б (B)	И и (I)	Р р (R)	Ш ш (SH)
В в (V)	Й й (Y)	С с (S)	Щ щ (SHCH)
Г г (G)	К к (K)	Т т (T)	Ъ (-)
Д д (D)	Л л (L)	У у (U)	Ы (Y)
Е е (E)	М м (M)	Ф ф (F)	Ь (')
Ё ё (YO)	Н н (N)	Х х (KH)	Э э (E)
Ж ж (ZH)	О о (O)	Ц ц (TS)	Ю ю (YU or IU)
			Я я (YA or IA)

1:25,000 mapping

a. Not drawn to scale b. Drawn to scale



Key to Numbers on Mapping

SD81_Manchester

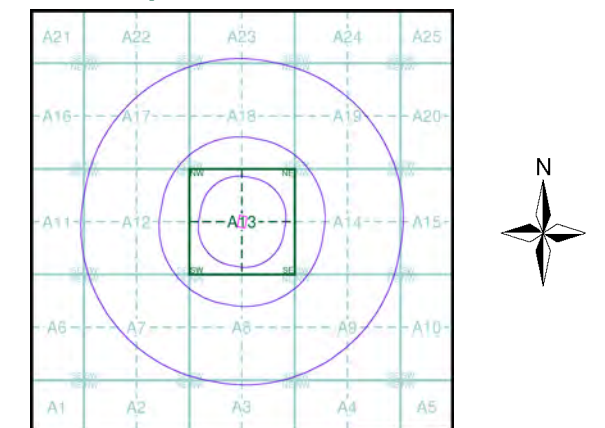
No.	Description
16	Depot (Bus)



Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Lancashire And Furness	1:10,560	1851	3
Lancashire And Furness	1:10,560	1894	4
Lancashire And Furness	1:10,560	1910 - 1911	5
Lancashire And Furness	1:10,560	1931	6
Lancashire And Furness	1:10,560	1938 - 1939	7
Ordnance Survey Plan	1:10,000	1955 - 1956	8
Ordnance Survey Plan	1:10,000	1965 - 1967	9
Ordnance Survey Plan	1:10,000	1974	10
Manchester	1:25,000	1975	11
Ordnance Survey Plan	1:10,000	1983 - 1984	12
10K Raster Mapping	1:10,000	1999	13
10K Raster Mapping	1:10,000	2006	14
VectorMap Local	1:10,000	2022	15

Russian Map - Slice A



Order Details

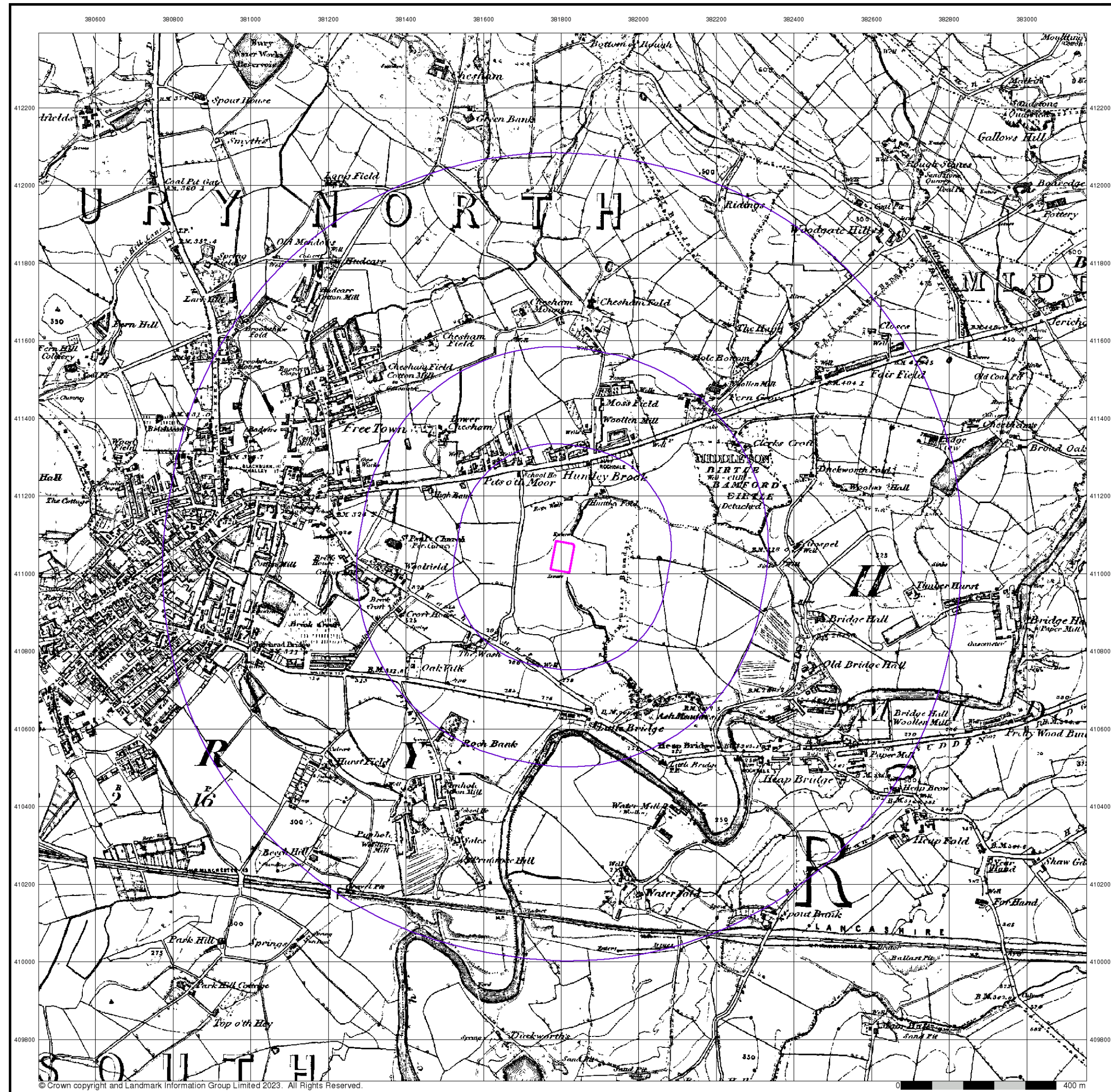
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 Search Buffer (m): 1000

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LK

GROUP

Lancashire And Furness

Published 1851

Source map scale - 1:10,560

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Map Name(s) and Date(s)

08800
1851
1:10,560

Historical Map - Slice A

A21

A22

A23

A24

A25

A16

A17

A18

A19

A20

A11

A12

A13

A14

A15

A6

A7

A8

A9

A10

A1

A2

A3

A4

A5

N

Order Details

Order Number:

307891304_1_1

Customer Ref:

LKC 23 1019

National Grid Reference:

381800, 411040

Slice:

A

Site Area (Ha):

0.37

Search Buffer (m):

1000

Site Details

Willow Street, Maxwell Street, Bury, BL9 7PY

Landmark

INFORMATION GROUP

Tel:

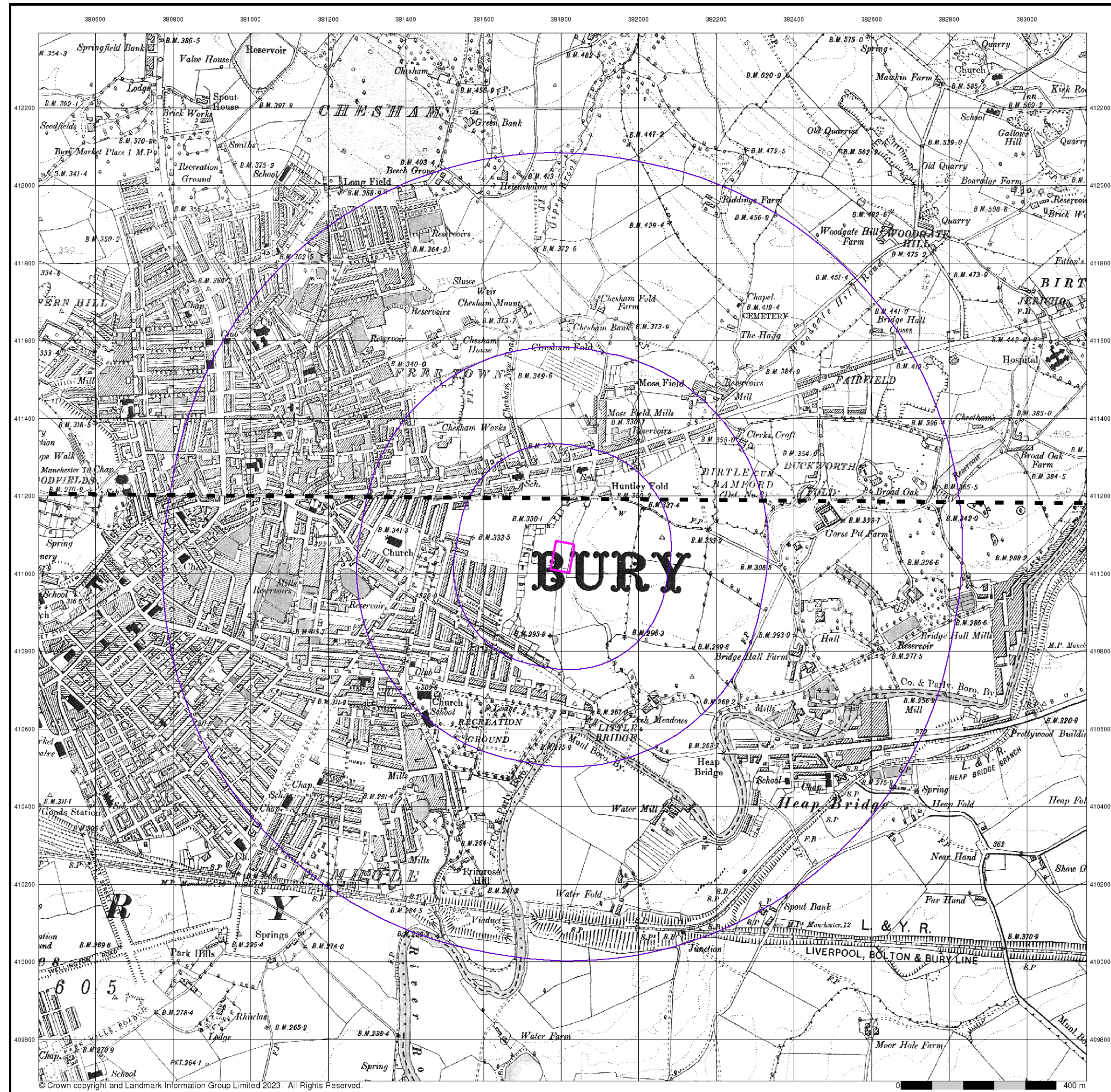
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LK GROUP

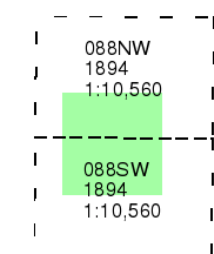
Lancashire And Furness

Published 1894

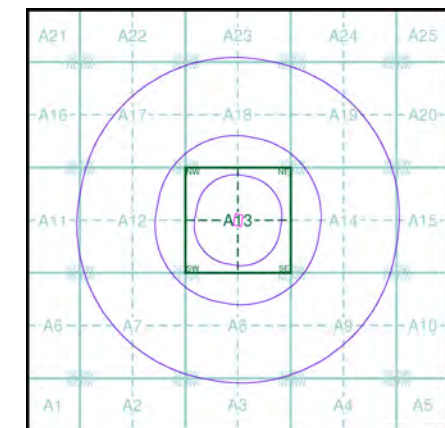
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

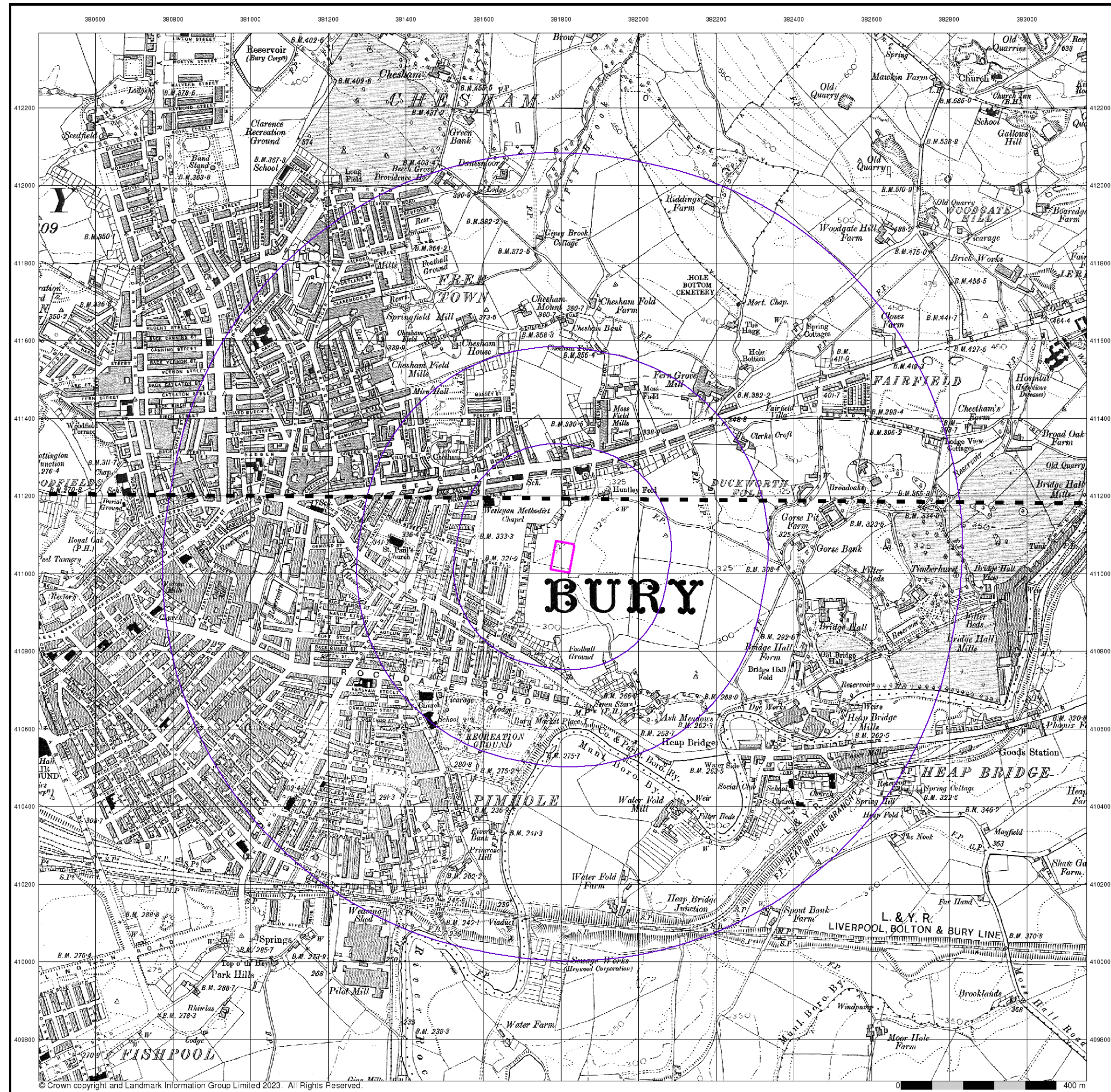
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Site Details

Willow Street, Maxwell Street, Bury, BL9 7PY



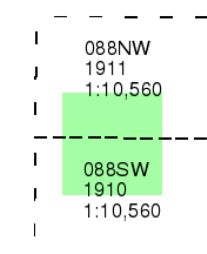
Tel: 0844 844 9952
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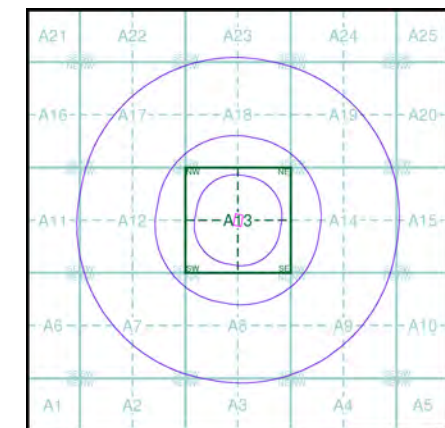
LK GROUP
Lancashire And Furness
Published 1910 - 1911
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

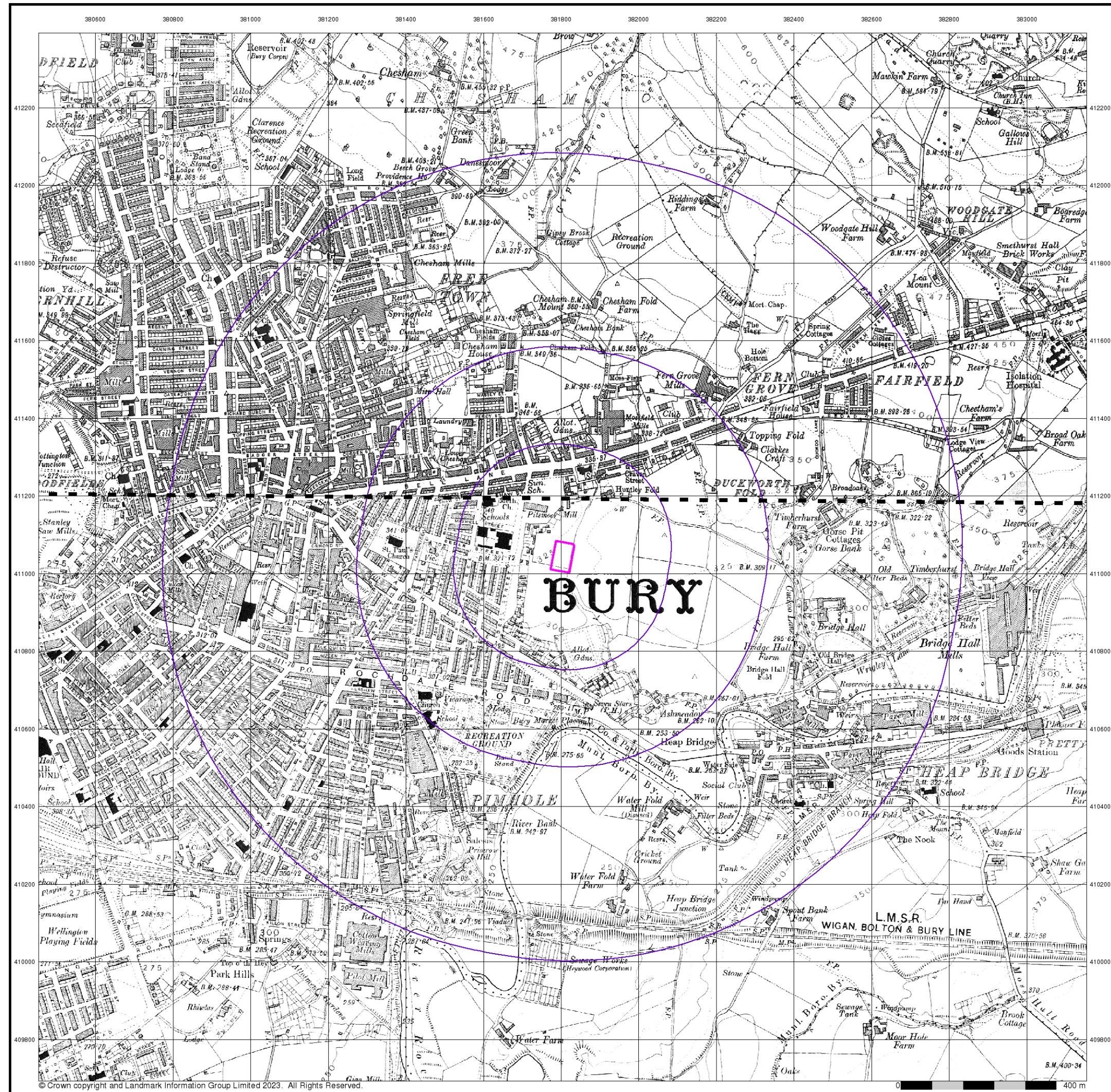
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Slice: A
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Search Buffer (m): 1000

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Landmark
INFORMATION GROUP

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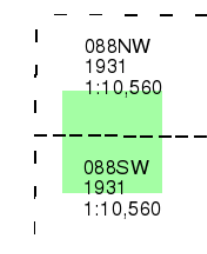
Landmark GROUP Lancashire And Furness

Published 1931

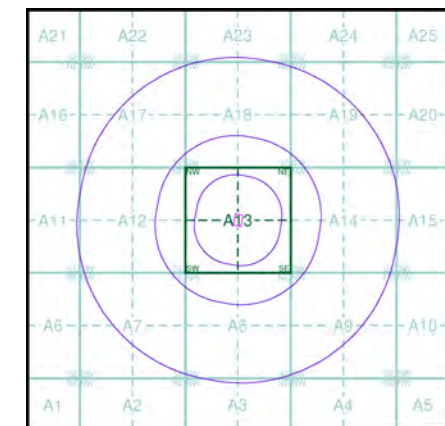
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

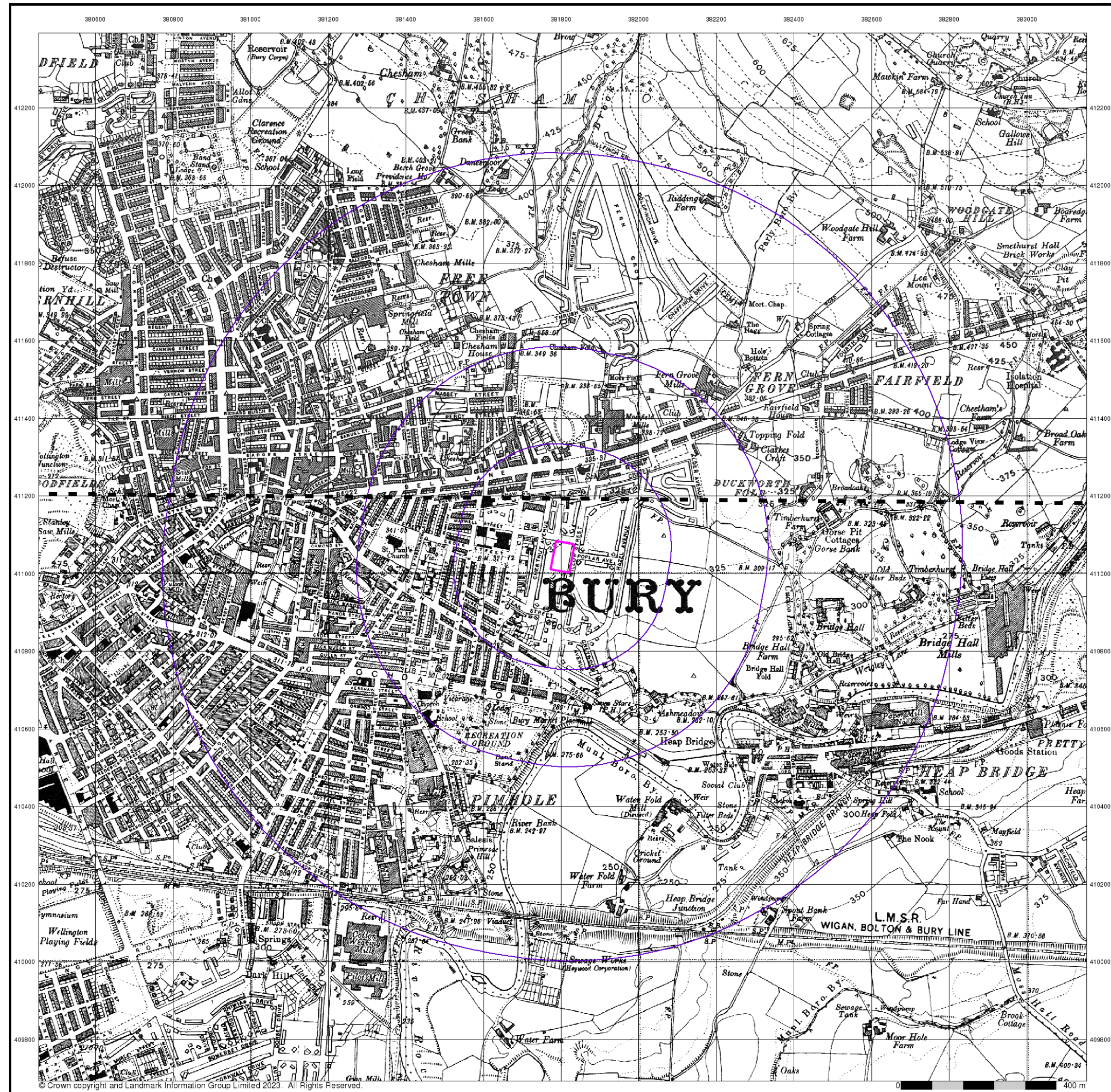
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Site Area (Ha): 0.37
Search Buffer (m): 1000

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Lancashire And Furness

Published 1938 - 1939

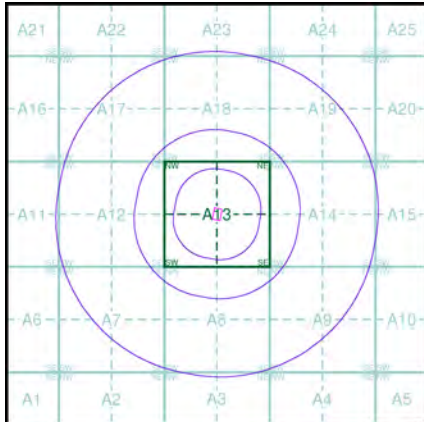
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

088NW	1939	1:10,560
088SW	1938	1:10,560

Historical Map - Slice A



Order Details

Order Number:	307891304_1_1
Customer Ref:	LKC 23 1019
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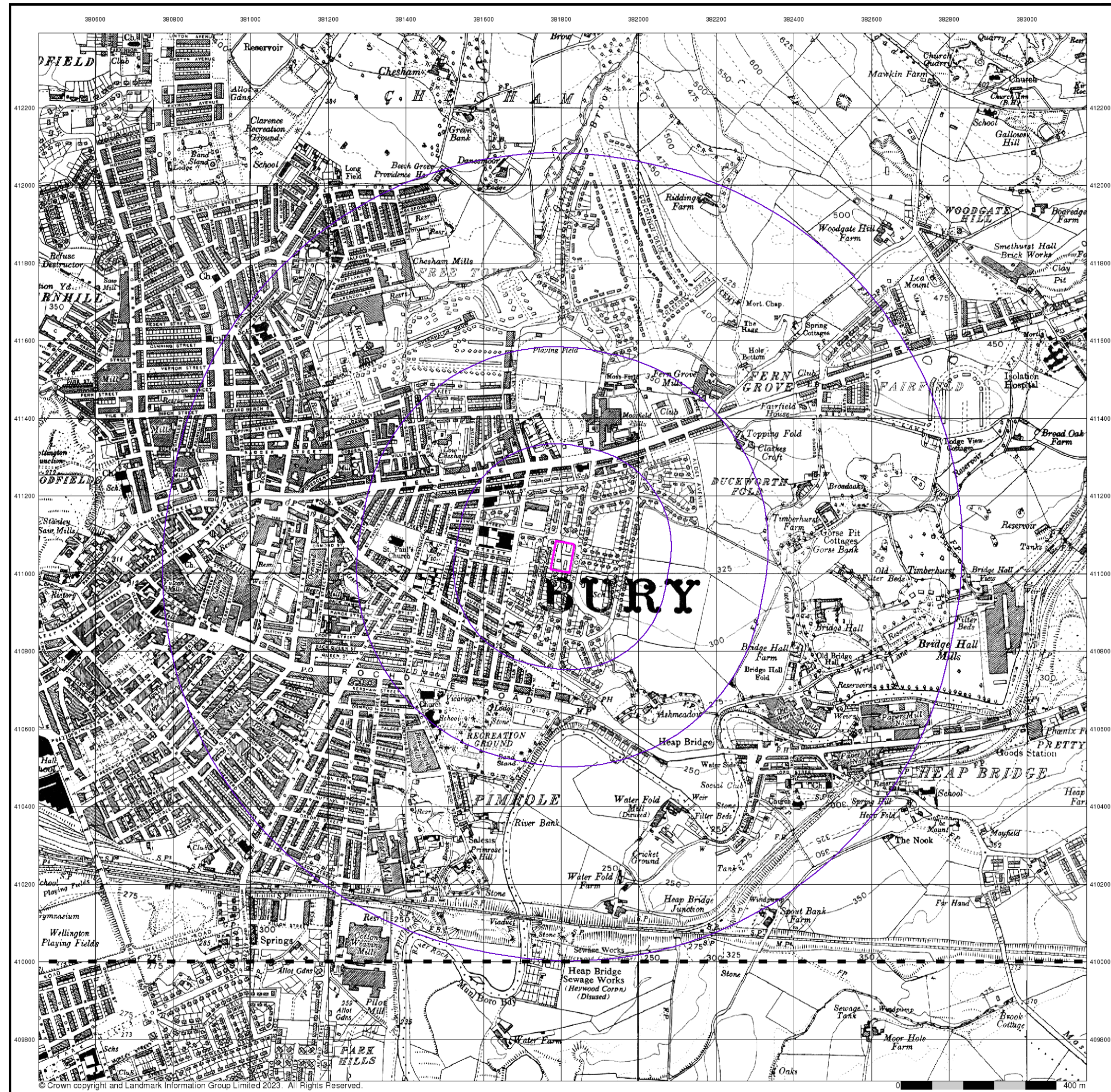
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GROUP

Ordnance Survey Plan

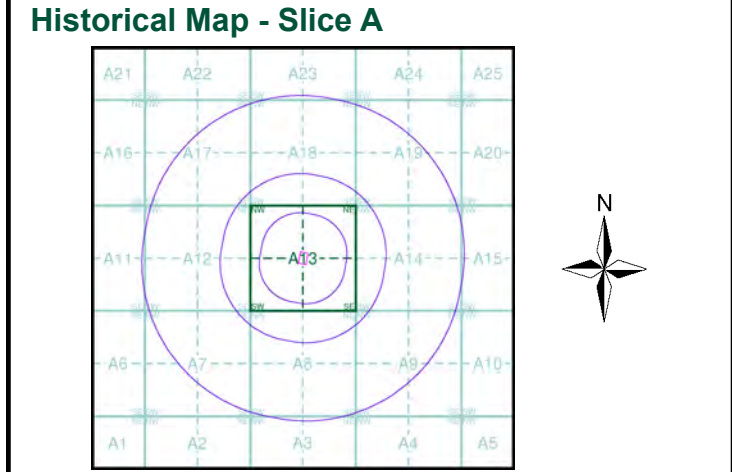
Published 1955 - 1956

Source map scale - 1:10,000

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

SD81SW	1956
SD80NW	1955



Order Details

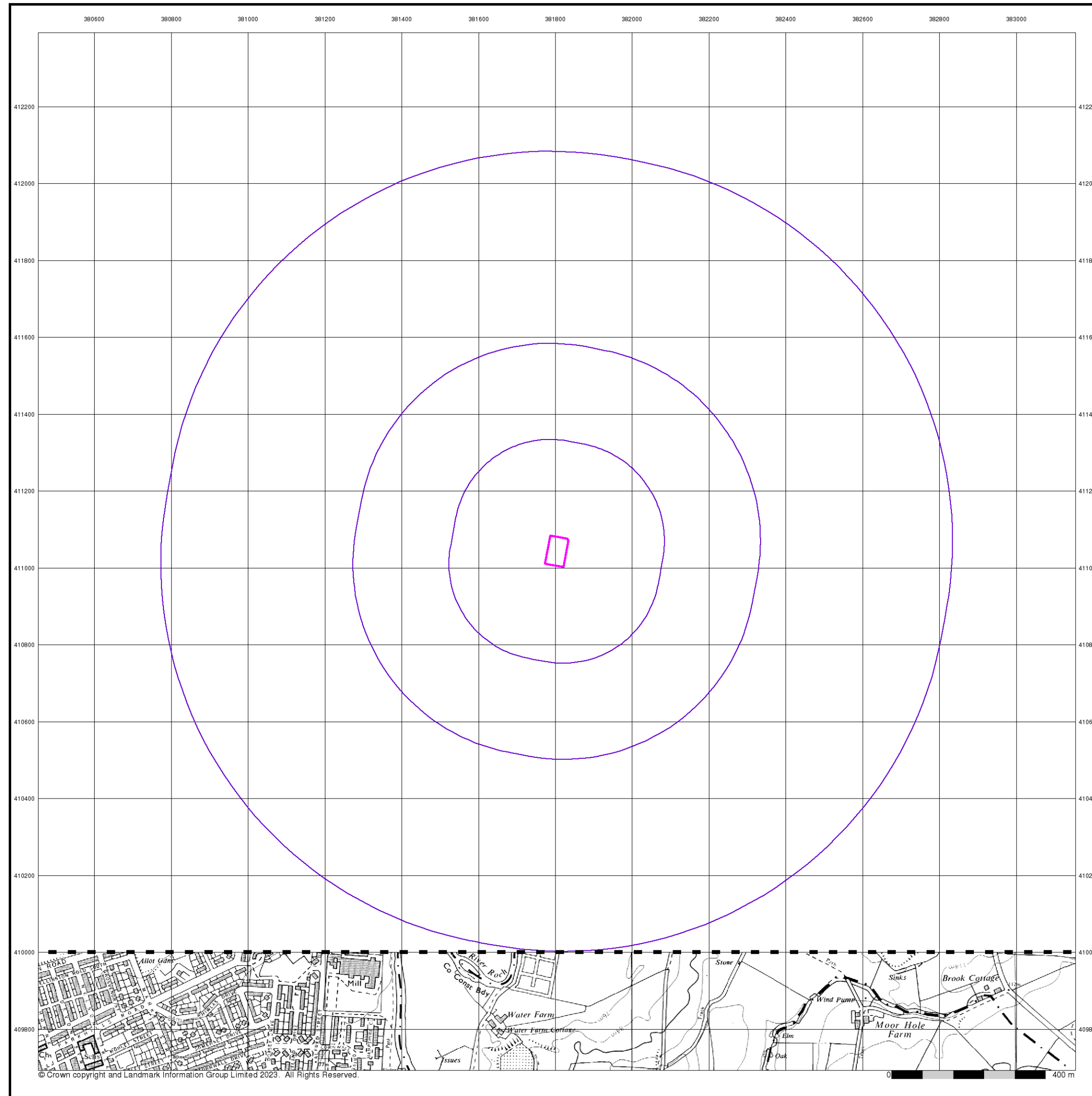
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GROUP

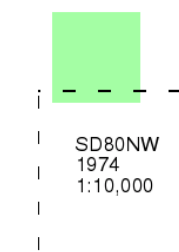
Ordnance Survey Plan

Published 1974

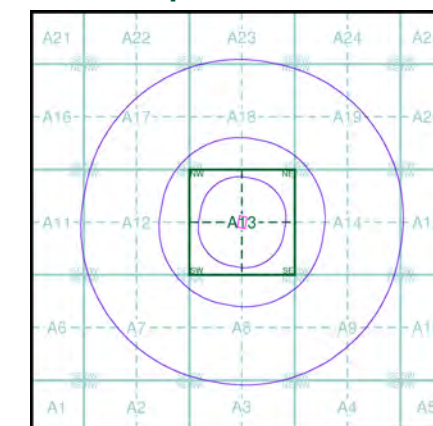
Source map scale - 1:10,000

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Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

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