A landscape study into the perceived effectiveness of the '*Stop Line Green*' anti-invasion defence.

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A dissertation submitted to the University of Bristol in accordance with the requirements of the degree of Masters in the Faculty of Arts.

Department of Archaeology & Anthropology - September 2005.

Word Count – 10,925.

ABSTRACT

Following the declaration of war, the period that ensued saw vast Allied defensive construction along the German borders to deter possible invasion. Known as the '*phoney war'*, the outmanoeuvring of these static defences by the German '*blitzkrieg*' took place in May 1940, with the subsequent fall of France and the evacuation of Allied troops in June 1940.

Documentary sources suggest Hitler had drawn up plans to invade Great Britain, the date for invasion 21st September 1940, landing along the southeast coast should air supremacy be achieved. The British government feared Britain would be the next stop for the *Wehrmacht.*

Summer 1940 saw the construction of a countrywide anti-invasion network to repel the expected '*blitzkrieg*', consisting of a series of defensive layers, starting with the Royal Navy and ending inland with *Stop Lines.* However, the following question '*Would the Stop Line linear defences have halted an invasion force?* has never been addressed.

With success or failure purely speculative and one that cannot be answered for certain as no invasion took place, conclusions drawn from documentary / archaeological evidence suggest the strategic positioning of the *Stop Line Green* around Bristol, would have had limited success in stopping an invasion force.

Aerial photographic (AP), cartographic and GIS visual analysis demonstrate the defences were adequately camouflaged from aerial reconnaissance and ground forces, with pillboxes utilizing the Wellow Brook valley, suggesting good strategic use of topography.

AP comparisons emphasize changes in land usage, with many hedge lines disappearing. These topographic features when reviewing defensive tactics were important in 1940, channelling enemy armour along predicted fortified routes, rather than across open fields. 3D cartographic evidence substantiates the notion that good use of the local landscape was made, providing concealment for strongpoints and protection from aerial / artillery bombardment. Using a raster based line-of-sight map (viewshed) of the given defences, visibility analysis demonstrates that the fields of view / fire afforded to the defences were good, verifying the notion of a strategic use of topographical features. Calculated distances between pillboxes and viewshed coverage support this, with crucial roads / river crossings within effective small arms range.

A church tower '*early warning'* network provided additional visual coverage. Combined with the defensive tactics deployed / available weaponry, should an invasion force advance towards Bristol, the defences would have held long enough for a counterattack to be launched.

DEDICATION

This dissertation is dedication to the men, women and children who served on the home front during World War II. It is without doubt their willingness to protect our homeland during those dark days of the early 1940s was a major factor in Hitler's decision not to invade Great Britain and ultimately victory in 1945.

Our thanks to you all.

'***Six years of sacrifice for sixty years of freedom'***.

ACKNOWLEDGEMENTS

In the preparation of this dissertation, acknowledgment is made, with many thanks, to the assistance given by the landowner of Hog Wood, Mr & Mrs R M Coles who gave kind permission for the survey of the AT ditch and pillboxes, as well as local information on the wartime defences of the area.

Additionally, many thanks go to Richard Davies who gave assistance with the G.I.S application, Peter J Rowe, who assisted with the geophysical survey of the AT ditch and my parents who provided valuable knowledge of the tense wartime situation of 1940 / 41.

Finally, special thanks go to Catherine Price, my partner, who not only assisted me with the collation of the background information needed for the preparation of this paper but has supported me throughout my University career.

My thanks to you all.

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AUTHOR'S DECLARATION

I declare that the work in this dissertation was carried out in accordance with the Regulations of the University of Bristol. The work is original except where indicated by special reference in the text and no part of the dissertation has been submitted for any other degree. Any views expressed in the dissertation are those of the author and in no way represent those of the University of Bristol.

The dissertation has not been presented to any other University for examination either in the United Kingdom or overseas.

SIGNED: DATE:

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ABBREVIATIONS

AA	Anti-aircraft.
ADS	Archaeological Data Service
AP	Aerial Photograph
AT	Anti-tank
B&NES	Bath and North East Somerset
BEF	British Expeditionary Force
ECB	Emergency Coastal Battery
FW3	Fortress Works Department 3
GHQ	General Headquarters
GPS	Global Positioning System
HG	Home Guard
LDV	Local Defence Volunteers
LMG	Light Machine Gun
MA	Master of Arts
NGR	National Grid Reference
NMR	National Monuments Record
OD	Ordnance Datum (Sea level)
OKH	High Command of the German Army
OKM	High Command of the German Navy
OKW	High Command of the German Armed Forces
RA	Royal Artillery
RAF	Royal Air Force
RE	Royal Engineers
RN	Royal Navy
SLG	Stop Line Green
SMR	Sites and Monuments Record
SP	Shell Proof

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CHAPTER 1

1.1 INTRODUCTION

With only fragmented *'primary'* documentary evidence for the World War II anti-invasion defence network of Great Britain available, previous studies into home defence is limited, with no known research into the perceived strategic effectiveness of the anti-invasion defences conducted to date. Compounding this issue, the generation that faced invasion during 1940 / 1941 are now passing on, taking vital information such as '*Where were the defences situated'*, '*Why they were placed where they were',* and *'How effective would the defences have been?'*.

The general perception of Britain's anti – invasion defensive network is that of a hastily conceived and constructed defence, short of men / equipment, and probably ineffective. A view best summed up by the BBC comedy '*Dads Army'*, but how accurate is this notion?

Following the '*Battle of Britain'* and the subsequent air supremacy of the Royal Air Force (RAF), knowledge / understanding of ground preparations have long been over shadowed, with the reality of invasion greatly underestimated. Previous studies into the anti-invasion defence network has failed to answer questions regarding their effectiveness, especially with reference to the linear '*Stop Line'* defences, established during the summer of 1940.

This dissertation will therefore address the hypothetical question '*Would the Stop Line linear defences, setup in 1940 as part of a national network of anti-invasion measures, have halted an invasion force?*, focusing for the purpose of this paper on *Stop Line Green,* set up around Bristol, by: –

A) Briefly reviewing the military situation in France from the declaration of war to the fall of the continent in June 1940, detailing the failure of the *Maginot* line, outmanoeuvred by German '*blitzkrieg*'.

B) Summarizing German invasion plans for Great Britain,

C) Outlining the overall national anti-invasion defence network, as set up prior to the 21st September 1940, German S Day**,** before,

D) Evaluating, using landscape / visibility analysis, the strategic effectiveness of the '*Stop Line Green*' (Bristol Outer Defence Line) (study area - Wellow to Hinton Charterhouse, near Bath), using field / aerial photographic evidence to determine the topographical positions of the defences within the landscape. Data recovered from the landscape investigation will be crucial in producing a visibility (viewshed) analysis of the area, with 3D topographical (© Memory-map) and Geographical Information System mapping software (© Arcview 3.3) demonstrating that the defensive structures / weapons deployed along the stop line would have halted an invasion force.

CHAPTER 2

2.1 FRANCE 1940

To understand why Britain faced the threat of invasion during the summer / autumn months of 1940, the following chapter will deal with the military situation in France from declaration of war, to the fall of the country in June 1940. Major events during this period will be outlined in brief, including the outmanoeuvring of the static linear *Maginot* line, a defensive measure Britain's '*Stop lines'* were believably based on, by the German '*blitzkrieg*',

2.2 WAR DECLARED – THE '*PHONEY WAR'*

Responding to the *Wehrmach's* invasion of Poland, Britain declared war on 3rd September 1939, deploying the British Expeditionary Force (BEF) to the '*buffer'* countries [1] and northern Europe (Norway) immediately, securing Western Europe within weeks of its mobilisation.

Signalling the start of a tense military / political stand off between the opposing forces that lasted several months [2], this static and inactive period often described as the '*Phoney War'*, provided the allies with valuable time to erect linear '*First World War'* style defensive positions along the French / German border.

2.3 MAGINOT LINE

Constructing *c*.400 pillboxes and 40 miles of anti-tank (AT) ditches within the BEF defensive sectors (Wills: 1985), the prime designated role for the BEF was to protect the Franco Belgian border from possible invasion. Not to antagonise the German high command, Belgium Ministerial officials had refused, at that moment in time, permission for any British / Allied troops to enter Belgium [3], thus leaving the BEF troops in defensive limbo and areas of Western Europe exposed, a failure the Germans exploited.

Believing in static defence strategies developed in the trenches of the First World War, the construction by the French of the '*Maginot*' line was considered by military strategists the ultimate linear defence, with miles of re-enforced concrete bunkers and gun emplacements providing an almost impenetrable shield, a factor that influenced not only the route of the German invasion of France, but also the initial anti – invasion defences of Britain.

Running roughly parallel to France's northern border (Longuyon to the Rhine River) (**Fig.1**), before heading down the Rhine Valley to the Swiss border and ending over the mountainous

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1 The '*Buffer*' (from invasion) countries were regarded by Britain as being France, Holland and Belgium, a notion conceived in the First World War and one that continued up until May 1940.

2 The only offensive launched during this period was the French into Saarland, gaining only a few kilometres before it became clear it would do nothing to take the pressure off the Poles (Allcorn: 2003)

3 In the early 1930s, France started fortifying her border with Germany (*Maginot* line), with an agreement drawn up stating that should any attack occur via Belgium, Franco-Belgian forces would meet it. This was receded in 1936 by the Belgium Government who undertook a position of neutrality, stating they were unwilling to enter any defensive agreements with either Britain or France (Lowry: 2004). Following the deployment of the BEF in September 1939 to continental Europe, the defensive plan was re-instated though this time it would be a Franco-British force that would counterattack any invasion, moving into Belgium only when invited!

border with Italy, the key static *Maginot* fortifications in north-eastern France and the border with Germany, were organised into two regions (Metz Fortified Region (**A**) and Lauter Fortified Region (**B**)), which were further sub divided into fortified sectors / sub sectors (Allcorn: 2003).

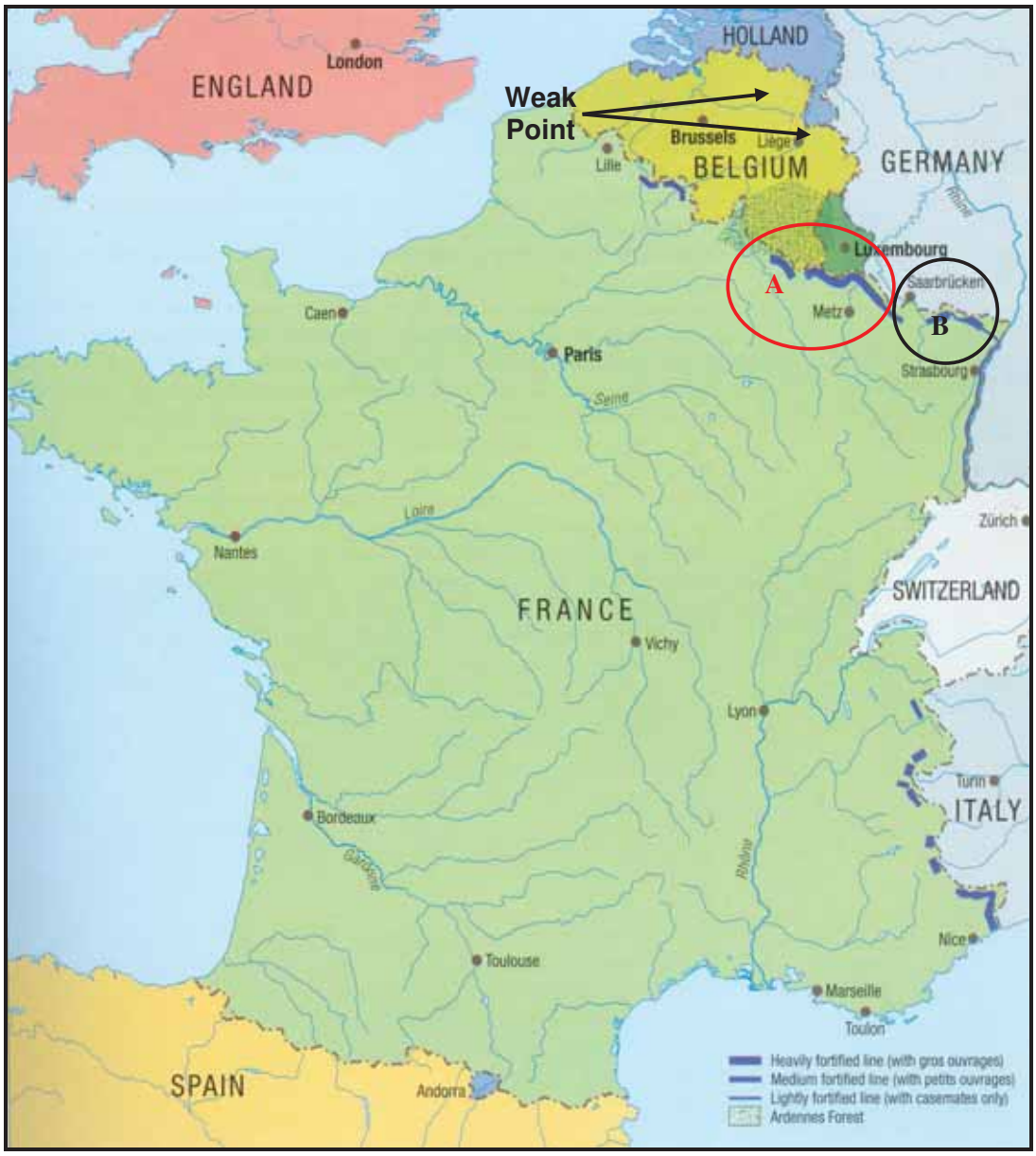

Fig.1 – General distribution of France's *Maginot* line (Allcorn: 2003).

Located on average between 5 – 10km from the border, in positions that provided optimum fields of fire / observation, the defences in this area consisted of an almost continuous line of AT obstacles, barbed wire and concrete bunkers (*casemates d'intervalles* or *casemates de mitrailleuses isolées* [1]) armed with AT guns and machine guns.

Strengthened at irregular intervals with underground forts known as *ouvrages* that were manned by *Fortress Units* comprising of regular and reserve soldiers, the very existence of the '*Maginot*'

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1 *Casemates d'intervalles* – Interval Casemate. *Casemates de mitrailleuses isolées* – Isolated machine gun casemates (Allcorn: 2003).

line was by no means a secret, making it a major deterrent to any hostile intentions the Germans may have had. From this, myths were to grow, with Allcorn (2003) suggesting of its exaggeration by the French government, an illusion not taken in by the German military, who had by 1937 detailed intelligence regarding the line strengths, leading to the suggestion that its effective strategic positioning was one of the key reasons the Germany military chose the invasion route they did.

2.4 '*BLITZKRIEG*' & THE INVASION OF FRANCE

The onset of spring brought this inactive, static '*Phoney war*', to a sudden end, with German Armed forces making good use of the weather and tides, invading the northern European countries of Denmark and Norway in April 1940. This marked the start of an offensive that would end with the fall of France.

Despite heavy resistance, the ill-equipped BEF (compared to the German Armed forces) were quickly forced to withdrawal from Norway, though Whitehall deemed this as a minor military setback, focusing now on Western Europe and France.

Despite experiencing first hand a new, mobile form of warfare ('*blitzkrieg*' or '*lightening*' war [1]), the British and French commanders were still confident the static, linear lines of defence along the French borders would hold back any invasion. Instead military strategists now feared that any attack would be through the lowland countries of Belgium and Holland, with the inability for the BEF to deploy onto the Belgian / German border, leaving the defence of these borders to the Belgian and Dutch Armed forces. A factor that even at this stage still did not seem to worry all, with Belgium and Dutch forces, despite their apparent neutrality, taking what they thought were adequate precautions, constructing extensive defensive positions along their borders.

Their Achilles heel was the Ardennes Forest area where, believing it to be inadequate ground for warfare, the military commanders proceeded to only lightly defend it, a mistake the German forces exploited.

Launching their attack along the Dutch / Belgian border regions on the 10th May 1940, the main German armoured / mechanized thrust was through the Ardennes Forest, bypassing Allied fortifications [1]. In response (after official invitation!), the BEF and French forces now moved into Belgium to head off the German thrust and by the 12th May, the Allied units were engaged in combat with the *Wehrmach*.

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1 ***Blitzkrieg*** – A combination of superior military tactics, highly mobile armoured / mechanized *Wehrmach* divisions and close *Luftwaffe* air support, resources when used together was seen to have great effect on the battlefield. Lowry (2004) in **APPENDIX A**. describes the most prominent five innovative assault methods.

2 See **APPENDIX B** for maps detailing the German offensive and the withdrawal of the BEF.

Remaining untested until mid June 1940, the German offensive never intended to directly attack the *Maginot* line [1], leaving fifty-nine French divisions deployed along the linear defence to remain static and in effect useless until early June 1940, when the French mobile reserve were finally deployed away from the line in a vain attempt to hold the Somme and Aisne rivers (Allcorn: 2003).

Breaking through the French lines in Belgium, the lead elements of the German offensive had, by mid May 1940, reached parts of the Somme River cutting in half the Allied armies and pinning the BEF to northern France and the Dunkirk area (Ward: 1997). With no ability to defend France '*in depth'* or mount any sort of counter attack, the race for the English Channel was on, with the BEF and Allied forces hastily retreating to the coast and the German forces attempting to cut off their withdrawal.

Unable to deal with the speed of the advancing German mechanized forces, defeat for the Allies was inevitable and the order to evacuate the remnants of the Allied forces (in particular the BEF) from France was given late May 1940, operational codename '*Dynamo*'.

The English Channel was the only obstacle between Britain and the German Armed forces, a fact the Prime Minister, Winston Churchill, was fully aware of, realising that in all probability Great Britain would be invaded by the *Wehrmacht*'s '*blitzkrieg*' campaign.

Addressing Parliament on the 4th June 1940, this grave situation was summed up in Churchill's speech, issuing the immortal words '*we shall defend our island whatever the cost may be. We shall fight on the beaches; we shall fight on the landing grounds; we shall fight in the fields and in the streets; we shall fight in the hills. We shall never surrender*' (HMSO: 1941).

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1 The assault on the *Maginot* line started on the 14th June 1940, with the Germans attacking through the *Sarre Gap*, an area between the *Metz* Fortified Region and *Lauter* Fortified Region. Virtually unopposed, the Germans were able to attack the line from the rear though it must be noted that it was not until the total surrender of France by the 25th June 1940 that the line finally conquered.

CHAPTER 3

3.1 OPERATION '*SEALION*' – THE INVASION OF GREAT BRITAIN

With the evacuation of the BEF and Allied troops complete by 4th June, the fall of France and the Low Countries by the end of June 1940 was to herald a new phase of the war, with preparations for invasion clearly visible on both sides of the English Channel.

German invasion intentions have, however, been suggested by some scholars as a propaganda tool used to unite the country following the defeat of the BEF in France [1]. A theory that, when reviewing the evidence available, is somewhat surprising, with numerous documentary sources clearly suggesting that the invasion of Great Britain, during 1940 / 41 was seriously considered by Hitler [2].

For the purpose of this paper, the above-mentioned debate will be avoided, with the following Chapter assuming the validity of Hitler's intentions, drawing upon previous detailed studies that have been conducted into the details of the German invasion plans.

3.2 INITIAL PLANS

Keen to implement the policy outlined on 23rd May 1939 [3], plans regarding an offensive against Western Europe, including Holland, Belgium and France were soon formulated. The aim, outlined by Hitler on 9th October 1939, to acquire as large an area as possible' *to use as a base offering good prospects for waging air and sea warfare against England'* (Wheatley: 1958). A notion codenamed '*Operation YELLOW'* would see the defeat of Britain by means of destroying her trade and starving her into surrender, a policy that nearly worked in 1917 (Longmate: 2004).

Suggesting at this stage, the invasion of Great Britain was not realistically considered by Hitler, preliminary plans were in the process of being drawn up by his commanders, with General *Raeder*, of the Naval High Command (OKM), initiating the first draft of plans relating to the invasion of Britain.

3.3 *KRIEGSMARINE* PLANS – NOVEMBER 1939

Stressing the difficulties of the operation, noting that not only the geography of the British Isles favoured the defender, but also excellent internal communication would make the movement of reinforcements to any beachhead easy, the report suggested that embarkation of the invasion

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1 A discussion regarding Operation *Sealion* and the German invasion plans was conducted with scholars during a recent visit to London, where the view to it being only a propaganda tool used to unite the country following the defeat of the BEF, was raised. Unwilling to go on record, no written evidence to support this view has, to date, been found.

2 See **APPENDIX C** for a translated Operation Instruction issued for the invasion of Britain (Wheatley: 1958).

3 Recognizing Great Britain as Germany's principle enemy, Hitler proposed to adopt the following strategy, stating *'If Holland and Belgium are successfully occupied and held, and if France too is defeated, the fundamental conditions for a successful war against Britain will have been secured. Britain can then be blockaded from western France at close quarters by the Luftwaffe, while the Navy with their submarines can extend. the range of the blockade.' (*Wheatley: 1958).

forces should take place in naval ports located within the Baltic and the North Sea, thus reducing the chance of discovery by the British and their subsequent interference.

Intending to land the *Wehrmacht* along the East coast of England, between the Thames Estuary and the Tyne, the long sea crossing would, conversely, increase the chance of detection, so it was critical that the *Kriegsmarine* (navy) had *Luftwaffe* air support, only proceeding once the RAF and Royal Navy (RN) had been eliminated or sealed off from the North Sea. A factor summed up in the conclusions of the hypothetical report, stating that should these military conditions ever be realized then '*the achievements of these conditions will in all probability result simultaneously in the complete collapse of her will to resist; thus a landing followed by occupation will scarcely be necessary'* (Alexander: 1998).

3.4 *WEHRMACHT* PLANS – DECEMBER 1939

Detailed Operation '*NORDWEST*', the High Command of the German Army (OKH) in December 1939 released a first draft outline of invasion plans for Britain (Wheatley: 1958), basing the embarkation of the main assault group from controlled ports in the Low Countries. Comprising of 19 divisions, the initial landings were to be made in East Anglia, with a diversionary landing north of the Humber.

Commencing with an airborne assault upon Great Yarmouth and Lowestoft, the main force would land at these ports, with further infantry landings occurring along the open Suffolk coast and on the beaches at Dunwich and Hollesley Bay.

Linking up with the forces holding Great Yarmouth and Lowestoft, once the beach head was secure, reinforcements were to follow, with a third wave of panzer divisions tasked explicitly with capturing London (Alexander: 1998).

3.5 OPERATION '*SEALION*' – BROAD FRONT OPTION JULY – AUG 1940

With Nordwest dismissed due to the same problems encountered with the OKM plan [1], the speed at which the fall of France and the Low countries was occurring once again brought the draft plans for the invasion of Britain to the fore. Confident of victory, Hitler, on 21st May 1940, requested to see the plans military strategists had previously drawn up.

Unimpressed by earlier proposals, by 27th May a memorandum had been drawn up requesting an assessment into the possibility of landings along the south and south-east coast of Britain, a change in direction that the navy favoured, providing the best opportunity of success due to the shorter sea crossing.

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1 The Luftwaffe General Staff had demanded that there should be prior air superiority and the Naval Staff objection was their inability to protect sufficiently an invasion fleet and supply line from the RN (Wheatley: 1958).

Now the concern of the High Command of the Armed Forces (OKW), planning for the invasion was to start on 2nd July 1940 following the issue of a formal directive from Hitler. Giving up hope of a peaceful settlement between Germany and Great Britain (Wheatley: 1958), within two weeks a plan under the codename Operation '*Sealion*', had been produced, followed shortly afterwards by *Directive No: 16 – Preparations for the Invasion of England* [1], the blueprint for the whole operation [2] (Longmate: 2004) (**Fig.2**).

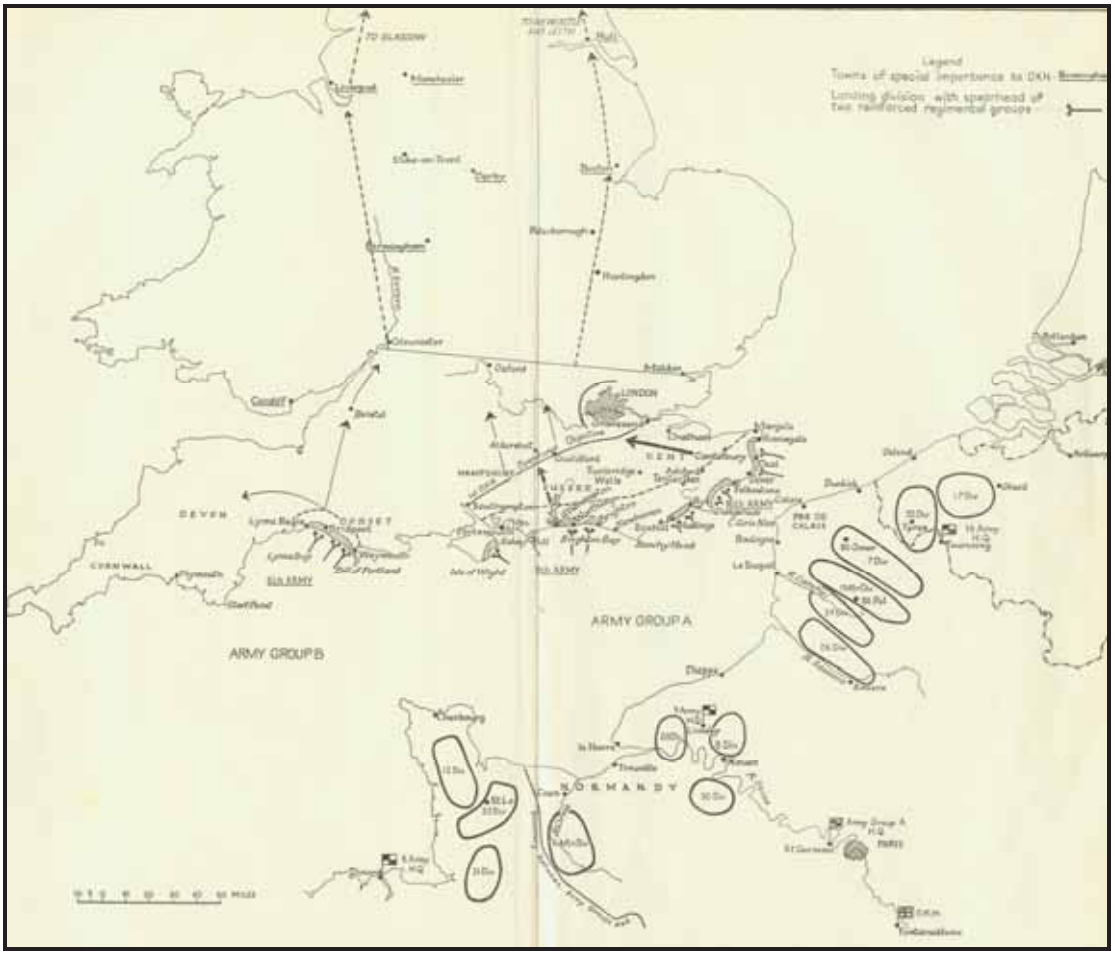

Fig.2 – Outline of Operation Sealion (first draft) (Wheatley: 1958)

Deciding upon an invasion force of *c.*260, 000 men that would land on a wide front, from Lyme Bay to North Forland, the *Wehrmacht* was to use three attacks groups, one centred around Calais, one around Le Havre and the third around Cherbourg [3] (Longmate: 2004).

Once landed and a beach-head established, Army Group A's (Calais and Le Havre's attack groups) task was to advance on Gravesend, Reigate and Portsmouth, capturing vital ports, before proceeding onto London and other important cities, including Bristol (Ward: 1997) with her

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1 Even at this stage of the preparations, there was a hint of reluctance for a confrontation with Great Britain, with Hitler in his Directive No: 16 stating '*…..Since England, despite its hopeless military situation, still gives no sign of any readiness to come to terms, I have decided to prepare for invasion of that country and,* ***if necessary, to carry it through****. . . . The aim of this operation will be to eliminate England as a base for carrying on the war against Germany and, should it be required, completely to occupy it.*' (Longmate: 2004).

2 An extract from the directive detailing the invasion plans are reproduced at **APPENDIX D** (Lowry: 2004).

3 *Wehrmacht's* dispositions for Operation Sealion (first draft) see Alexander's (1998) TABLE 1 - **APPENDIX E**

deep-water port at Avonmouth.

Army Group B sailing from Cherbourg, was to land in Lyme Bay (Weymouth area) and once the beach-head established, move north and eastwards, isolating Cornwall in the process and advancing on Taunton and Bristol ending at Gloucester, whilst in the east advancing on London. Airborne landings during this phase would be in support of the main assault forces, capturing airfields and areas of open countryside ideal for the vital re-supply of the main assault forces. Fleming (1957) suggests that a total of *c.*15, 000 men, in ideal conditions, would have been deployed in a straightforward tactical role, dropping in the immediate vicinity of the beachheads.

With preparations underway (**Fig.3**), the wide front attack, as proposed in *Directive NO: 16,* troubled the OKM Naval War staff due to the lack of both ships and resources to transport, land and defend such as invasion force (Alexander: 1998).

Fig.3 – German troops practicing landing techniques – Northern France Summer 1940 (Lowry: 2004).

Recommending the invasion should be either postponed until spring 1941 or limited to landings on a narrower front (Dover to Beachy Head [1]) (Alexander: 1998), it was not until 16th August 1940, that it was signaled the Lyme Bay landings were to be suspended, with the assault mounted from Le Harve and aimed at the coast between Brighton and Portsmouth, also scaled down (Longmate: 2004) in an amended *Wehrmacht* invasion plan drawn up on 30th August 1940 [2].

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1 *Wehrmacht's* dispositions for Operation *Sealion* (revised draft) see Alexander's (1998) table.2 - **APPENDIX F**

2 A translation of the revised invasion plans are reproduced at **APPENDIX C** (Wheatley: 1958).

Once Army Group A's forces were ashore, a planned advance northwards was tasked to destroy the main British reserves, before encircling London, whilst additional mechanized forces pushed through Wiltshire and Berkshire. Occupying London, the final task for Army Group A was to mop up any remaining forces in Southern England, capturing the main industrial centres and principle seaports in the process (**Fig.4**). Although not involved in the planned invasion, Army Group B was still held in reserve, charged with executing a landing in Lyme Bay, to occupy Weymouth and Lyme Regis before advancing towards Bristol (Alexander: 1998) should the situation dictate it.

Fig.4 – The final '*Sealion*' invasion plan set for September 1940 (Lowry: 2004).

One year from the outbreak of war, the campaign timetable was set, including the date for invasion. It read (Longmate: 2004):-

1) The earliest date for

(a) The departure of the transport fleets will be 20 September 1940.

*(b) S day (Invasion day) will be **21 September 1940**.*

2. The order for the start of the operation will be given on S —10 days, probably on 11 September 1940.

3. The final decision on S day and S time (beginning of the first landing) will follow at the latest on S—3 days at noon.

4. All measures will be taken so that the operation can still be held in suspense 24 hours before S time.

CHAPTER 4

4.1 ANTI-INVASION DEFENCES

Whilst not clear of the German intentions [1], Churchill was fully aware of the situation faced by the country, stating in a speech '*Hitler knows he will have to break us in this island or lose the war'* (Brown: 2001).

Fearing the English coast would be the next stop for the *Wehrmacht,* the summer of 1940 saw, at breathtaking speed, the construction of a vast defensive network of anti-invasion measures, built to repel the German '*blitzkrieg*' attack.

The next chapter will review the measures put in place by the military planners from May to the end of September 1940, outlining the type of defences employed, how they were to be used and the change / development in defensive tactics [2].

4.2 THE DEFENCE OF BRITAIN

Formed to both counter the threat of airborne attack and to expand available manpower, the Local Defence Volunteers (LDV), later renamed the Home Guard (HG), was formed on 14th May 1940, with nearly a quarter of a million men answering the call immediately (Lowry: 2004).

This first phase of defending Britain, the formation of the HG was soon followed by a report made to the War Cabinet on 25th June 1940 by General Ironside, the newly appointed *Commander-In-Chief Home Forces* (27th May 1940) outlining his intentions regarding the defence of Great Britain.

Produced as *Home Forces Operational Instruction No: 3* on 15th June 1940, the report stated his plan to defend the coastline with a '*crust*' of infantry expected to disrupt any enemy landing long enough to allow the arrival of reinforcements. If the enemy did succeed in breaking out from a beachhead, these forces would be delayed in their advance by a series of *Stop Lines* and defended localities that extended deep inland [3] (Alexander: 1998). Once impeded and the direction of attack established, a counterattack using reserve forces could be efficiently co-ordinated, with the enemies ability to manoeuvre inhibited by AT obstacles, defended pillboxes and strong-points (*nodal points*), a notion Lowry (2004) suggests as being created following the battle for Warsaw where the Germans lost numerous tanks to these concentrated '*killing fields'*.

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1 A war of words had started between Britain and Germany following the fall of France, with the Propaganda Ministry bombarding British radio with stories of their impending defeat. A good example is a statement made by a German radio commentator on the 18th July 1940 where it was said '*The English fear of an impending German military invasion is weighing like a huge nightmare on the inhabitants of the British Isles'* (Longmate: 2004). This campaign was backed further by a leaflet drop across the country on the 1st August 1940 headed a '*Last Appeal to Reason'* , in a final attempt by Hitler, suggests Brown (2001), to justify his actions and achieve a negotiated peace.

2 The focus of this paper is the defensive network set prior to the invasion date of 21st September 1940, relating with particular interest to the Stop Line anti-invasion defence (case study – Stop line Green), as developed by Ironside.

3 See **APPENDIX G** for an extract of Section 13 taken from HOME FORCES OPERATION INSTRUCTION No: 3 (Alexander: 1998).

4.3 THE COASTAL *'CRUST'*

Initiated by Ironside's predecessor, General Kirke, in May 1940, the shortage of equipment faced by the British Army influenced the defensive setup proposed in the *Home Forces Operational Instruction No: 3.*

Losing a large proportion of its armour, artillery, motor transport and small arms in the evacuation from France [1], the plan dictated that it was crucial for any invasion to be delayed long enough on the beaches for two responses to take place. First, the RN had to deploy from bases in Scotland to interrupt the passage of the invasion forces as well as any subsequent supply lines and second, reinforcements located inland could move to the appropriate area to counterattack (Osborne: 2004).

On the beach, scaffolding poles, minefields, AT ditches and field gun positions (**Fig.5 / 6**), located alongside already established coastal batteries, many dating to the Victorian period, were hurriedly constructed in preparation of the expected invasion.

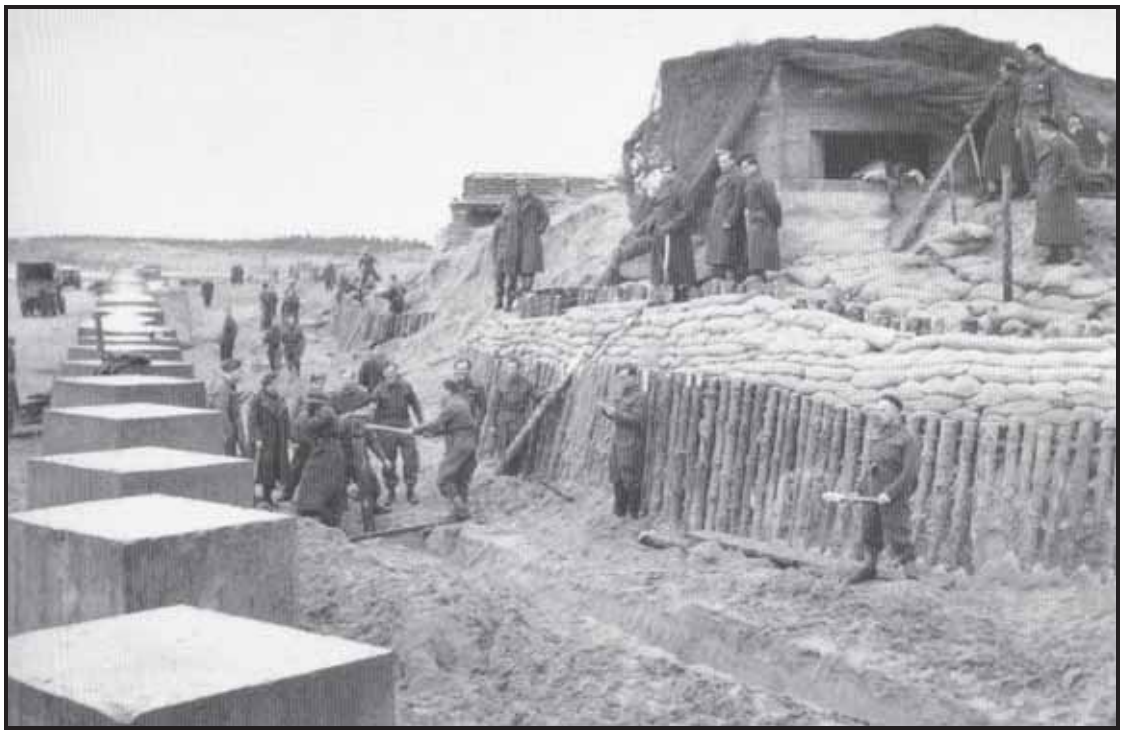

Fig.5 – The construction of beach defences in Fife (Lowry: 2004).

[1] The defence of Britain rested on only 15 infantry divisions (four of which were training). Of those, eight were deployed in coastal defence, with the remaining three deployed inland as reserve / to counter any airborne assault. The only formed armoured units were the 2nd Armoured Division, armed with *c.*180 light tanks and the 8th Battalion Royal tank Regiment that consisted of *c.*50 MKI Matilda tanks. A token force when considering that at the beginning of 1940, the BEF had at its disposal c.963 tanks, though it must be noted that most of these were obsolete when compared to their German counterparts.
Regarding artillery, the situation was even direr, with the BEF losing 880 field guns, 310 heavy artillery pieces, 500 AA guns, 650 AT guns, 6,400 AT rifles and *c.*11, 000 machine guns, all left following the withdrawal from France.
As a consequence, at the start of June 1940, only 420 field guns (most obsolete with only 200 rounds per gun), 153 Heavy / medium guns (150 rounds per gun), 54 AT guns, and 2,300 Bren LMG's were available for use by British forces (Jackson: 1995). a factor that Ironside, in his plans, HAD to take into account, leading to the suggestion that this was key in his decision to erect primarily static linear defences in response to the imminent threat of invasion.

Fig 6 – The erection of scaffolding poles in addition to AT cubes and barbed wire (Wills: 1985).

To strengthen the coastal '*crust*' further, a number of additional Emergency Coast Batteries (ECB's) were built at minor ports and landing points around the British coastline, using, naval guns re-directed from large RN stocks.

Mounted on naval fixtures that did not need gun pits, using instead a bolt ring or holdfast set into a concrete floor, the ECB's were mainly equipped with 6 inch, 5.5, 4.7 and 4 inch guns as well as a few 138mm guns acquired from French ships (Brown *et al*: 2002). Consisting of typically two gunhouses, each of which had a holdfast for the gun that was set in a sunken pit, a semi-circular concrete apron, ammunition lockers and crew shelter, what set the ECB's aside from earlier coastal batteries was the addition of enclosed gun houses, identified as essential for protection against aerial attack (**Fig.7**) (Osborne: 2004).

Complimenting the ECB's defences out to sea were heavy booms, strung across estuaries such as the Thames, Medway and Humber in an effort to prevent the movement of German warships / landing barges [1], whilst concrete pillboxes, machine gun emplacements and improvised self-propelled guns were built to guard beach exits and slipways.

Completing the coastal '*crust'* defences armoury was RAF Coastal Command, whose

1 With no purpose built landing craft; the Germans had to convert canal barges into landing ships.

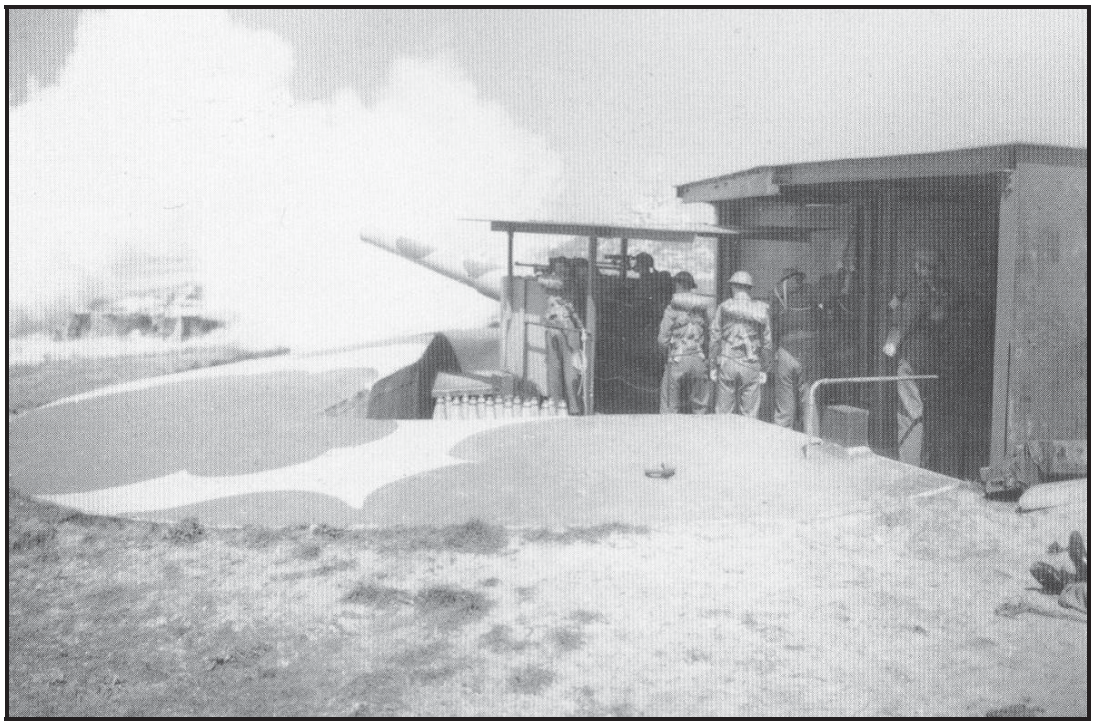

Fig.7 – 6-inch gun at Fort Crosby being fired. Though not an ECB the position has been modified to provide overhead protection and carries a shield (Lowry: 2004).

'*Scarecrow*' patrols of de Havilland Tiger Moths and Miles Trainer aircraft, armed only with light bombs and machine guns, were ready to be used in repelling of any beach landing [1] (Lowry: 2004).

4.4 STOP LINES

Located behind these coastal '*crust*' defences was a national network of Command, Corps and Divisional *Stop-Lines* [2] (designated according to their status) (Cruickshank: 2001), constructed to both hinder and ideally contain any German advancement inland from a beachhead, holding the position long enough until reinforcements could arrive. Strengthened by natural as well as purpose built artificial obstacles such as AT ditches, cubes and pillboxes, the backbone of this centrally co-ordinated defence plan was the General Headquarters Anti-tank Line (GHQ Stop Line).

With the decision to start construction of these defences taken on 7th June 1940, only days after the evacuation from Dunkirk, Ironside, following directions by the Chiefs of Staff to implement a particular defensive strategy [3], set about phase one, to prepare for the protection of London

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1 Following a request by Churchill into the possibility of use, the stockpiling of 'mustard gas' was approved. Should the Germans have been successful in landing, then the use of 'mustard gas' bombs are one that is quite possible.

2 See **APPENDIX H** for examples of planned *Stop Lines* for southern Britain in June 1940 (Alexander: 1998).

3 The decision to construct these linear defences have been the subject of much criticism, with Ruddy (2003) suggesting that Ironside was a traditionalist who based his defensive tactics on those conceived in First World War, with *blitzkrieg* instantly invalidating them. Whilst it is accepted that both the Chiefs of Staff as well as Ironside were probably influenced by their previous experiences, especially between 1914-18, and that *blitzkrieg* was a new form of warfare. it cannot be forgotten that with huge limitations imposed on the British Armed Forces following the withdrawal of the BEF from France, the construction of a network of linear defences were the best option.

from direct attack. Expanding in strategy, the next phase was securing the key industrial and urban centres of Birmingham, Leeds and Sheffield by constructing the remainder of main GHQ line, whilst in Scotland; defences were constructed in an attempt to prevent any German columns reaching Glasgow and Edinburgh.

With work commencing a few weeks after the *Home Forces Operational Instruction No: 3* was received by the relevant Commands (Aldershot, Northern, Eastern, Southern and Scottish) (Alexander: 1998). The route the GHQ Line took started at Highbridge, *c*.37km southwest of Bristol (*Stop Line Green*), moving eastwards, running along the Rivers Brue, Wellow, Frome and Avon to Great Somerford (Wiltshire – 128km) [1]. Leaving the Green line at Semington (Wiltshire) to become a 96km section of *Stop Line Blue*, the GHQ line continues to follow rivers, running along the Kennet and Avon Canal, to Theale, *c*.7km east of Reading (Berkshire).

Recognising that linear defence lines had an inherent weakness, that of depth, military planners [2], at this point, built in a rear line (*Stop Line Red*) behind this area, linking Great Somerford (Wiltshire) to the Thames at Cricklade (Wiltshire). From there it proceeded to Pangbourne before dropping south, along the Sulham Valley before linking back up to the *Blue Line* (109km).

Continuing onwards to Farnham, taking in 48km of Aldershot Command before re-entering Southern Command at Shalford (Surrey), the GHQ line entered Eastern Command along the Rivers Mole and Eden before ending at Penshurst (Kent) and the River Medway.

Following the pivot of a dogged legged southerly extension that continues up from Newhaven (Sussex), through Kent, along the River Medway and Tonbridge / Maidstone onto Rochester, the line then turns north across the Hoo Peninsula to the Thames at Higham Marshes.

Running north of the Thames, GHQ Line East continues through Essex for *c*.80km, up the old A130 road and around Chelmsford, entering Cambridgeshire at Great Chesterford. From here it follows the River Cam before linking up with an AT ditch located east of Cambridge itself, linking up with Littleport and the Eastern Command Line.

Continuing along the Forty Foot Drain to Ramsey before turning north past Whittlesey and Thorney, reaching the River Welland *c*.112km later, the correct route of the GHQ line north of Ely, as noted by Osborne (2004) in his description of the route, is still the matter of

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1 Originally, planners had intended for the Stop Line Green to continue northwards to the River Severn at Upper Framilode, *c*.11km southwest of Gloucester, to form the Bristol Outer Defence Line, however with a change in defensive strategies occurring in July / August 1940, then only part of this line was built in any strength.

2 Provided with a car and authorised to draw petrol from ANY military pump, the task of the military planners (Tactical Reconnaissance Parties) normally consisted of an Infantry Officer, a RE Officer, a RA Officer if possible and a draughtsman clerk. Tasked to mark on the ground proposed positions of pillboxes etc, once chosen, the positions of said defences were to be accurately recorded on 1:25,000 maps, with notes made of work to be completed in order to create effective fields of fire as well as points of weakness (Alexander: 1998). In many cases, the military planners who decided the routes of the stop line were often, in civilian life before the war, were surveyors and architects, a good example being that of Captain Stiles who built Stop Line Green, who prior to call up was an architect (Brown: 2001).

debate. Papers from local building contractor's detail the above course, whilst official records suggesting a route that follows the Rivers Cam and Ouse before terminating at Kings Lynn (Norfolk).

To this point, the GHQ line totals c.640km in length, forming as a consequence a continuous AT barrier, with waterways, rivers and canals, many of which had been revetted, dredged, deepened or widened, supplemented by *c.*180km of purpose built AT ditches, the latter identified by Alexander in his research (Osborne: 2004).

Undecided in the original reconnaissance report from which *Home Forces Operational Instruction No: 3* was taken, the two proposed routes north from the Rivers Welland to Trent never saw any great work done on them [1]. Unsatisfactory on equal accounts, the line was planned generally to run parallel to the East coast, following, as seen previously, rivers and streams through Yorkshire and Northumberland before ending in central Scotland (Alexander: 1998) (**Fig.8**).

4.5 STOP LINE DEFENCES

Built in varying degrees of depth to avoid easy penetration or the outflanking by mobile forces, the siting of *Stop Lines* were to make effective use of local, tank restricting, topographical features, such as rivers and valley bottoms, with artificial physiognomy such as canals or railway embankments as obstacles [2]. Integrated to create a continuous and coherent system of defence, to supplement these topographic features further the introduction into the landscape of measures such as fences of barbed wire, minefields, AT ditches / cubes, demolition zones [3] and strategically placed concrete pillboxes.

4.5.1 BARBED WIRE FENCES

Used to great effect along the coast, the use of barbed wire inland was primarily restricted to areas that natural topographic features could not provide a barrier for. Not well documented as to their locations, probable uses were roadblocks, where it could be quickly deployed across the road, gaps in hedge lines that formed part of a *stop line* or surrounding defensive slit trenches.

4.5.2 MINEFIELDS

Whilst the use of minefields along the coast of Britain in defence of ECB's, pillboxes etc, as well as along wide stretches of beach is well documented, the use of mines inland along the GHQ Stop Lines is not. Believed to have been deployed for use by defending forces at nodal points / roadblocks, the construction / deployment of minefields out in the open countryside is uncertain**.**

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1 Work on the stop lines ceased by August / September, due to a change in tactics – See Chapter 4.7.

2 This notion of good use of local topography is demonstrated in the case study area - Chapter 5.

3 Bridges etc were earmarked for demolition in an attempt to hinder the advancement of German forces should they of invaded.

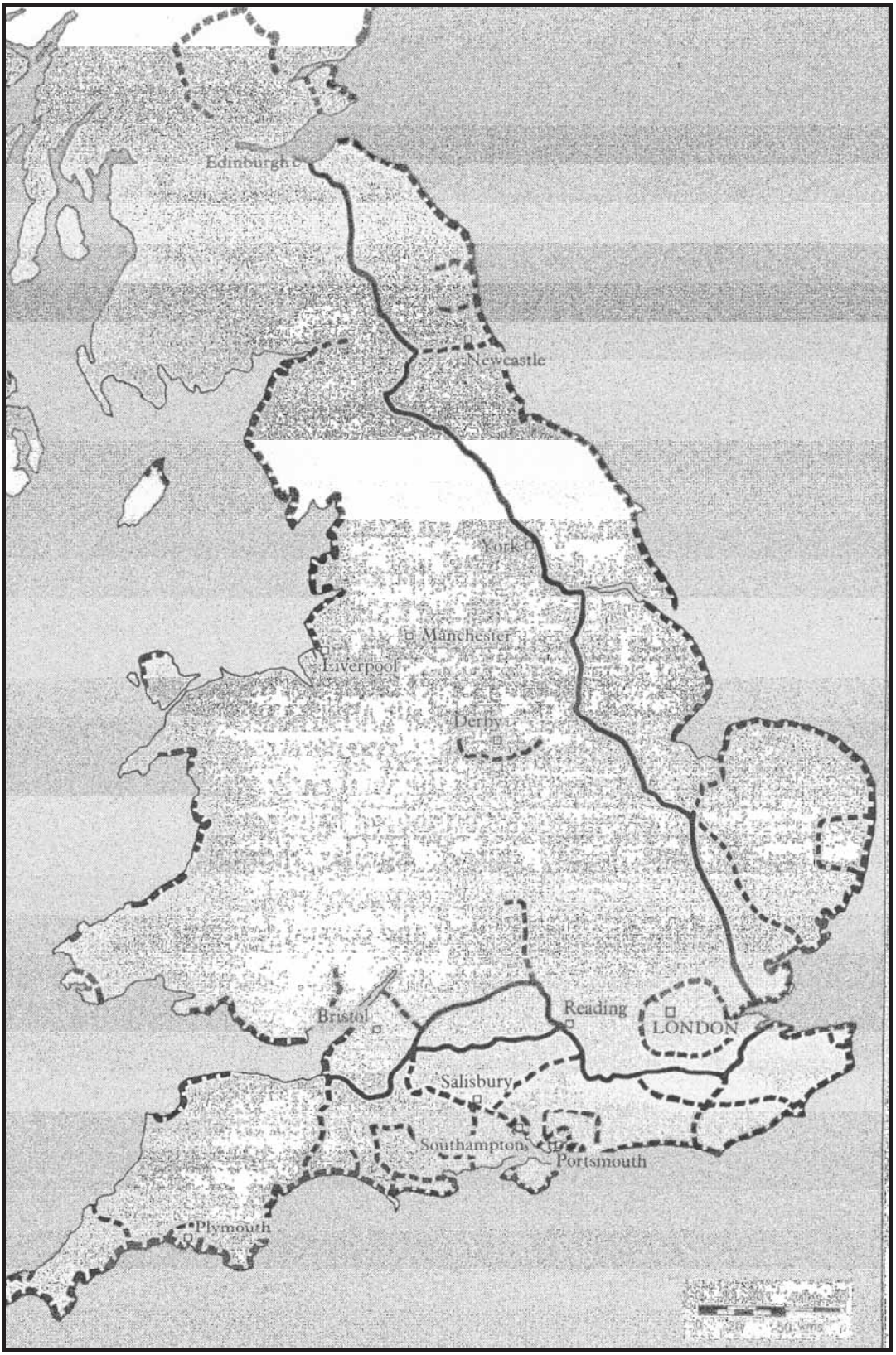

Fig.8 – Map of Great Britain detailing the GHQ line (solid) and other Stop Lines / Coastal 'crust' (dashed) (Wills: 1985).

4.5.3 AT DITCHES

Surviving in some areas within the landscape**,** the AT ditch presented attacking forces with an impassable barrier, hindering their advance, thus providing valuable time for countermeasures to be taken, e.g. use of AT guns and small arms to neutralise tanks / infantry.

Immobilising both armoured and soft skinned vehicles by either confronting it with an unclimbable vertical face or in the case of V-shaped / two-way ditches, trapping the vehicle nose-down, the dimensions recommended for such a ditch was 4.52m x1.78m and 5.49m wide x 3.35m deep respectively (**Fig.9**) (Brown *et al*: 2002).

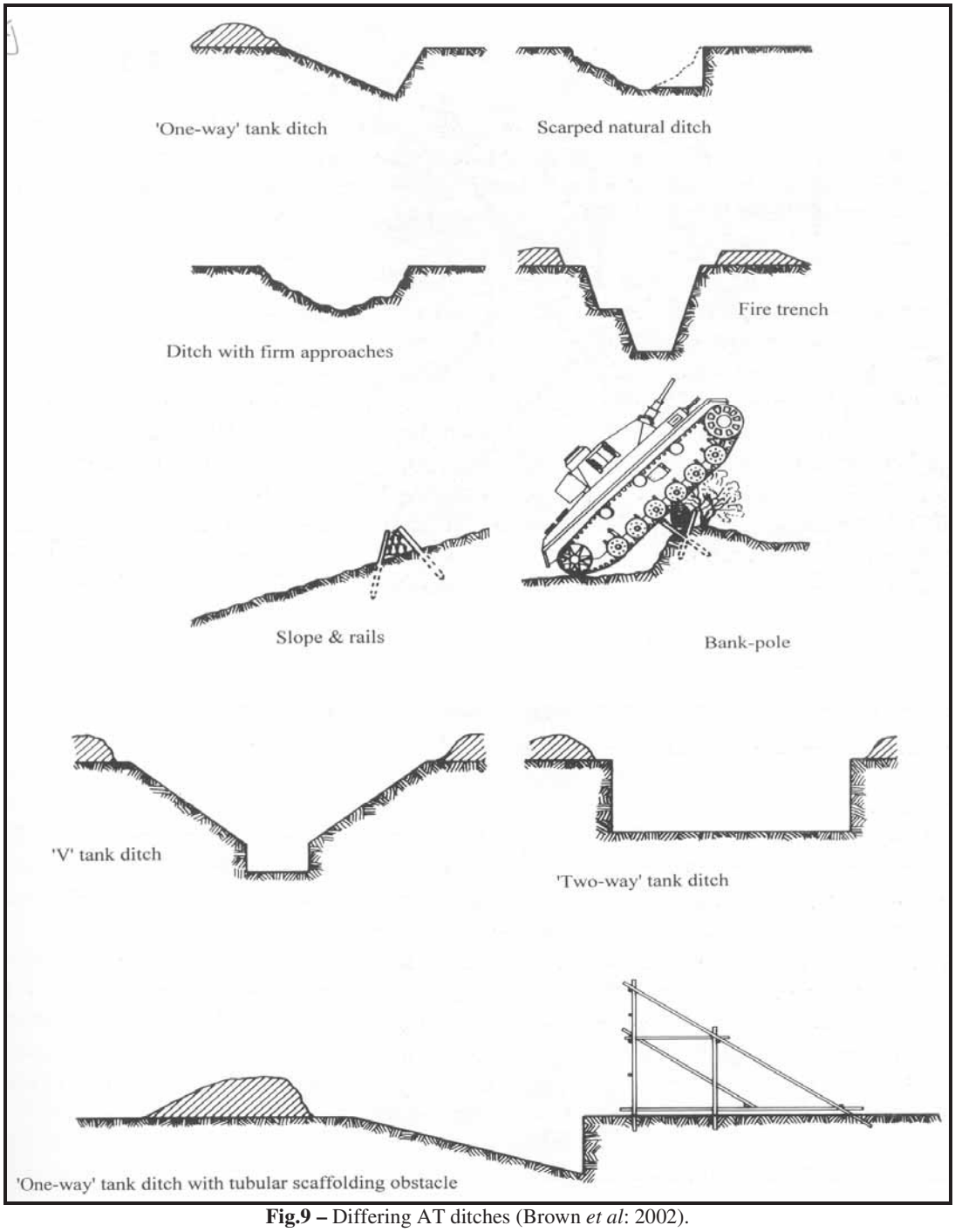

Fig.9 – Differing AT ditches (Brown *et al*: 2002).

4.5.4 AT CUBES / BLOCKS

Cast in a variety of forms, their role was to obstruct the progress of armoured / soft-skinned vehicles along a road or landscape, exposing, should they attempt to cross over them, their lightly armoured undersides to AT fire.

Found on both coastal sites and inland defence lines (**Fig.10 / 11**), the standard size and form of a cube with sides either 1.07m or 1.53m, occurring in single or multiple rows. Brown *et al* (2002) suggests that AT cubes erected pre-1941 can be identified by their placing side-by-side of one another, usually spaced at 2.59m centres, whilst later variants were placed corner to corner.

A variant to the standard cube was the square, flat-topped pyramid ('*pimples*' or '*dragon's teeth'*), measuring 0.9m square or 1.2m on soft ground (beaches etc) x 0.6m high, these '*dragons teeth'* were usually placed in multiple rows with centres spaced at 2.28m (Brown *et al*: 2002) (**Fig.12**).

4.5.5 DEMOLITION ZONES & NODAL POINTS

When conceived, the various *stop line* Commands were given the additional responsibility of developing '*demolition zones'* in front of their defences, by creating nodal points (strongpoints) at main road junctions.

As a strategically crucial point in the defensive line, with enemy armoured units expected to make wide use of the road network thus avoiding the hedge lined countryside and the *stop lines*, the roadblock was to have deployed around it a variety of weapons to create a tank / infantry '*killing field'* (**Fig.13).** Involving the blowing of bridges, cratering of roads, and the blocking of junctions, the policy was revised August 1940, due to the risk of routes being hastily put out of action, hindering the movement of GHQ Mobile Reserve Forces instead of the Germans. Where possible road / railway bridges were to be blocked with removable concrete / steel obstacles, rather than blown or put permanently out of action (**Fig.14**) (Alexander: 1998).

Fig.10 – Beach AT cubes (Osborne: 2004).

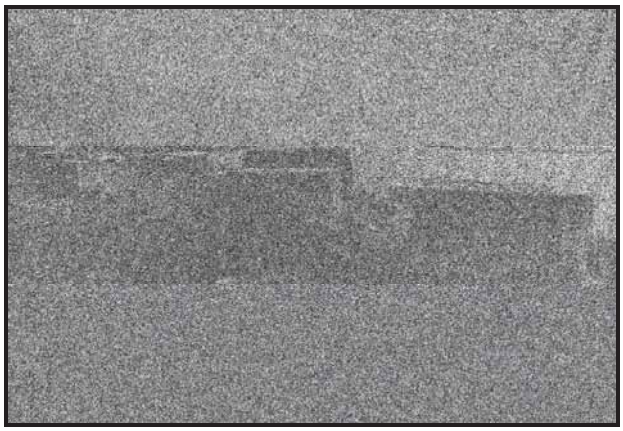

Fig.11 – AT cubes forming part of a *stop line* (Wills: 1985).

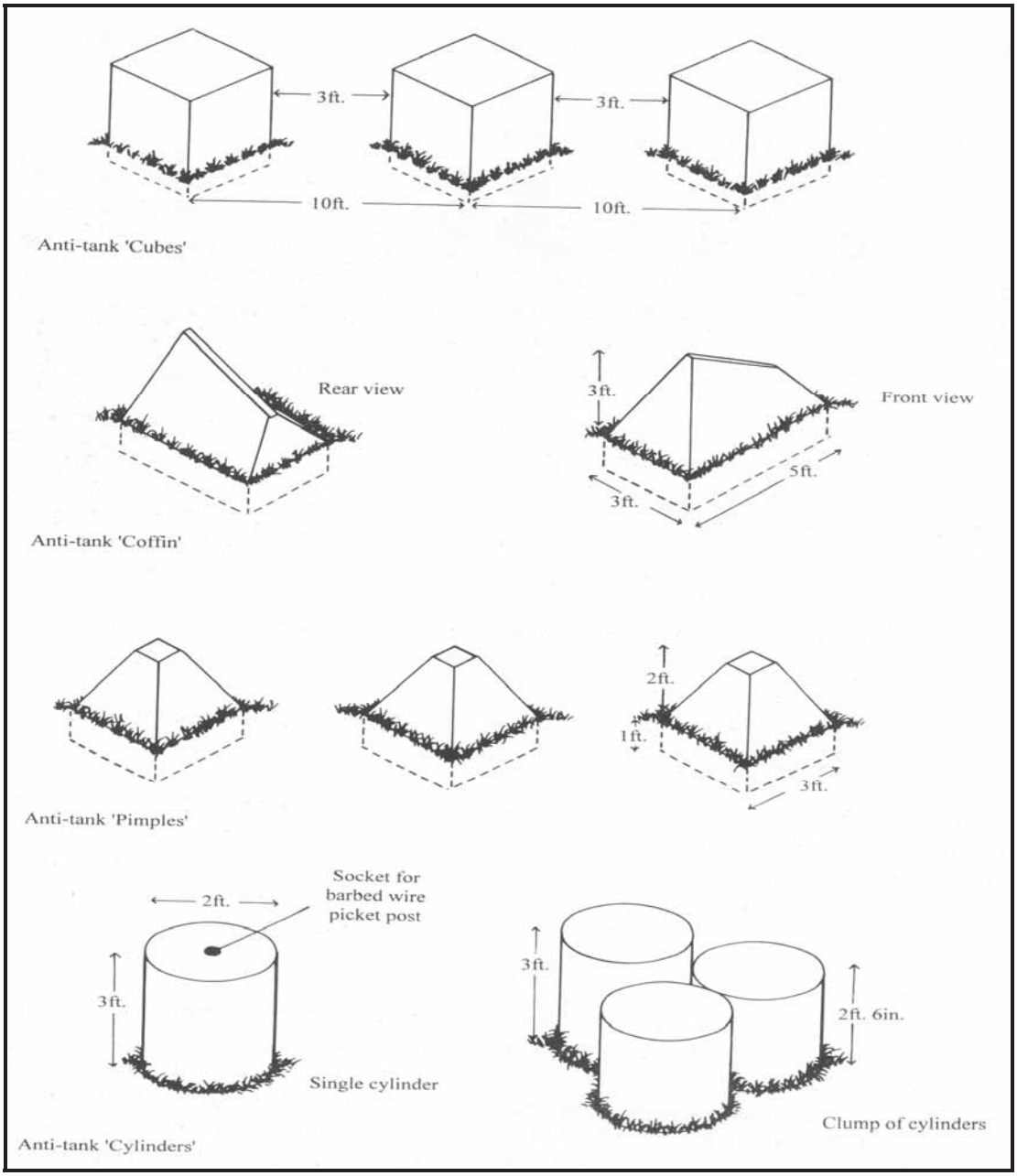

Fig.12 – AT cubes profiles (Brown *et al*: 2002).

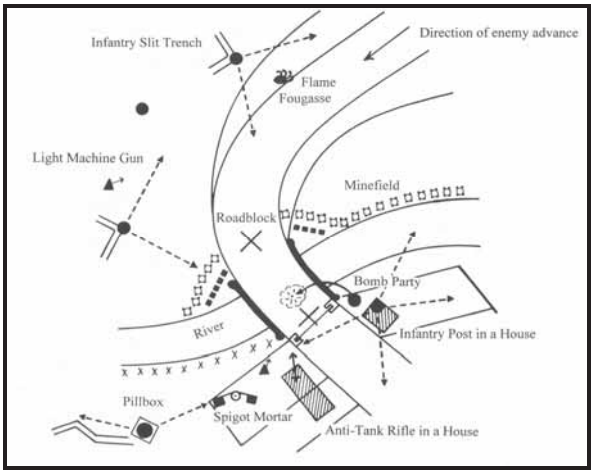

Fig.13 – Roadblock defences (Brown *et al*: 2002).

Fig.14 – Roadblock in progress (Lowry: 2004).

4.5.6 PILLBOXES

Still prominent in the landscape, the most obvious defensive feature present along the GHQ Line was the pillbox, a low concrete structure with loopholes from which weapons could be fired. Built to a high degree of standardisation, it was in June 1940 that the Fortress Works Department 3 (FW3) of the War Office's Directorate of Fortifications and Works (Ruddy: 2003) issued a series of designs ('*Types*') for the pillbox in home defence.

Based on designs used by the BEF along the Franco Belgian border, the overall design pattern of the pillbox was relatively simple, a factor largely based on the weapons deployed and the constraints placed upon their building, chiefly time and materials or the lack of.

Designated design numbers between 22 and 28 [1], the construction of the pillboxes were placed under the remit of the RE who, following an initial survey by the local Command's Tactical Reconnaissance Party, started construction work, sub-contracting out to civilian contractors [2].

Working at speed [3], often in specialised moving stages, the first gang dug / laid the foundations, the second erected shuttering (initially wood but to save resources brick or corrugated iron), whilst the third poured concrete in (Ruddy: 2003) (**Fig.15**). With contractors working 12 hour days, seven-days a week, weeks on end, by early July 1940, so intense was this pace of construction, that concerns were raised by FW3 into the level of cement stocks, in a

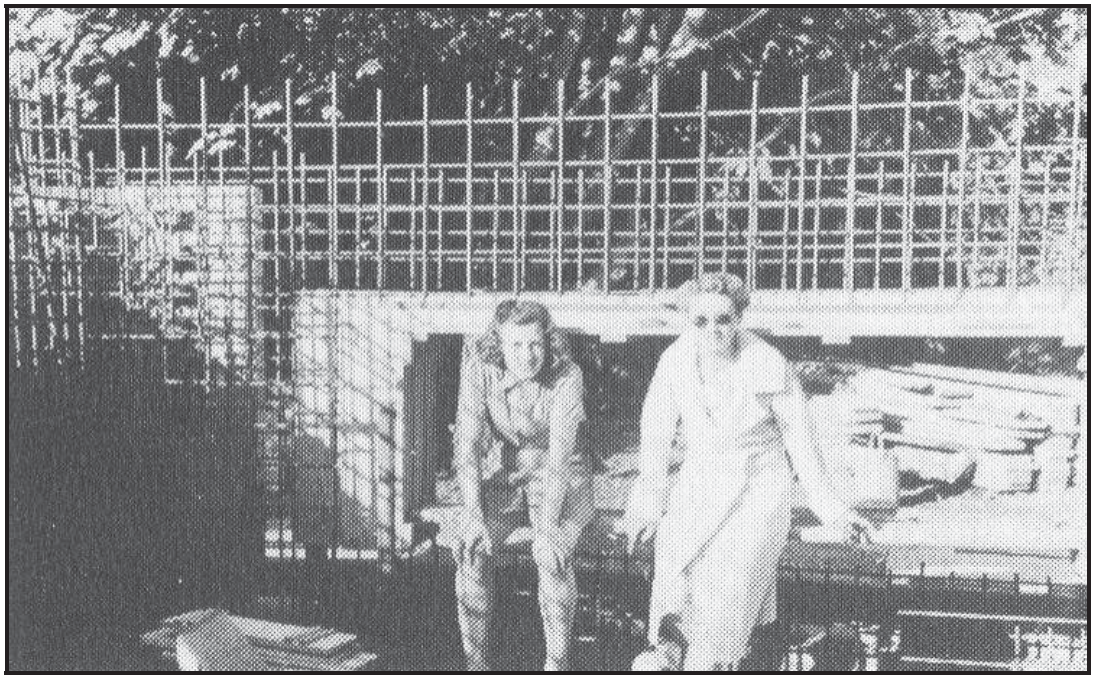

Fig.15 – A pillbox under construction (Wills: 1985).

1 Designated design numbers between 22 and 28, what happened to the 21 prior design patterns is not known, with Ruddy (2003) suggesting they could relate to other types of defensive structures, a matter that needs more research.

2 In restricted areas the construction work was completed by the RE only.

3 Prior to their building, work was undertaken by the RE in May 1940 to establish which civilian contractor could cope with the demanding workload, that of the construction of 200 pillboxes along a 50 mile stretch in 3 weeks! (Wills: 1985).

memorandum, *Economy of Cement in Defence Posts*, issued to all Chief Engineers of the Home Commands (Wills: 1985). This intensity was not to last, with a change in defensive tactics seeing the mass pillbox-building programme scaled down by September 1940.

Standardised to make production easier, the resulting pillboxes were built with flat sides, square, rectangular or polygon in shape, as curves, though more efficient for defensive purposes by increasing the chance of deflecting direct hits, was, for construction purposes, time consuming [1].

Often modified at Command level to suit the local topography / conditions, seven basic designs were issued by FW3, with five *Types* [2] (22-28) finally being accepted and built along the GHQ Line. They are:-

Type 22 (FW3 / 22)

The most common type of pillbox located along the GHQ Line and coastal / airfield defences, the FW3 / 22 (**Fig.16**) is hexagonal in plan, with walls *c.*0.3m thick x *c.*1.8m long (Brown *et al*: 2002), and an internal 'Y' shaped wall to prevent ricochets. Affording 360º of loophole coverage (entrance covered by rifle loophole for rearward defence) that provides good fields of fire, the Type 22 could hold a garrison of *c.*6 men (Ruddy: 2003) and was built to house small arms weapons only.

Type 24 (FW3 / 24)

Consisting of an irregular hexagonal plan, with the rear wall, containing the entrance, longer than the others, the FW3 / 24 (**Fig.17 / 18**) came in two forms, standard and shellproof**.** Measuring 3.65m long (rear) with the side walls 1.8m – 2.4m in length, the wall thicknesses varied from 0.3m (standard) to 0.9m (shellproof) (Brown *et al*: 2002). Garrisoned by up to eight men (Ruddy: 2003), the Type 24 with its internal 'Y' shaped wall and entrance covered by rifle loophole, provided defenders with 360º of loophole small arms coverage.

Type 25 (FW3 / 25)

Breaking the construction norm, being circular in design, the FW3 / 25 (**Fig.19**) was the smallest pillbox, measuring *c.*2.4m in diameter, with walls *c.*0.3m thick (Brown *et al*: 2002). Three loopholes provided a possible garrison of four (Ruddy: 2003) with 270 º of small arms fire coverage, the use of this type of pillbox along the GHQ line was very limited, with a more wider use seen on the coast.

Type 26 (FW3 / 26)

Square in plan, the FW3 / 26 (**Fig.20**) measured 1.8m internally, with walls 0.45m thick

[1] Some pillbox designs did make use of a curve (Type 25), though it was not common practice due to cost.

[2] Though seven designs were built, primarily only five were employed along the GHQ Line (Alexander: 1998).

(Brown *et al*: 2002), providing limited 360º small arms fire coverage to a garrison of four to five men (Ruddy: 2003).

Type 28 (FW3 / 28)

Seen as the only true AT pillbox, the FW3 / 28 (**Fig.21 / 22**), measuring *c*.6.1m square, with walls *c*.0.9m thick (Brown *et al*: 2002), was designed to house a Vickers heavy machine gun or AT gun with a wide embrasure at the front allowing maximum fields of fire coverage. Garrisoned by ten men (Ruddy: 2003), the standard Type 28 had two small arms loopholes set in opposing walls, whilst the Type 28A had an additional frontal small arms loophole. The Type 28A Twin was a double version of the 28A.

With no attempt to provide pillboxes with living accommodation [1], fit steel doors or armoured shields for the embrasures, most designs were built to a shell-proof standard, though in some cases only to bullet proof. Incorporating simple blast walls to protect open entrances as well as limit ricochets, most pillboxes provided cramped fighting conditions, leading to a common practice for garrisons to conduct the envisaged fighting outside, using the pillbox only in close quarters fighting or cover from artillery [2].

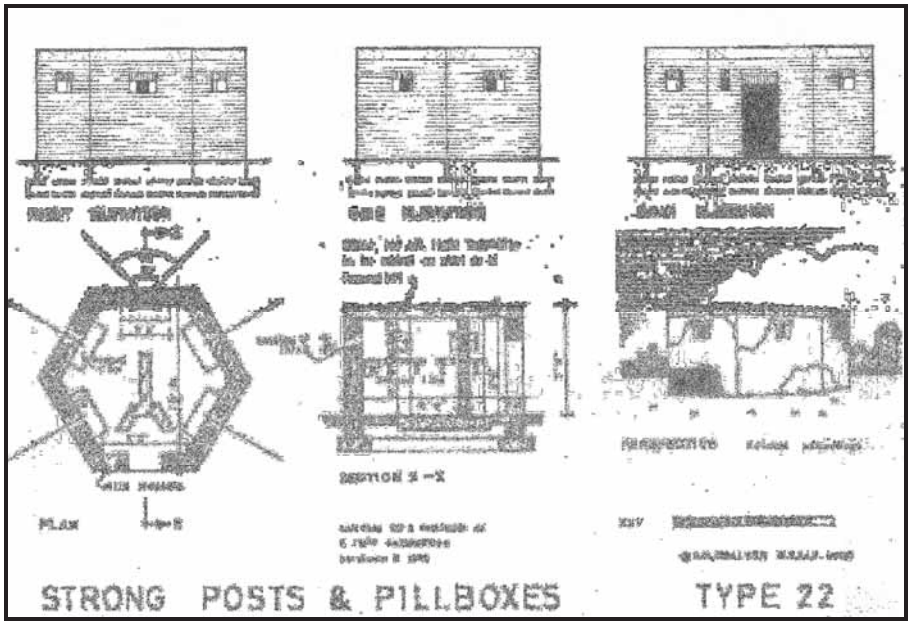

Fig.16 - FW3 / 22 Pillbox design (Wills: 1985).

[1] Point of interest: A recent field trip to the southeast coast uncovered a story where a local builder, contracted to build pillboxes, was also a member of the local Home Guard. Detailed to operate the defences once built, additional luxuries were added to the pillboxes such as kitchens, sleeping quarters and inside toilets!

[2] See **APPENDIX I** for an extract from an Infantry Training Manual, dated 1941, which outlined the operational procedure for pillbox use (Green: 1999).

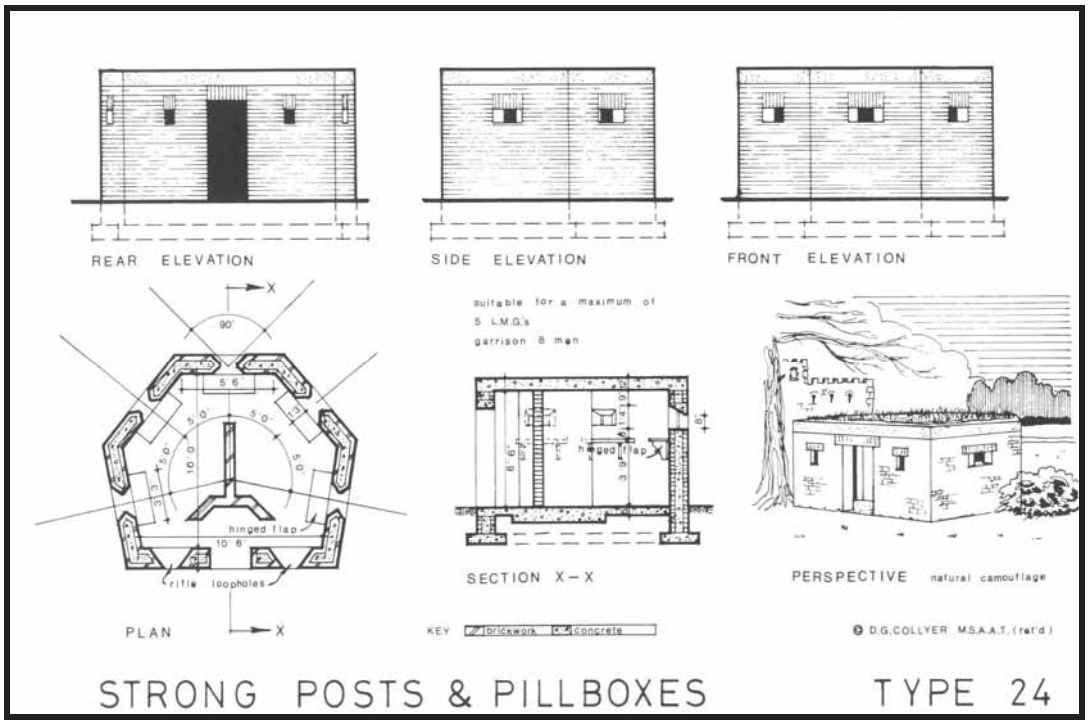

Fig.17 – FW3 / 24 Pillbox design (standard) (Wills: 1985).

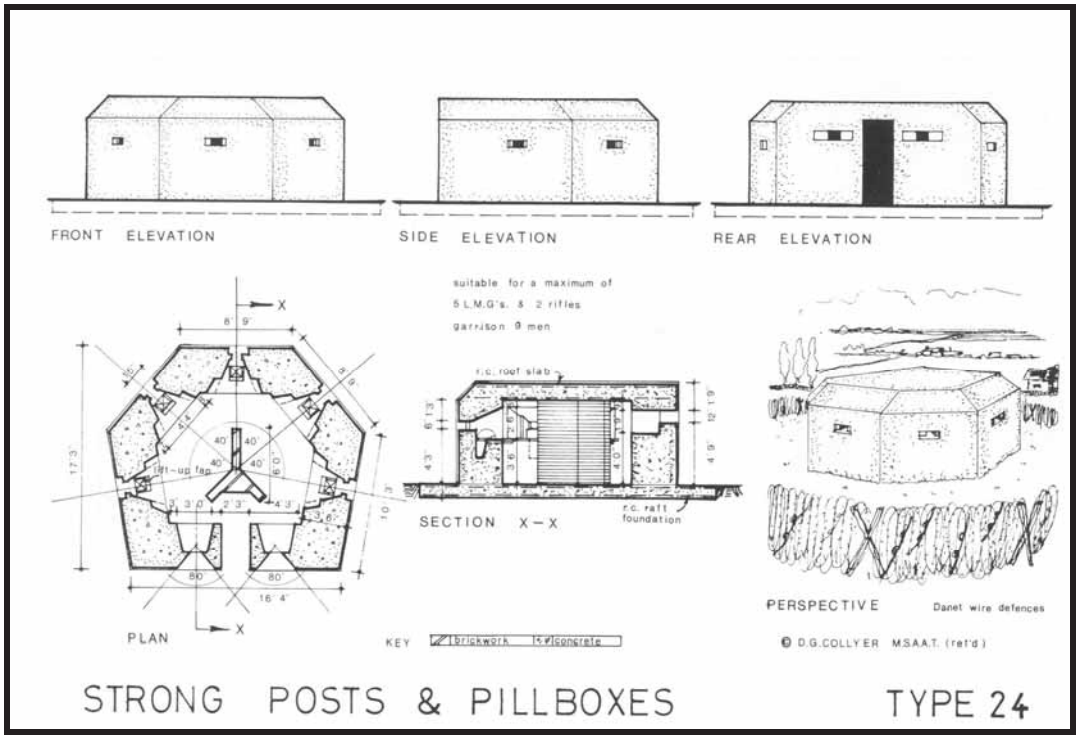

Fig.18 – FW3 / 24 Pillbox (Shellproof) design (Wills: 1985).

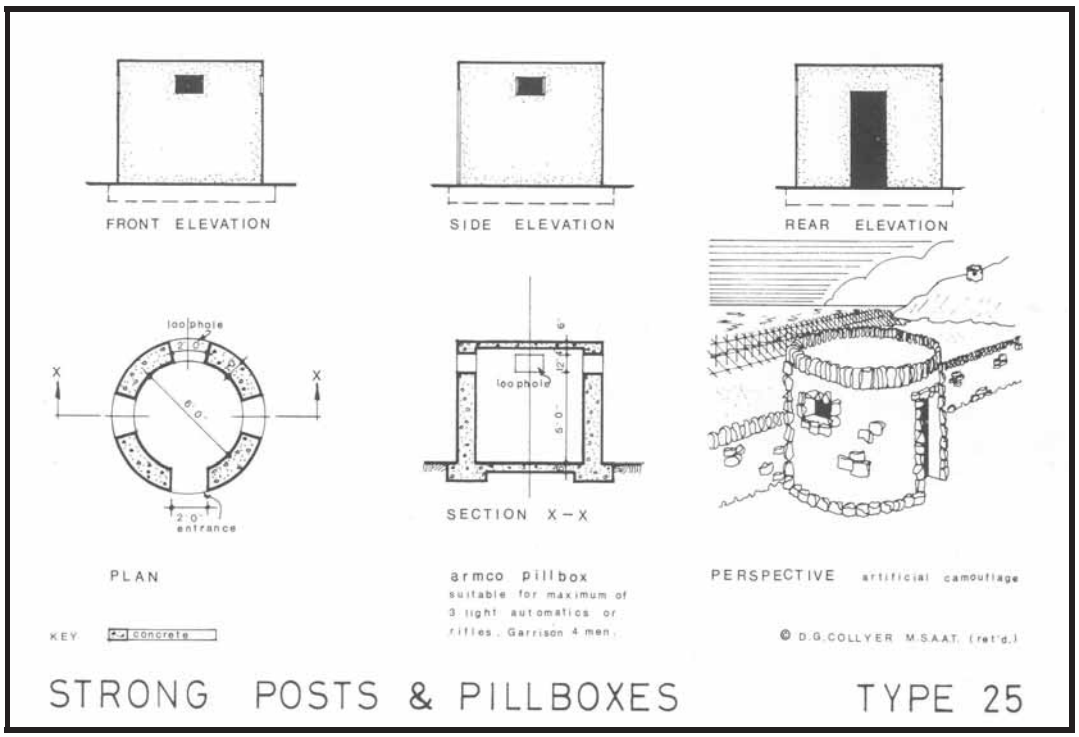

Fig.19 – FW3 / 25 Pillbox design (Wills: 1985).

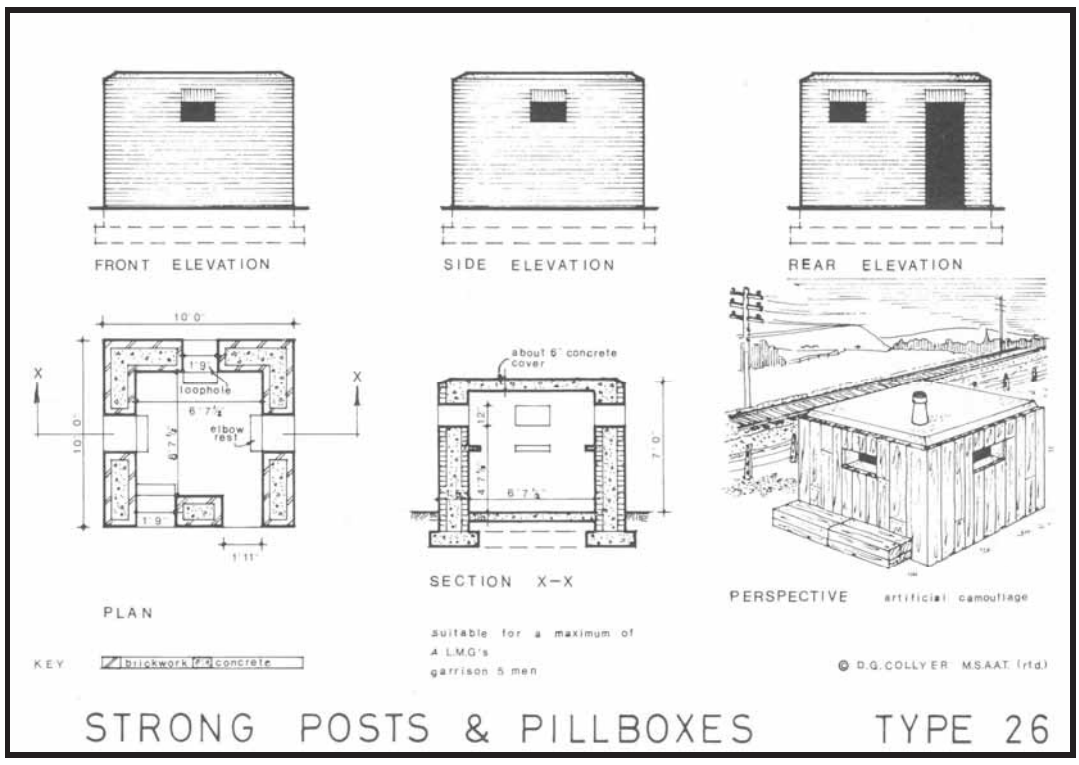

Fig.20 – FW3 / 26 Pillbox design (Wills: 1985).

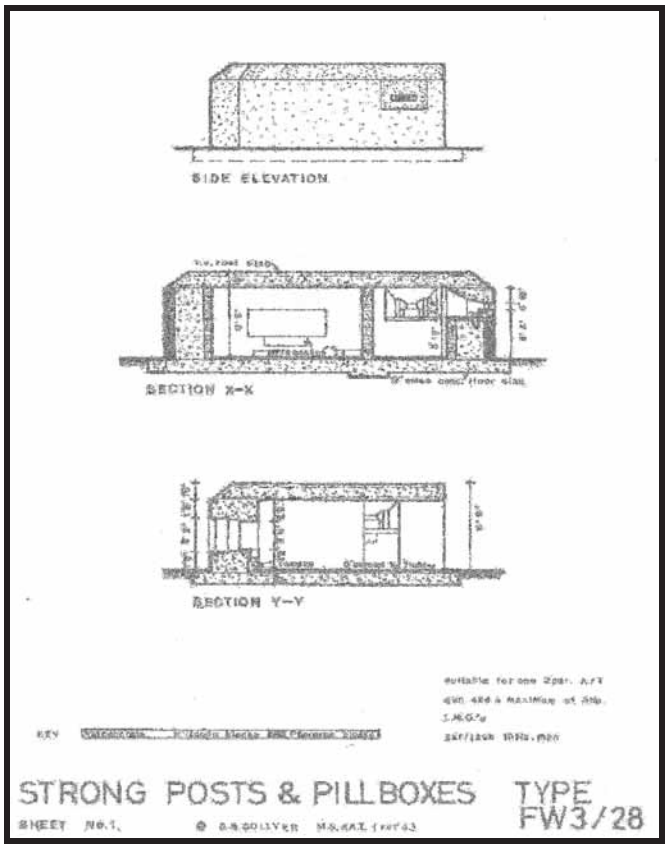

Fig.21 – FW3 / 28 Pillbox design (Wills: 1985).

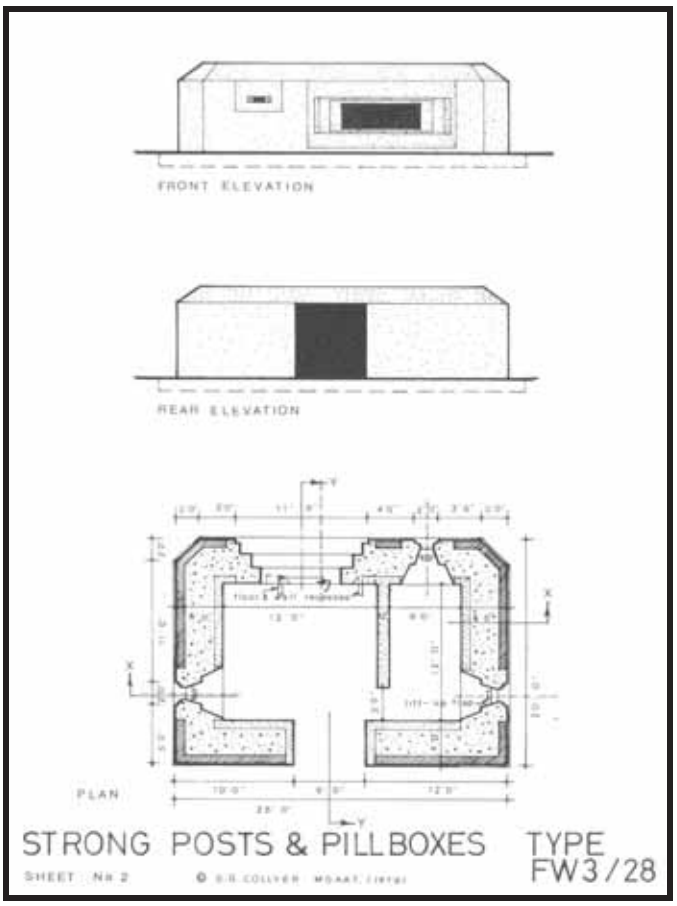

Fig.22 – FW3 / 28A Pillbox design (Wills: 1985).

4.5.7 AT WEAPONS

Short of AT guns and small arms, the Home Army in June 1940 had *c.*170 2-Pounder [1] (**Fig.23**) and *c.*100 6-Pounder Hotchkiss AT guns [2] (**Fig.24**). Predicated to take *c.*4 months of uninterrupted production before loses were replaced, the British Government ordered from the American National Pneumatic Company *c.*500 37mm AT guns together with *c.*2000 rounds of solid shot per gun (Alexander: 1998).

With delivery expected September 1940 onwards, delays in production resulted in the first shipment not being ready until March 1941, six months after the planned German S-Day. To alleviate this short fall, a large proportion of available 2-Pounder AT guns were deployed with the GHQ Mobile Reserve, whilst the 6-Pounder Hotchkiss guns, initially deployed along the GHQ Line, was relocated to coastal defence. To provide additional AT support, the 40mm Bofor AA guns, deployed in defence of airfields and key industrial sites, were issued with AP rounds, allowing the gun crews to engage enemy tanks should the need arise.

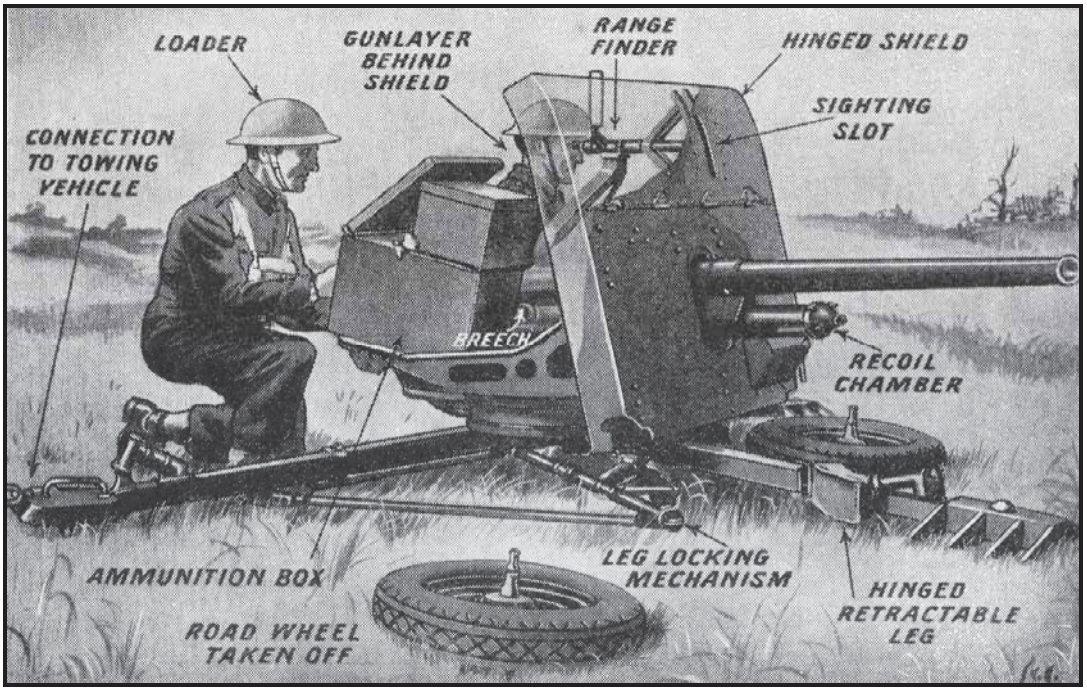

Fig.23 – Vickers Armstrong 2-Pounder QF Mobile AT gun (Hawks: 1942?)

Short of artillery pieces, the mainstay of the GHQ Line AT capability was the Boys AT rifle [3] (**Fig.25**), with pillboxes constructed accordingly. In support of the AT weapons, .303 inch Vickers medium machine guns, .303 inch Bren LMG's and .303 inch Short Magazine Lee-Enfield (SMLE No:1) rifles were employed by the infantry on the *Stop Lines*, in conjunction

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1 40mm semi automatic breech AT gun mounted on a removable 2-wheeled carriage that created a stable firing platform. Able to traverse 360º, the gun proved itself in France against German armour (Alexander: 1998).

2 Reconditioned First World War ex naval gun mounted upon a concrete pedestal (Alexander: 1998).

3 0.55 in calibre, the Boys AT rifle had a penetration of 20mm at 500m, striking angle 0 degrees (Hogg: 1977). To increase its effectiveness, the weapon would be used at shorter ranges to boost penetration.

with various improvised weapons devised by the HG for anti-invasion defence [1] (**Fig.26**).

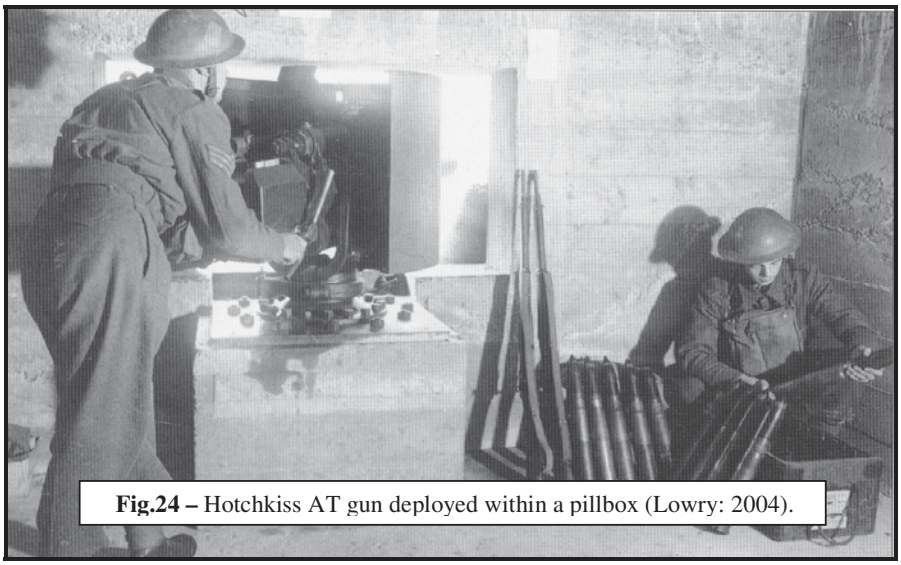

Fig.24 – Hotchkiss AT gun deployed within a pillbox (Lowry: 2004).

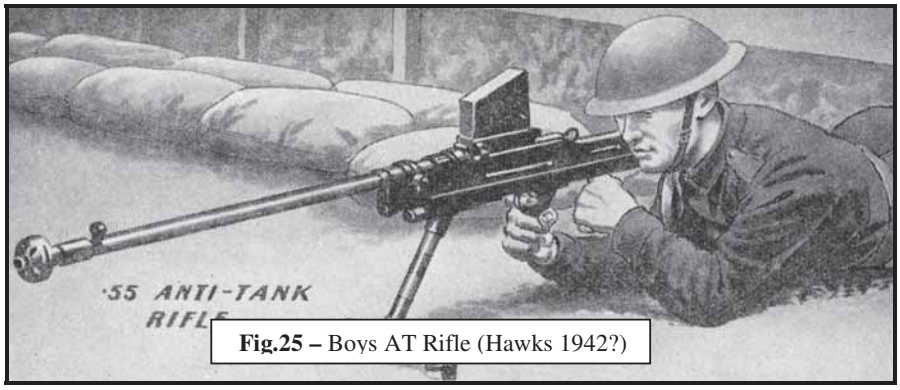

Fig.25 – Boys AT Rifle (Hawks 1942?)

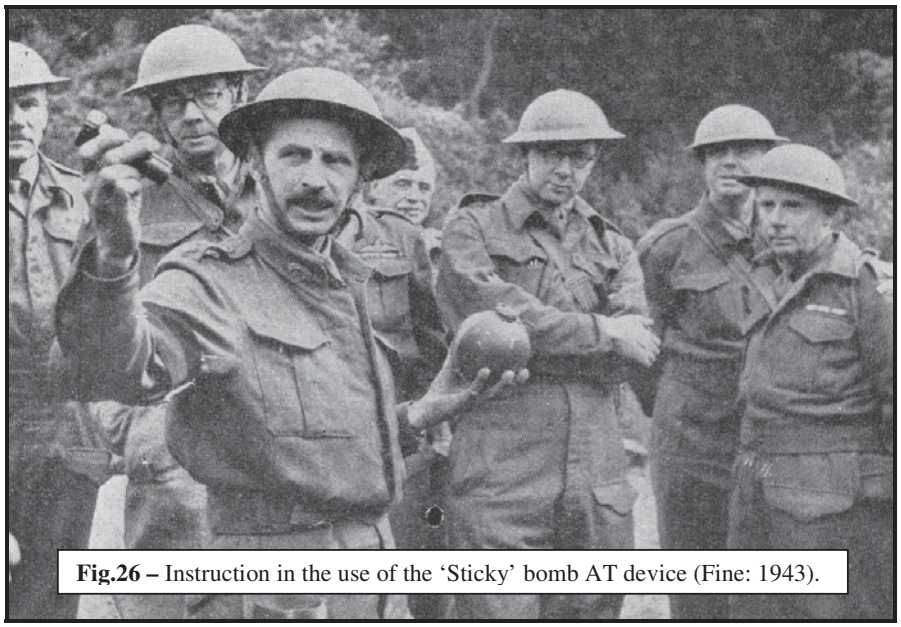

Fig.26 – Instruction in the use of the 'Sticky' bomb AT device (Fine: 1943).

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1 A variety of improvised AT devices were developed by the HG (Molotov cocktail filled with petrol, tar or paraffin). By early 1941, a number of other AT guns (Spigot Mortar and Smith Gun etc) had been developed and deployed. The weapons available summer 1940 were the Vickers Medium Machine Gun, effective at targets over 1000 yards and was able to undertake a miniature artillery role up to 4,500 yards. The Bren LMG effective up to 1000 yards (Barlow: 1942), and the SMLE rifle producing a similar effective range (600 – 1000 yards) (Gorman: 1942)

4.6 MOBILE RESERVE

Combining AT obstacles and defended nodal points in a linear, static defensive line that extended the length of Great Britain, the GHQ Line was located inland to prevent any unpredicted landings (sea or airborne) by German mechanized forces from reaching London or key industrial centres.

In support of the GHQ Line was the GHQ Mobile Reserve, a corps comprising of better-equipped and organized mobile infantry divisions deployed primarily north and south of London [1]. Formed originally from IV Corps, their role was to be a highly mobile armoured / infantry force, deployed near the GHQ line to reinforce areas of the defensive line, from the Wash to Sussex, as well as providing counterattacks / harassment raids.

Enlarged July 1940, to incorporate the newly formed VII Corps with its much-needed 1st Armoured Division and tanks, the operational remit for the GHQ Mobile Reserve changed, with no geographical restriction on their area of operations or time limit. VII Corps now located in the southeast of the country, and IV Corps northwest of London, the strengthening of the GHQ Mobile Reserve continued throughout August and September, 1940, influenced by a change in defensive tactics by the newly appointed *Commander in Chief Home Force*, General Brooke (Alexander: 1998).

4.7 CHANGE IN DEFENSIVE TACTICS

Criticised as soon as the *Home Forces Operation Instruction No: 3* was issued, Ironside's plan of a GHQ linear *Stop Line* was quickly compared to the failed *Maginot Line*, with area Commanders expressing concern over this defensive policy.

Expressing concerns regarding the amount of defence in dept, the Vice Chiefs of Staff stated in early July 1940 '*It appeared that the main resistance might only he offered after the enemy had overrun nearly half of the country, and obtained possession of aerodromes and other vital facilities'* (Alexander: 1998).

With Churchill's support for static defence lines dwindling, on 19th July 1940 Ironside was informed that he was to be retired, with General Alan Brooke, a veteran of the fighting in France months earlier, replacing him.

Experiencing *blitzkrieg* firsthand, within days of taking over the command, a review of the countries defensive strategies was underway, with Brooke, during a visit to Eastern Command on 22nd July, writing in his diary of concerns regarding the GHQ Line [2].

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1 The GHQ Mobile Reserve, formed originally from IV Corps, was initially made up of the following divisions: - 52nd Lowland Division, 43rd Wessex Division, 1st Canadian Division and the 2nd Armoured Division. From July, onwards VII Corps was created and added to the Mobile Reserve, bringing with it much needed armoured divisions.

2 See **APPENDIX J** for extract of Brooke's diary (Alexander: 1998).

Changes afoot, 3rd August 1940 saw the first of a series of orders issued, stating that construction work was to cease on the *Stop Lines*, with Scottish and Northern Commands instructed first and Southern, Eastern and Aldershot Commands informed five days later [1] (Alexander: 1998).

With temporary plans drawn up to counter an invasion, that of a skeleton force of Area HQ troops and HG detailed to hold the lines until relieved by the Field Army, the changes in defensive tactics were to last well into Autumn 1940, past the German S-Day!

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1 Experiencing blitzkrieg first hand, Brooke's tactical change was to enhance the strategic notion of defended nodal points at the main crossing points across the GHQ line, before abandoning the line completely in 1941 to develop a national network of AT Islands (large nodal point) and centres of resistance.

CHAPTER 5

5.1 STOP LINE GREEN

With the cessation of construction work [1] ordered by Brooke early August 1940, in hindsight, this period of transition to home defence tactics was a huge gamble that could easily have failed, with the defensive limbo coinciding with the planned date for the German invasion. If the invasion had occurred on the 21st September 1940, then the principle defence the British Home Forces had at their disposal was the GHQ Stop Line(s).

With this in mind, the next chapter will investigate the question '*Would the Stop Line linear defences have halted an invasion force?* by evaluating, using visibility / landscape analysis [2], the perceived effectiveness of the '*Stop Line Green*' anti-invasion defence (case study area - Wellow to Hinton Charterhouse, near Bath).

5.2 ROUTE

Strategically located in the south-west of the country, Bristol, with its key aircraft factories and deep-water port at Avonmouth, was a prime target for the invading German Army. Expecting a thrust northwards from the south coast**,** military planners decided upon a Bristol Outer Defence that encircled the city to a distance of *c*.20 miles (**Fig.27**) to keep the port open for evacuation / reinforcement purposes.

Taken from a reconnaissance report dated 18th June 1940 on the Bristol Outer Defences [3] (Green: 1999), the general route of the Stop Line Green (SLG) uses both natural as well as artificial topographic features (rivers, railway lines etc), and was supported by 319 pillboxes (48 bullet proof only), and 20 miles of AT ditch (Wills: 1985).

Extending for *c*.91 miles in a rough semi-circular pattern from Highbridge, Somerset to Upper Framilode, south of Gloucester, the detailed route chosen for the *Stop Line* ran from the Bristol Channel (Highbridge) along the River Brue to a point just east of Wells. Crossing the Mendip Plateau to Masbury, the line of the Somerset & Dorset Railway was followed to Radstock before ensuing along the Wellow Brook to Midford Hill. From here, SLG traverses a plateau to the River Avon at Bradford On Avon before continuing upstream to Malmesbury. Spanning the Cotswold Plateau to Nailsworth and Stroud, the final stretch of the route took it along the River Frome and Stroud Water Canal before continuing onto the River Severn at Upper Framilode (Green: 1999).

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1 The order stated that only work in hand was to be completed, with no new anti-invasion defences to be construction along the GHQ Line.

2 To achieve this, visibility (viewshed) analysis of the area, using 3D topographical mapping (©memory-map) and Geographical Information System software (©Arcview 3.3) will be employed in conjunction with landscape (AP / cartographic / fieldwork) studies.

3 See **APPENDIX K** for details of reconnaissance report / review on the Bristol Outer Defences (Green: 1999).

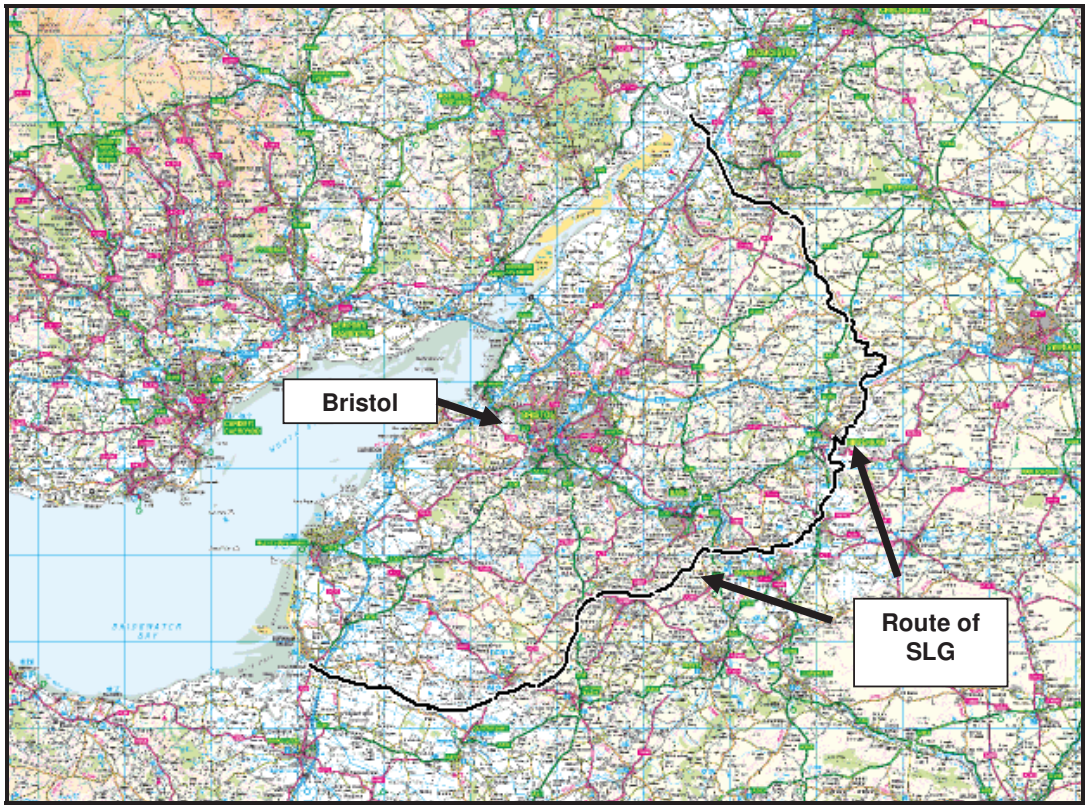

Fig.27 – Map detailing the route of SLG (©Memory-Map).

5.3 AT WEAPONRY & TACTICS

Located on the western side of the country, if an invasion occurred, then by the time German troops reached Bristol; most of the Home Army would have been destroyed or reduced to pockets of resistance. Mindful of this, it was decided that the limited number of AT guns would be better deployed to the coastal defences and the GHQ Mobile Reserve, in an effort to defeat an invasion force before they gained a foothold inland. As no AT guns were deployed along the line, the defence of the SLG was left to the Boys AT rifle and small arms, a decision reflected in the pillbox construction (FW3/ 24 and 26 the predominant '*Types*').

Limited in its armament, the key to the SLG defence was the efficient use of available small arms effective range capabilities, drawing any advancing enemy formations into killing zones where competent engagement could take place.

With 20mm penetration at 500m (547 yards [1]) (striking angle 0 °) (Hogg: 1977), the 0.55in Boys AT rifle could, if struck accurately, puncture the majority of German armour [2], with the Vickers Medium Machine Gun, predominately engaging infantry and soft skinned vehicles over 1000 yards (> 914.08m), undertaking an alternative role of scale-down artillery to 4,500 yards (<4113.35m) if required.

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1 1m = 1.0940 yards (Dorling Kindersley: 1998).

2 See **TABLE A** - **APPENDIX L** for German tank specifications.

With the Bren LMG effective up to 1000 yards (< 914.08m) (Barlow: 1942) and the SMLE rifle, effective range (600 – 1000 yards) (548.45m – 914.08m) (Gorman: 1942), supporting the Vickers in an infantry / soft skinned vehicle role, the most efficient way of maximizing the weapons capabilities were to draw enemy forces into areas where a bottlenecking effect would occur. Weakest on its underside, an armoured vehicle was most vulnerable when passing over an obstruction.

Facing both a natural water obstacle (Wellow Brook), as well as an AT ditch along the SLG, the tank would be at its most vulnerable should it attempt to navigate at any given point. Too wide to straddle, the armoured vehicle would have entered the obstacle in its entirety, running a great risk of getting stuck and exposing its underside to AT fire should it be successful in climbing the opposing bank.

Compounding this further, many of the fields approaching the SLG contained hedge lines / rows that if substantial in growth, would act in the same way as an artificial obstacle, forcing the tank to drive over the hedge, exposing its underside. With knowledge of these possible problems, it is conceivable that military planners anticipated this in their placing of defences within the landscape, forcing advancing armoured columns to make use of road networks and channelling the enemy along routes into nodal strong points, blocked with moveable roadblocks (see 4.5.5)

5.4 CASE STUDY AREA – WELLOW TO HINTON CHARTERHOUSE

Having reviewed the build-up to invasion, and the development of the anti-invasion measures taken to counter the threat, the question '*Would the Stop Line linear defences have halted an invasion force?* is one that has never been addressed. Green (1999) suggests that though not tested in battle conditions, their construction had the disadvantage of penetration in one-section compromising the rest of the linear defence. He further suggests that they may have been intended to deter an invasion, rather like the *Maginot* Line, with their existence obvious to German aerial reconnaissance, or even a plight to convince the United States of America into intervention. Notion's that whilst it is difficult to dismiss the American theory, is one that both AP as well as topographic evidence suggests is flawed, as the results from the visibility / landscape analysis demonstrates.

5.4.1 FIELD SURVEY

Located *c*.6 km's south of the City of Bath, a *c*.5 km stretch of the SLG that best typifies the overall defences was chosen as the case study area for this paper, with a field survey of the surviving structures (**Fig.28**) detailed below:-

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1 A GPS survey of the pillbox / defence locations was completed however, data corruption resulted in incorrect map references to be produced. With this in mind, the grid references quoted have been taken from the ADS *Defence of Britain* database. A new survey is therefore required to update the records.

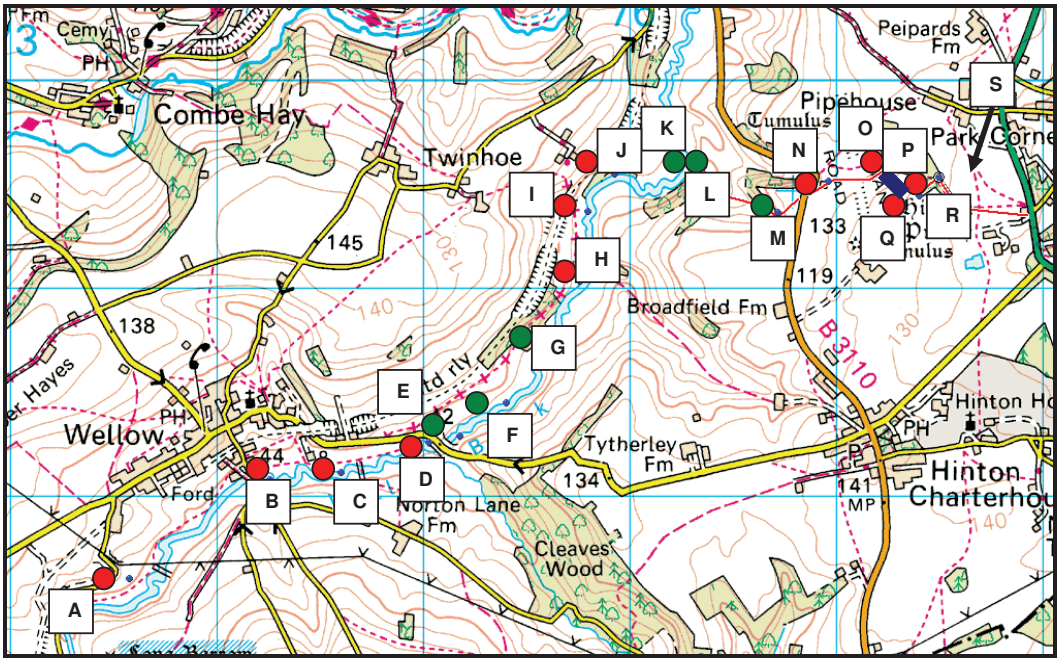

Fig.28 – Map of case study area with SLG defences highlighted [1] (© Memory-Map 1:50000).

A) FW3/ 24 SP Pillbox (**Plate's 2 - 4**) - Starting *c*.0.6km southwest of Wellow (NGR: ST 7359 5770 [1]), Pillbox A is located mid way up an open field. Providing excellent all round visibility across the valley and a river crossing point (bridge / shallow fording point), 1940s AP (see 5.4.2) suggests it was once in a hedge line. Garrisoned by > 8 deployed in / around the structure, the main armament would have been small arms (rifles and a Bren LMG / Boys AT rifle).

B) FW3/24 SP Pillbox (**Plate's 5 - 7**) – Situated *c*.0.79km northeast of A and *c*.110m east of a road ford (NGR: ST 7428 5805), Pillbox B is located in the hedge line on a bend along the Wellow Brook. With enfilading fire across the brook and to both sides, it is likely that > 8 men would have been deployed in / around this structure and armed with small arms only.

C) FW3 / 24 SP Pillbox (**Plate's 8 - 10**) – Located a further *c*.0.275km along the winding Wellow Brook (NGR: ST 7458 5811), Pillbox C is located along the brook hedge line, providing enfilading fire back towards B and onwards towards D. Likely manned by > 8 in / around the structure and armed with small arms only, no direct lines of fire are possible between these structures (pillboxes not intervisible), though their zones of fire do interlock, providing good area coverage [2].

D) FW3 / 24 SP Pillbox (**Plate's 11 - 13**) – Positioned in the brook hedge line, adjacent to the road, *c*.50m from the road bridge and *c*.0.475km from C (NGR: ST 7508 5825). Pillbox D

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1 This section of SLG was last surveyed for the ADS *Defence of Britain* project, as well as featured publications (Wills / Alexander / Green), late 1990's. Following their plotting, differences were identified which resulted in a new more accurate survey (Rowe: May 2005) being completed. Locations marked in green were NOT located and are taken from Alexander's / Green's survey – See **APPENDIX M** for plotted maps of the previous surveys in comparison with the May 2005 survey.

2 See **5.4.4 f**or a GIS 3D Topographic view of the surveyed line that demonstrates the interlocking forward and enfilading coverage of fire

affords good visibility across Wellow Brook and the road / road bridge providing the > 8 man garrison armed with small arms good covering fields of fire.

E) FW3 / 26 Pillbox – Unable to locate on the ground [1], the ADS *Defence of Britain* database suggests (referencing Alexander (1998) and Green (1999)), a Type 26 pillbox is / was situated at the Ford Road Bridge, Hinton Hill south of Wellow Brook (NGR: ST 7519 5824), *c*.120m east of Pillbox D. Covering the main road crossing of the brook, with good all round fields of fire, Pillbox E would have been garrisoned by > 5 men armed only with small arms.

F) FW3 / 24 SP Pillbox – Unable to locate on the ground, Pillbox F, as listed on the ADS database [2], is / was located on the north bank of Wellow Brook at Hankley Bottom (NGR: ST 7541 5842), *c*.180m northeast of Pillbox E. Typical of a Type 24, the normal garrison of > 8 men armed with small arms, provided good coverage of fire across the valley, interlocking with other pillbox zones of fire.

G) FW3 / 24 SP Pillbox – Unable to locate on the ground, Pillbox G, a Type 24 is / was located *c*.475m northeast of Pillbox F at NGR: ST 756 587, on the north bank of Wellow Brook, south of Hankley Wood (ADS database), and been garrisoned by > 8 men armed with small arms. Not intervisible with other pillboxes, the need for direct lines of sight between the emplacements was not necessary as their zones of engagement interlocked to provide both good forward as well as enfilading coverage of fire**.**

H) FW3 / 24 SP Pillbox (**Plate's 14 - 16**) – Situated in the brook hedge line, *c*.100m southwest of a small river crossing, *c*.120m southeast of a railway cutting and *c*.330m northeast of G (NGR: ST 7579 5902). Pillbox H, a Type 2 manned by > 8 men armed with small arms providing a good coverage of fire across the river valley.

I) FW3 / 24 SP Pillbox (**Plate's 17 - 19**) - Located in the hedge line on the west bank of Wellow Brook, *c*.300m north of H and *c*.90m southeast of the railway cutting (NGR: ST 7580 5935). Pillbox I, a Type 24, garrisoned by > 8 men armed with small arms, providing, much like the others, good enfilading and forward coverage of fire.

J) FW3 / 24 SP Pillbox (**Plate's 20 - 22**) – Positioned in the north bank hedge line on the bend of Wellow Brook, *c*.30m southeast of Rainbow Wood, Twinhoeford (NGR: ST 7593 5950) and *c*.220m from I. Pillbox J, garrisoned by > 8 men armed with small arms, affords good visibility / coverage of fire across the valley and northeast towards the main B3110 road.

K) FW3 / 26 Pillbox – Unable to locate on the ground, the positioning of Pillbox K, taken from

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1 The field survey was unable to locate these pillboxes on the ground, therefore a new FULL survey is urgently needed

2 As well as referencing Alexander and Green as the source of information, the database also refers to AP 1946/04/14 106G UK 1415 F/20 (3453-3455) (Copies attached at **APPENDIX N**).

the ADS database, is / was east of Wellow Brook at the north end of Poorfield Wood, Midford Valley (NGR: ST 7631 5962). *c*.350m from J, the location of Pillbox K, on the east bank is seen as the start of SLG's move away from Wellow Brook valley. This would have been manned by > 5 men armed with small arms.

L) FW3 / 24 SP Pillbox – Unable to locate on the ground, the location of Pillbox L is is / was *c*.75m east of K and Wellow Brook in Midford Valley (NGR: ST 7639 5960). A Type 24 garrisoned by > 8 men armed with small arms, the positioning of Pillbox L is on higher ground to the north east edge of a wood that affords excellent visibility / coverage of fire across Midford Valley,

M) FW3 / 24 SP Pillbox – Unable to locate on the ground, Pillbox M is / was situated at the southern end of Hang Wood, west of the B3110 road and *c*.425m southeast of L (NGR: ST 7672 5935). Garrisoned by > 8 men armed with small arms, Pillbox M, located *c*.100m above OD [1], is ideally situated to provide cover both down the valley and across to the B3110 road.

N) FW3 / 24 SP Pillbox (**Plate's 23 - 24**) - Positioned in a hedge line *c*.275m northeast of M and *c*.75m east of the B3110 road, Midford Hill, (NGR: ST 7702 5950). The location of Pillbox N, garrisoned by > 8 men armed with small arms, affords good visibility / coverage of fire west towards the main B3110 road, south towards the intended invasion direction and east towards Pillbox O.

O) FW3 / 26 Pillbox (**Plate's 25 - 26**) – Located *c*.275m northeast of N on the western end of Hog Wood (NGR: ST 7722 5955), Pillbox O, a Type 26 typically garrisoned by > 5 men armed with small arms, is sited at the beginning of a section of unfilled AT ditch that runs through Hog Wood.

P) AT Ditch (**Plate's 27 - 29**) (**Fig.29**) – Running for *c*.350m in length in a limited zigzag pattern that makes several changes of direction through the woods, the dimensions / construction suggest that the AT ditch is that of a flat bottomed *two-way* AT obstacle [2] (NGR: ST 7751 5962 – ST 7722 5955). intended to both prevent the crossing of armoured / soft skinned vehicles, as well as funnel infantry troops towards pillboxes / slit trenches located at key strategic points, this section of AT ditch is the only surviving part of a wider obstacle that ran from Pillbox K and Wellow Brook to the A36 main road, c.330m east of Hog Wood [3].

Q) FW3 / 24 SP Pillbox (**Plate's 30 - 31**) – Located in the hedge line at the southern end of Hog Wood, *c*.220m southeast from O, Pillbox Q (NGR: ST 7741 5944), a typical Type 24, is situated

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1 Information obtained using a handheld Garmin *Etrex* 12 Channel GPS system (accuracy to 5m).

2 See Rowe (2005: Unpublished) for detailed landscape survey of the AT ditch within Hog Wood. Attached at **APPENDIX O** is a description of a flat-bottomed two-way AT obstacle.

3 See Chapter 5.4.2 for aerial photographic evidence of this continuance of the AT ditch.

in an excellent strategic position. Positioned on a bend in the AT ditch that affords both visibility / coverage of fire south across open countryside as well as enfilading fire along the ditch; > 8 men armed with small arms only would have garrisoned Pillbox Q.

R) FW 3 / 24 SP Pillbox (**Plate's 32 – 33**) – Situated in the northern hedge line of Hog Wood, *c.*140m northeast of Q, Pillbox R (NGR: ST 7751 5952) dominates a strategic position that provides both enfilading fire along the AT ditch, as well as north and eastwards across open fields. Manned by > 8 personnel armed with small arms, surviving next to the pillbox is a zigzagging slit trench (**Plate 34**) that supports the notion of troops being positioned outside the pillbox in order to engage enemy troops.

S) Slit trenches (**Plate 35**) – Located on the ground from AP RAF/3G/TUD/UK/25 No: 5166 Dated 14th January 1946 (**Fig.30**), a zigzagging slit trench is seen to run in a north-south direction to a possible structure (pillbox?). Typological differences when compared to First World War practice trenches (**Fig.31**) suggests a WWII construction for use by infantry to defend / cover the main A36 road to the east (road block would have been employed there) as well as provide enfilading fire west / southwards towards the AT ditch.

Plate 2

Plate 3

Plate 4

Plate 5

Plate 6

Plate 7

Plate 8

Plate 9

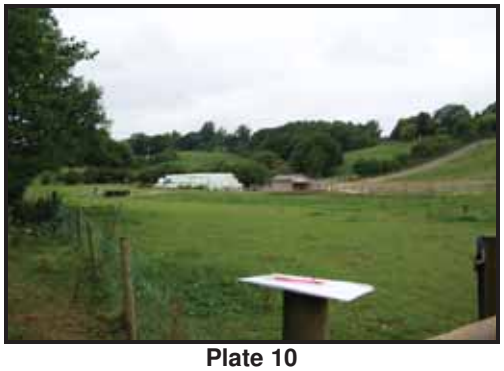

Plate 10

Plate 11

Plate 12

Plate 13

Plate 14

Plate 15

Plate 16

Plate 17

Plate 18

Plate 19

Plate 20

Plate 21

Plate 22

Plate 23

Plate 24

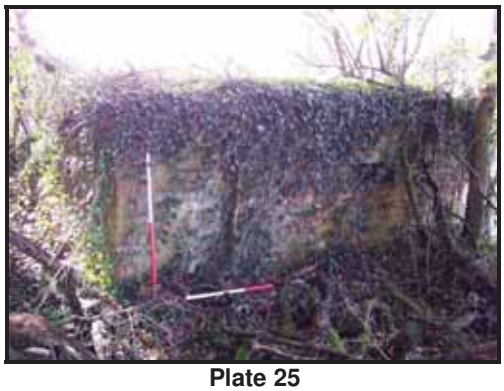

Plate 25

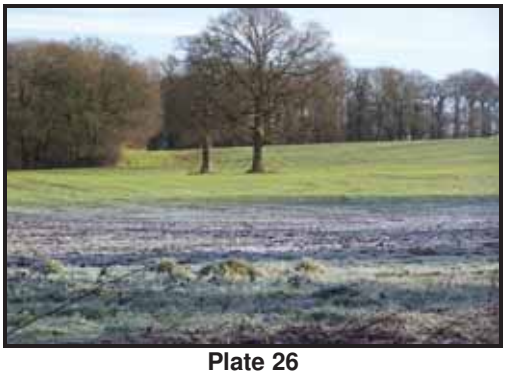

Plate 26

Plate 27

Plate 28

Plate 29

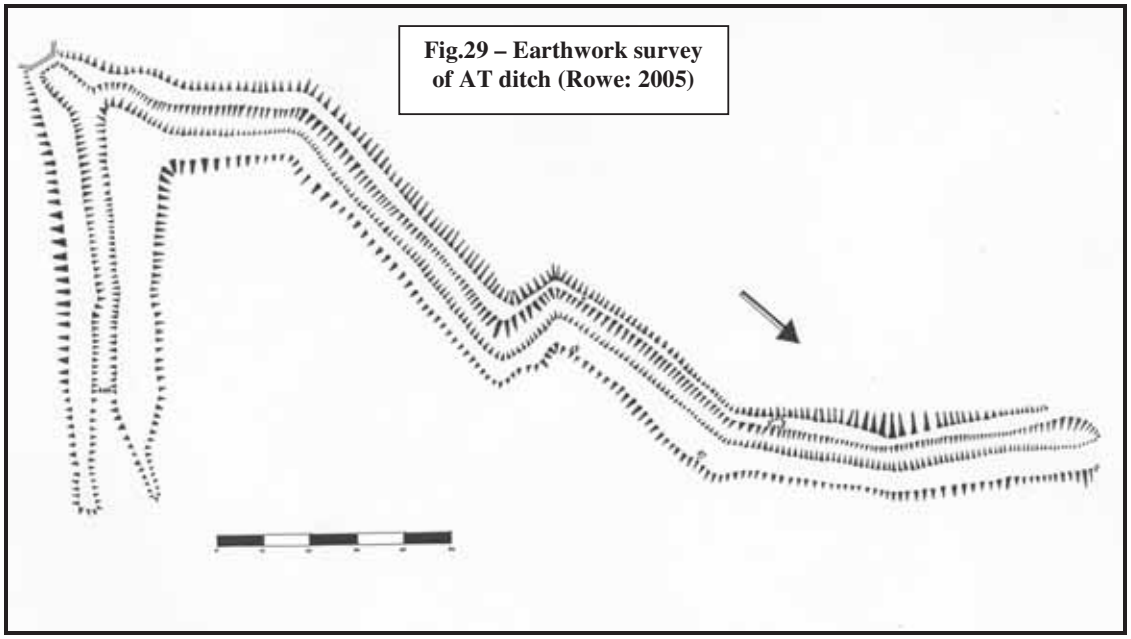

Fig.29 – Earthwork survey of AT ditch (Rowe: 2005)

Plate 30

Plate 31

Plate 32

Plate 33

Plate 34

Plate 35

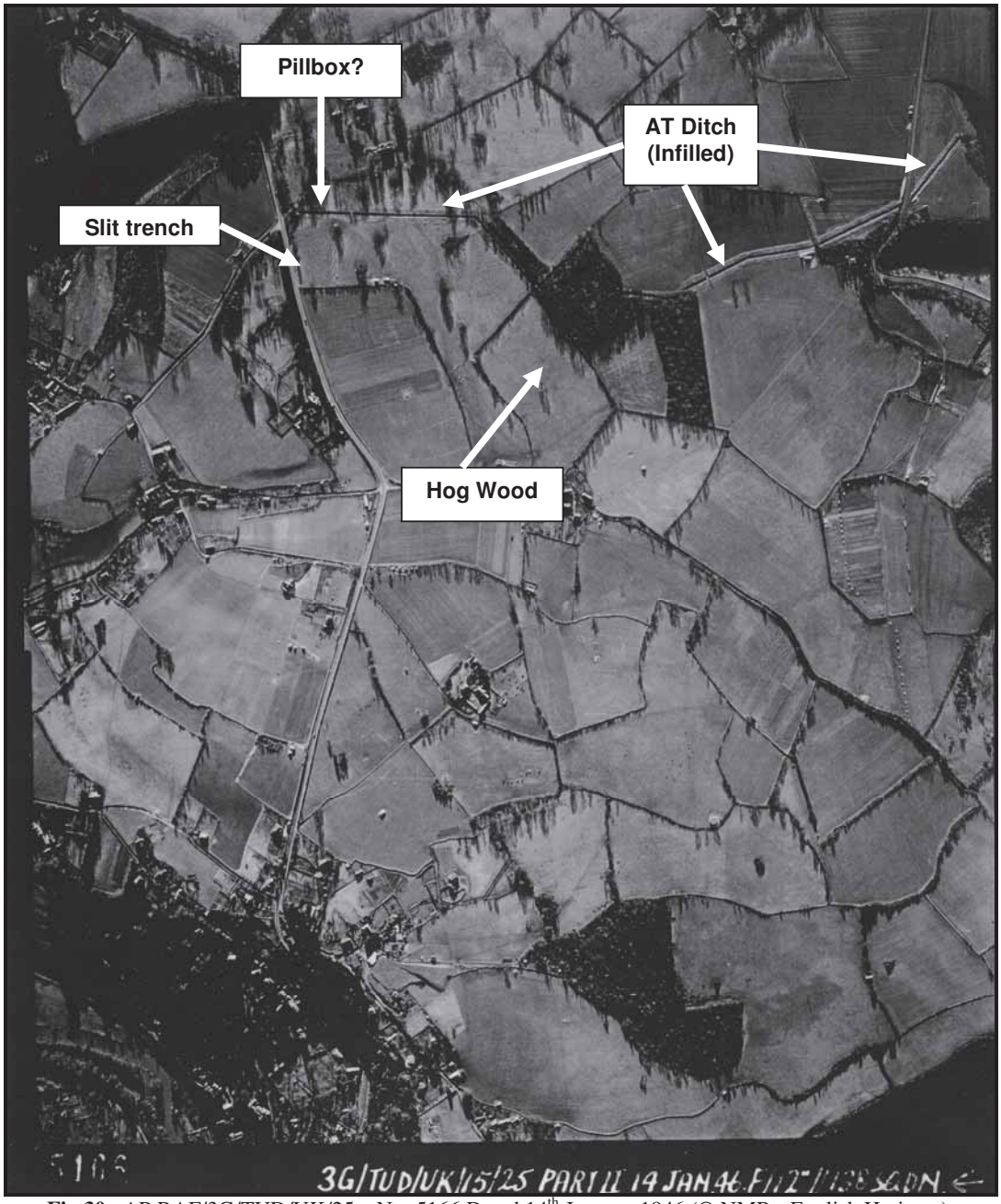

Fig.30– AP RAF/3G/TUD/UK/25 – No: 5166 Dated 14th January 1946 (© NMR - English Heritage).

Fig.31 – WWI practice trenches (Brown *et al*: 2002)

5.4.2 AERIAL PHOTOGRAPHIC EVIDENCE

When viewed today, it is easy to infer that the erected SLG defences were hastily built and located not always in the best location, with some pillboxes and defensive structures now seen stranded in the middle of fields etc (**Plate 2**), but land use since the 1940s has evolved.

Comparing post-war AP's to modern satellite imagery, (**Fig's 32 – 33**), it is apparent that the rural landscape has altered, with many hedge lines and field boundaries disappearing. If viewed solely in a present-day context, then any modern landscape analysis of the defence's topographic sitings can incorrectly conclude that a rapid construction of the SLG with poor strategic strategy was employed. This inference Green (1999) takes further by proposing the SLG was possibly built as a visible deterrent, rather like the *Maginot Line* (see 5.4), though these notions are easily dismissed when reviewing the 1940s AP evidence of the case study area.

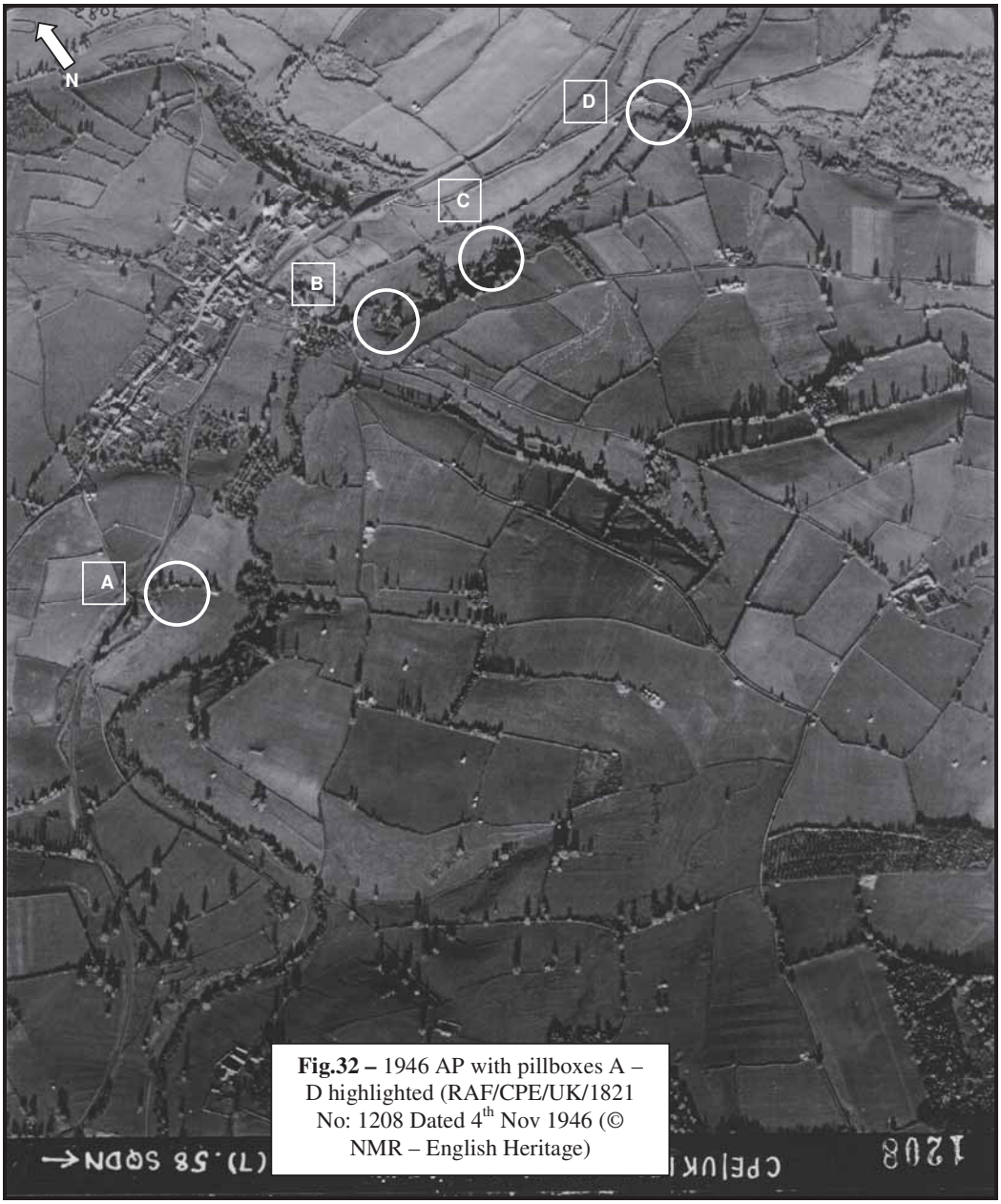

Fig.32 – 1946 AP with pillboxes A – D highlighted (RAF/CPE/UK/1821 No: 1208 Dated 4th Nov 1946 (© NMR – English Heritage)

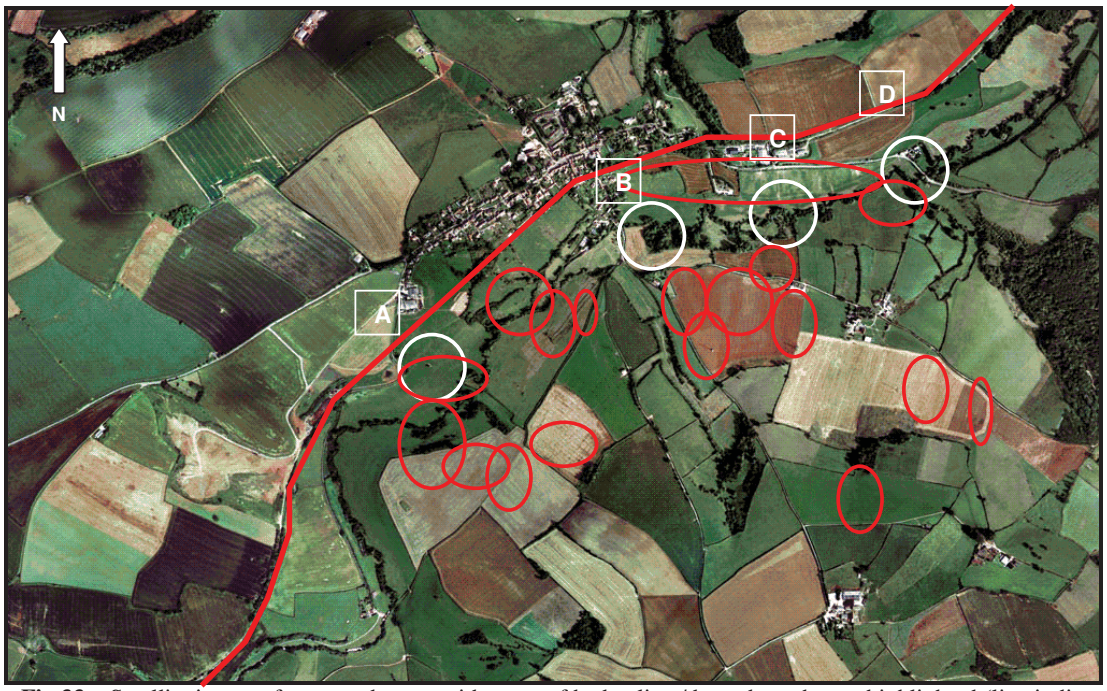

Fig.33 – Satellite image of case study area with areas of hedge line / boundary change highlighted (line indicates old railway line) (© Memory-Map).

Examination of war / post-war AP's of the Wellow to Hinton Charterhouse area (1945-46) (**Fig's 34 – 37** - Overleaf) [1], undeniably prove that most of the SLG defences were well camouflaged against Luftwaffe AP reconnaissance, and conceivably any northwardly approaching invasion forces. This dispels the theory of a visible '*Maginot line'*, suggesting in turn a deliberate attempt to conceal the SLG defences from the enemy by making best use of the local topography, a notion supported by other case studies of attempted pillbox camouflage where topographic features could not be used (**Fig's 38 – 39**).

Fig.38 – Pillbox camouflaged (Osborne: 2004).

Fig.39 – *'It looks to me like one of last season's machine-gun nests'* -1940s Cartoon (Wills: 1985).

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[1] When studying the AP evidence it is indeed very difficult to pick out individual pillboxes within the landscape though the AT ditch running from Wellow Brook to the A36 is clear however whether the German's realised its true nature is not known.

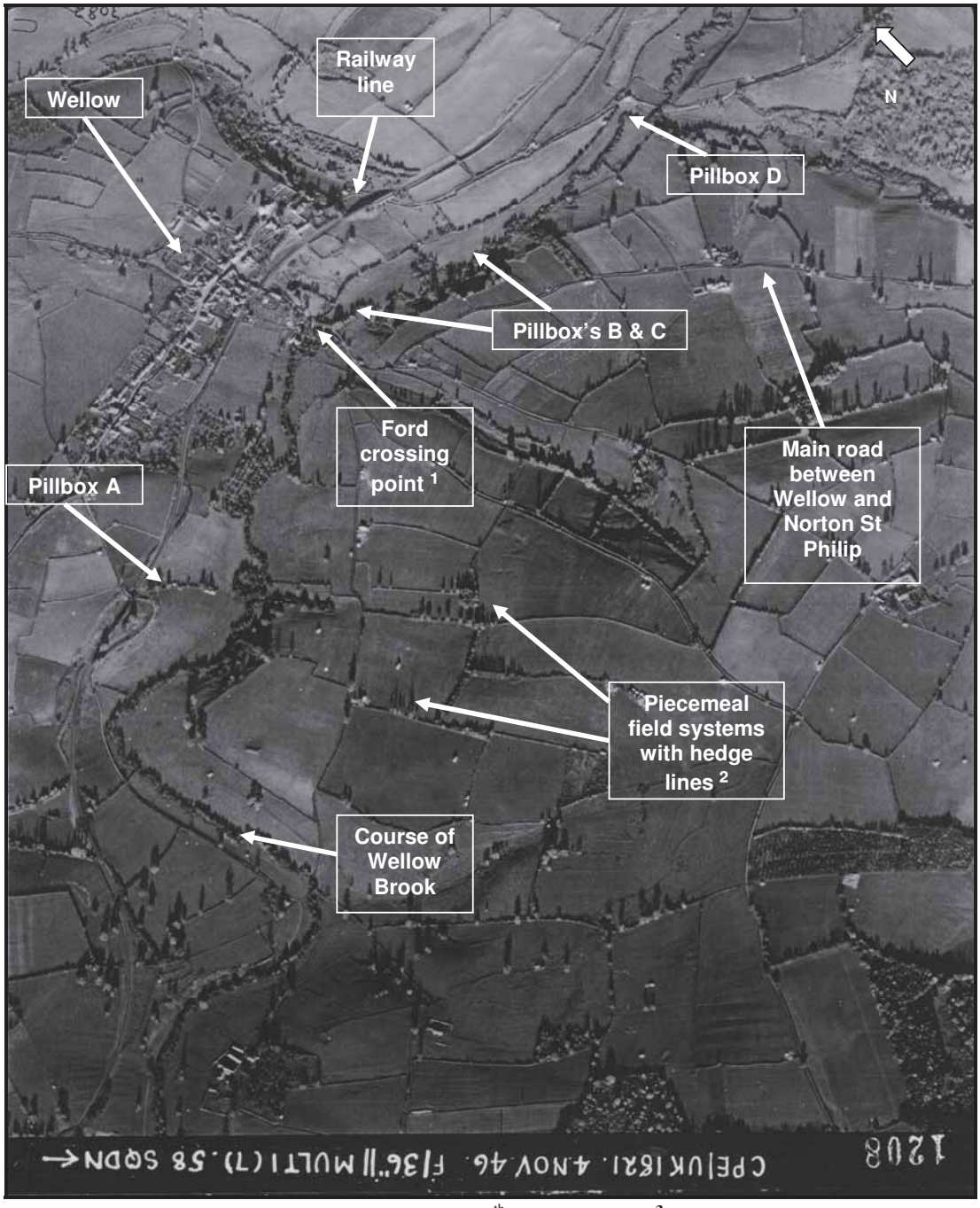

Fig.34 - AP RAF/CPE/UK/1821 No: 1208 Dated 4th November 1946 [3] (© NMR – English Heritage)**.**

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1 Main ford crossing point of road to Norton St Philip. Protected by a pillboxes to the east, moveable roadblocks would have been deployed in the event of invasion allowing access for defending forces / evacuated civilians, whilst channelling advancing enemy armour, due to water / hedge obstacles, into bottlenecked killing zones along roads

2 Field boundary hedge lines / rows provided a limited natural AT obstacle, afforded additional problems for enemy tank commanders.

3 SLG defences highlighted on AP as per field survey / ADS 'Defence of Britain' database. Luftwaffe aerial reconnaissance would have been from a greater altitude thus it is of my opinion that the pillboxes etc were well concealed and NOT intended to be seen as a visible deterrent.

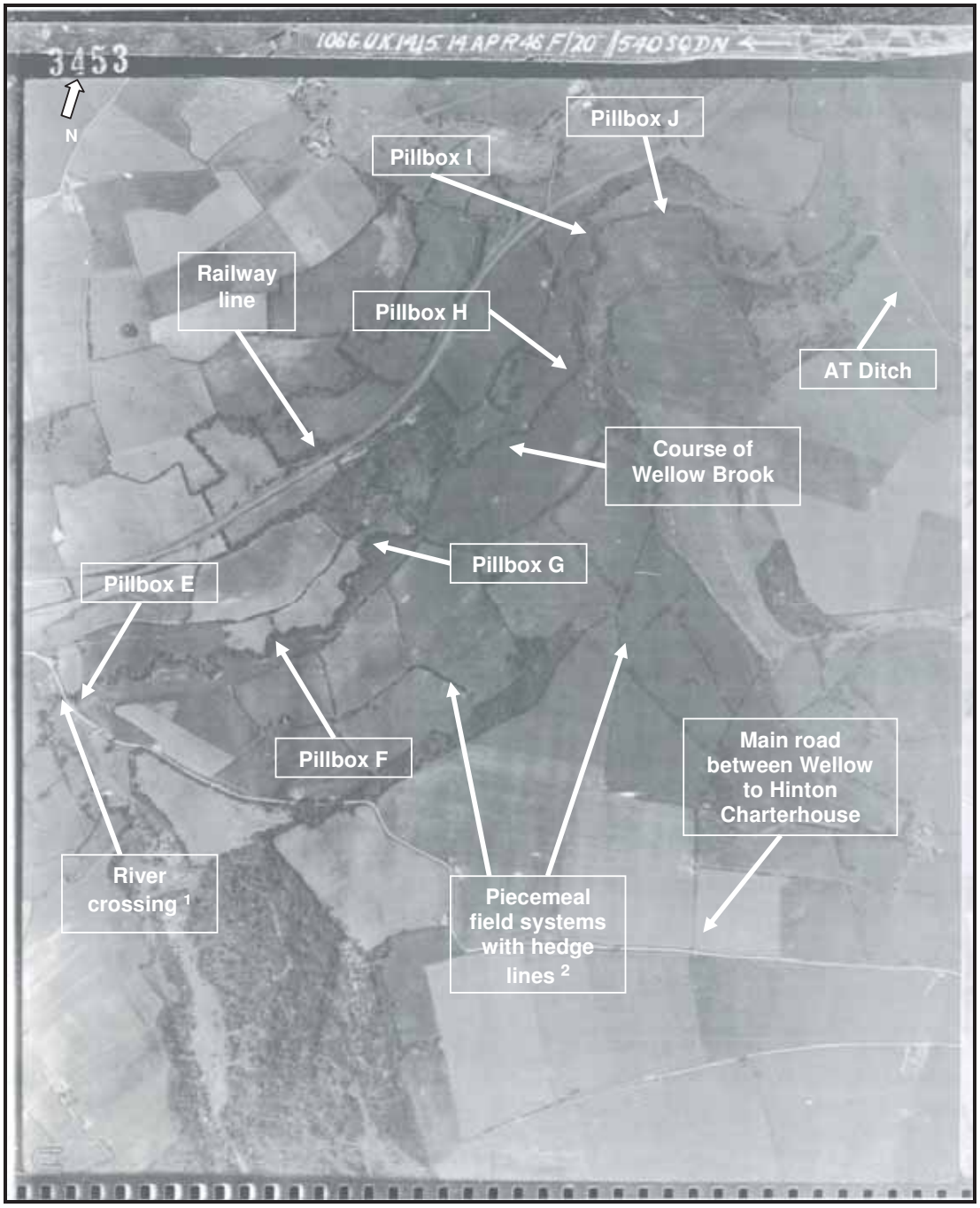

Fig.35 - AP RAF/106G/UK/1415 No: 3453 Dated 14th April 1946 [3] (© NMR – English Heritage)**.**

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1 Main crossing point of road to Hinton Charterhouse. Protected by pillboxes either side, moveable roadblocks would have been deployed in the event of invasion allowing access for defending forces / evacuated civilians, whilst channelling advancing enemy armour, due to water / hedge obstacles, into bottlenecked killing zones along roads.

2 Field boundary hedge lines / rows provided a limited natural AT obstacle, afforded additional problems for enemy tank commanders.

3 SLG defences highlighted on AP as per field survey / ADS 'Defence of Britain' database. Pillboxes E, F & G were NOT located on the ground and have been entered from database grid references. Careful study of the AP at the given locations, in my opinion, does not display conclusive evidence of defensive structures, leading to the conclusion of successful concealment from Luftwaffe aerial reconnaissance.

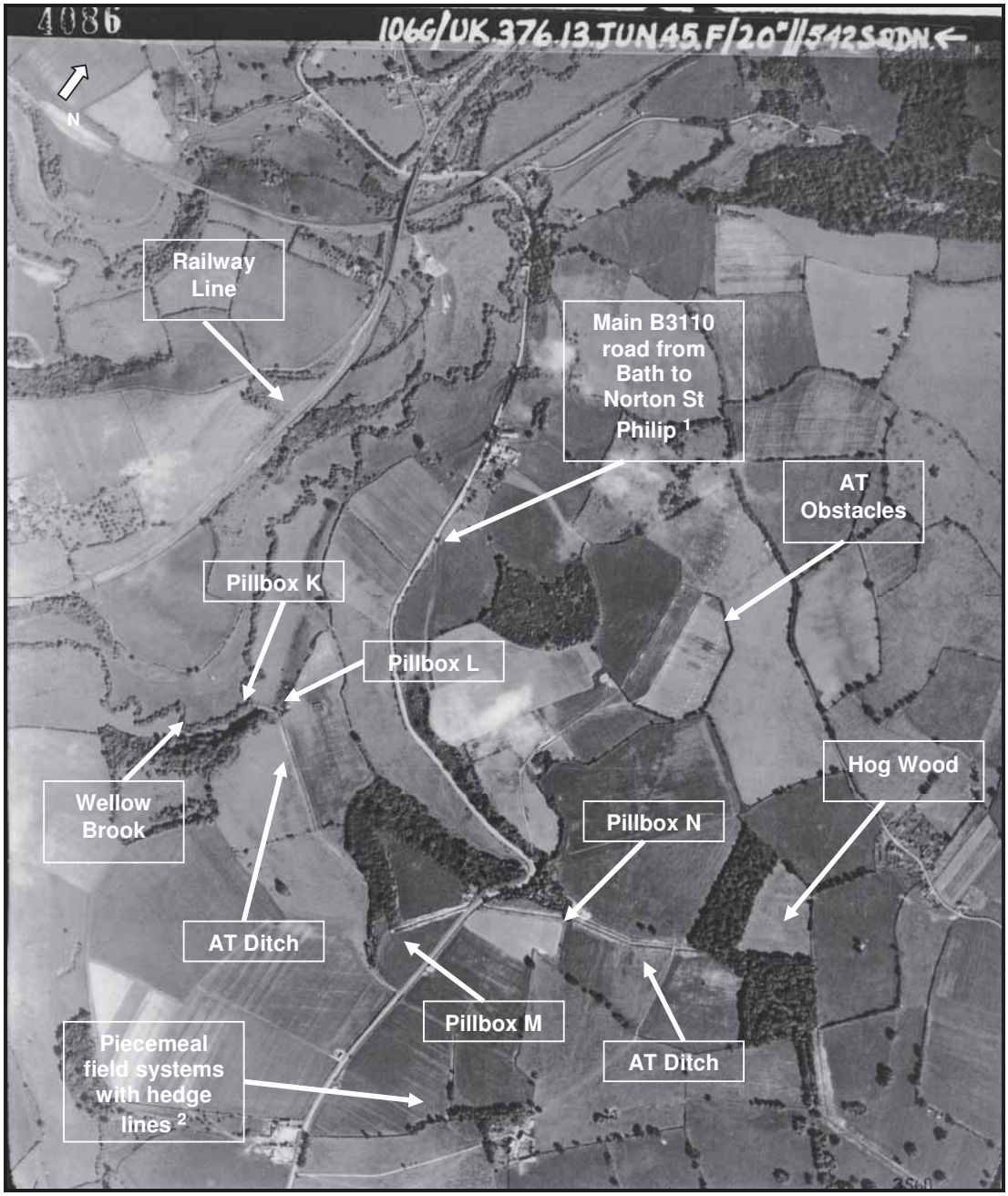

Fig.36 - AP RAF/106G/UK/376 No: 4086 RS Dated 13th June 1945 [3] (© NMR – English Heritage)**.**

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1 Main B3110 road from Bath to Norton St Philip. Cutting the AT ditch between Pillboxes M & N, moveable roadblocks would have been deployed in the event of invasion allowing access for defending forces / evacuated civilians, whilst channelling advancing enemy armour, due to AT ditch / hedge obstacles, into bottlenecked killing zones along roads.

2 Field boundary hedge lines / rows provided a limited natural AT obstacle, afforded additional problems for enemy tank commanders.

3 SLG defences highlighted on AP as per field survey / ADS 'Defence of Britain' database. Pillboxes K, L & M were NOT located on the ground and have been entered from database grid references. Careful study of the AP at the given locations, in my opinion, does not display conclusive evidence of defensive structures, leading to the conclusion of successful concealment from Luftwaffe aerial reconnaissance.

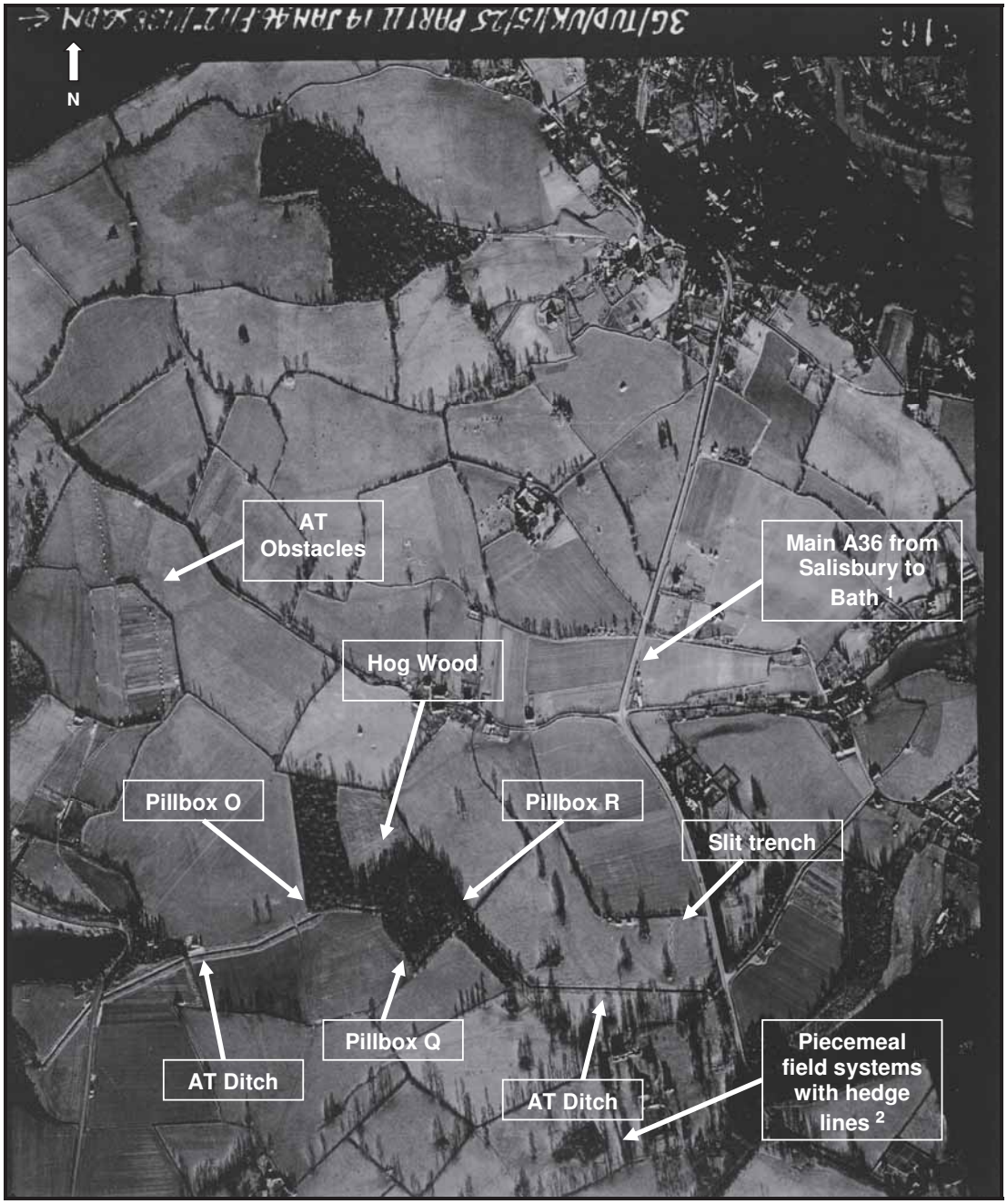

Fig.37 - AP RAF/3G/TUD/UK/25 No: 5166 Dated 14th January 1946 [3] (© NMR – English Heritage)**.**

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1 Main A36 road from Salisbury to Bath. Cutting the AT ditch between Hog Wood and the River Avon Valley (AT obstacle continues down to River Avon), moveable roadblocks would have been deployed in the event of invasion allowing access for defending forces / evacuated civilians, whilst channelling advancing enemy armour, due to AT ditch / hedge obstacles, into bottlenecked killing zones along roads.

2 Field boundary hedge lines / rows provided a limited natural AT obstacle, afforded additional problems for enemy tank commanders

3 SLG defences highlighted on AP as per field survey / ADS 'Defence of Britain' database. Careful study of the AP at the given locations, in my opinion, does not display conclusive evidence of defensive structures, leading to the conclusion of successful concealment from Luftwaffe aerial reconnaissance.

5.4.3 CARTOGRAPHIC EVIDENCE

To support the notion of a strategically well-planned SLG, 3D topographical mapping software (©Memory-Map 1:50000) of the case study area was used to illustrate the cartographic contours as a three dimensional image. Highlighting the locations of the anti-invasion defences within the landscape, the results clearly support the view of careful strategic siting planned by military surveyors in 1940.

Exploiting the winding river valley (**Fig.40**), the siting of pillboxes adjacent to the Wellow Brook are seen to make good use of this natural AT obstacle, but to also manipulate the surrounding flora, enabling excellent concealment from aerial and ground forces (see 5.4.2). Providing good 360 ° fields of view / fire, by locating the camouflaged defences within the valley bottom reduced the risk of engagement by artillery / aerial bombardment, forcing enemy forces to close in to effective small arms ranges. With artificial AT ditches constructed, linking the Wellow and Avon Rivers across a narrow point on a plateau south of Bath, additional use of the railway line immediately north of the SLG at Wellow was also made, forming, a secondary defence line on higher ground (**Fig.41**).

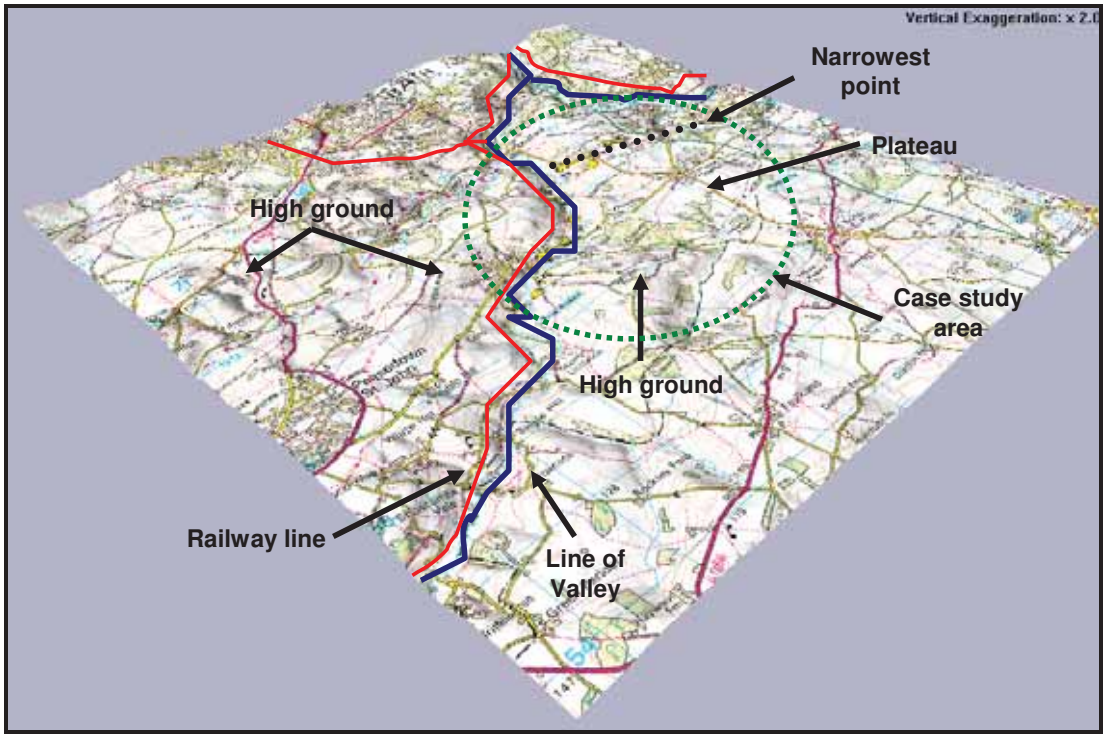

Fig.40 – Far out 3D cartographic map detailing principal topographic features. Scale 1:50000 (© Memory-Map).

By reviewing the utilization of the landscape [1], it becomes apparent that not only was its use financially prudent, saving the War Office much needed construction time and resources, but

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1 There is no evidence to suggest that geological factors influenced the siting of the defences – See Sheet 281 Solid and Drift Edition (Frome), Geological Survey of Great Britain (England & Wales) (1985–Scale 1:50000) for details.

also strategically sound in its planning. Using local topographic features / flora to great effect, the siting of the SLG would have conceivably hindered an advancing armoured formation by presenting it with a series of camouflaged strongpoint's and natural / artificial obstacles, channelling tanks / infantry along narrow routes (predominately roads) to designated roadblocks where they could be engaged to maximum efficiency [1] (**Fig.42**).

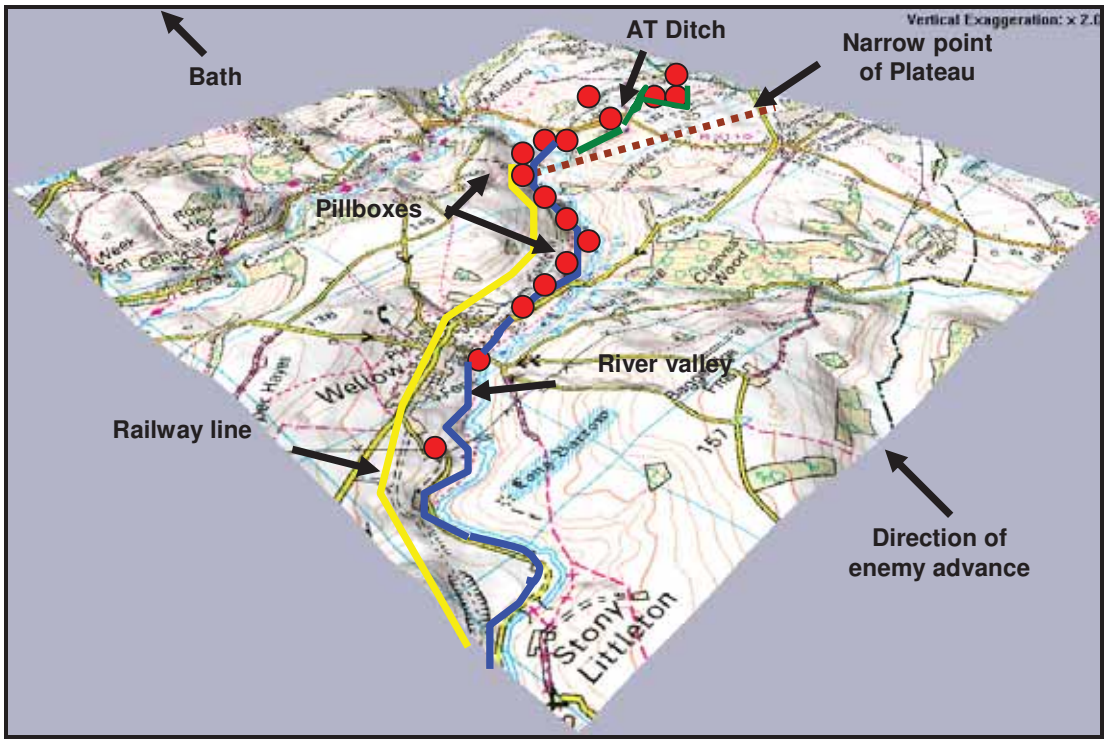

Fig.41 – Close up 3D cartographic map of case study area with principal defensive / topographic features highlighted. Scale 1:50000 (© Memory-Map).

Fig.42 – Moveable roadblock as probably used within the case study area [2] (Longmate: 2004).

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1 During the Normandy campaign in the summer of 1944, Allied armoured forces experienced many problems with hedge lines as the tank would go over it rather than through it, exposing it's lightly armoured underside to AT fire as a consequence. This problem would have most definitely been encountered by German forces in the rural countryside of England, forcing their armoured columns to make use of the road network as much as possible, leaving themselves open, as a result, to effective AT countermeasures such as road blocks etc.

2 In addition to small arms, a variety of other weapons would have been employed at these roadblocks including 'sticky bombs' (Fig.28) and 'flame fougasses', a barrel of oil with explosives that when detonated created a wall of fire.

5.4.4 VISIBILITY ANALYSIS

With cartographic evidence suggesting that local topographic conditions were ideally utilized by the military planners, it is possible to analysis the visibility afforded to the defences positioning within the landscape using the GIS application ©ArcView 3.3.

Calculating a raster-based line of sight map [1] (viewshed) for a given location, Arcview 3.3 determines for each cell in the raster, a straight line interpolated between a chosen location and every other cells within the elevation model. Coded as one for visible and zero for not, the use of viewshed models to interpretate the visibility of archaeological sites is commonplace, though it must be reminded that it is not without its complications [2] (Wheatley & Gillings: 2002).

When viewing **Fig.43**, a GIS three dimensional topographical model overview of the case study area and its defences, it is apparent that by following the Wellow Brook valley before crossing a plateau at its narrowest point, good strategic use of the local topographic conditions were made by military planners, as inferred in 5.4.3.

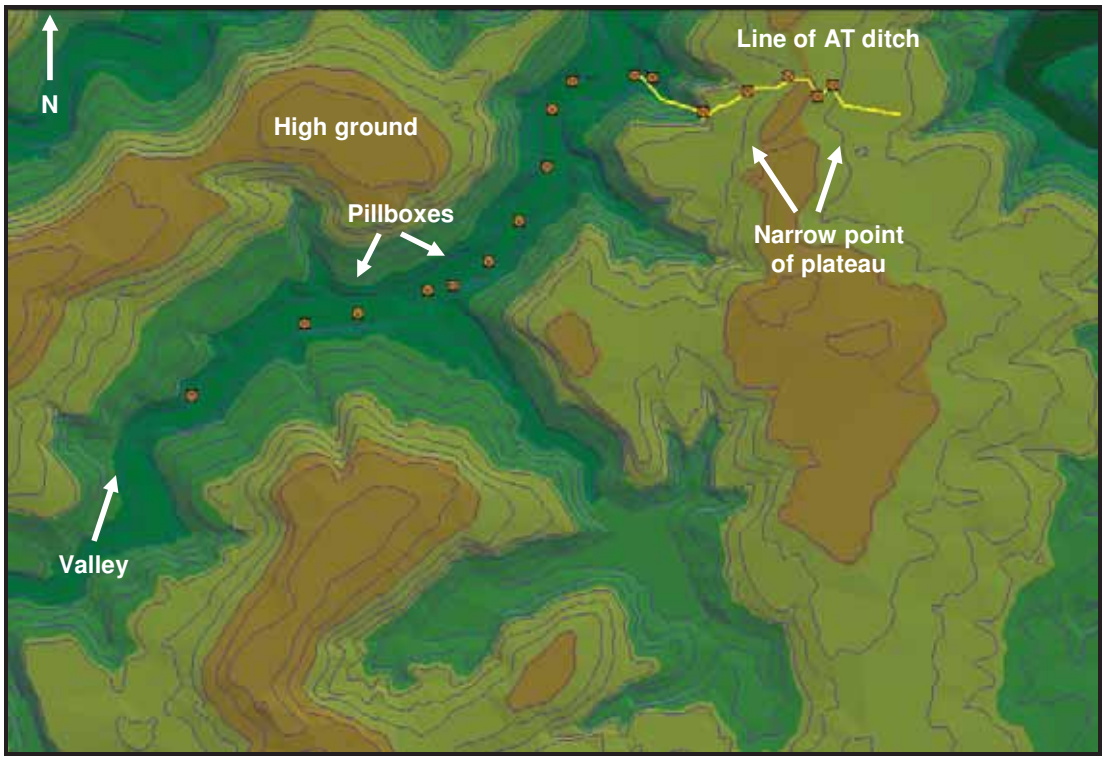

Fig.43 – GIS Topographical model displaying SLG's defence's relationship with the landscape (© ArcView 3.3).

With an average distance of 321.31m between pillboxes [3], by adding a raster viewshed analysis that displays the visibility (coded one) as orange and the non-visibility (coded zero) set to

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1 The topographic base map used detailing contour heights was created from © Digimap, with raster fields overlaid.

2 Detailed by Wheatley & Gillings (2002) in '*Spatial Technology and Archaeology – The archaeological application of GIS*', the main drawback encountered when reviewing the GIS results for the case study was that of flora obstruction. Kept simple, the viewsheds obtained and presented as graphic images do NOT take into account any obstruction of views afforded by hedges, bushes etc. Though not in reality affecting the results tremendously, this possible error must be bore in mind.

3 See **APPENDIX P** for cartographically calculated distances between pillboxes (**TABLE B**).

background, from the defences (**Fig.44**), then it becomes evident that good fields of view / enfilading fire was afforded to the SLG.

Viewed in an alternative perception, with the viewshed raster laid over the base ST 64 map tile (**Fig.45**), then the full extent of the perceived visibility from the defences becomes apparent.

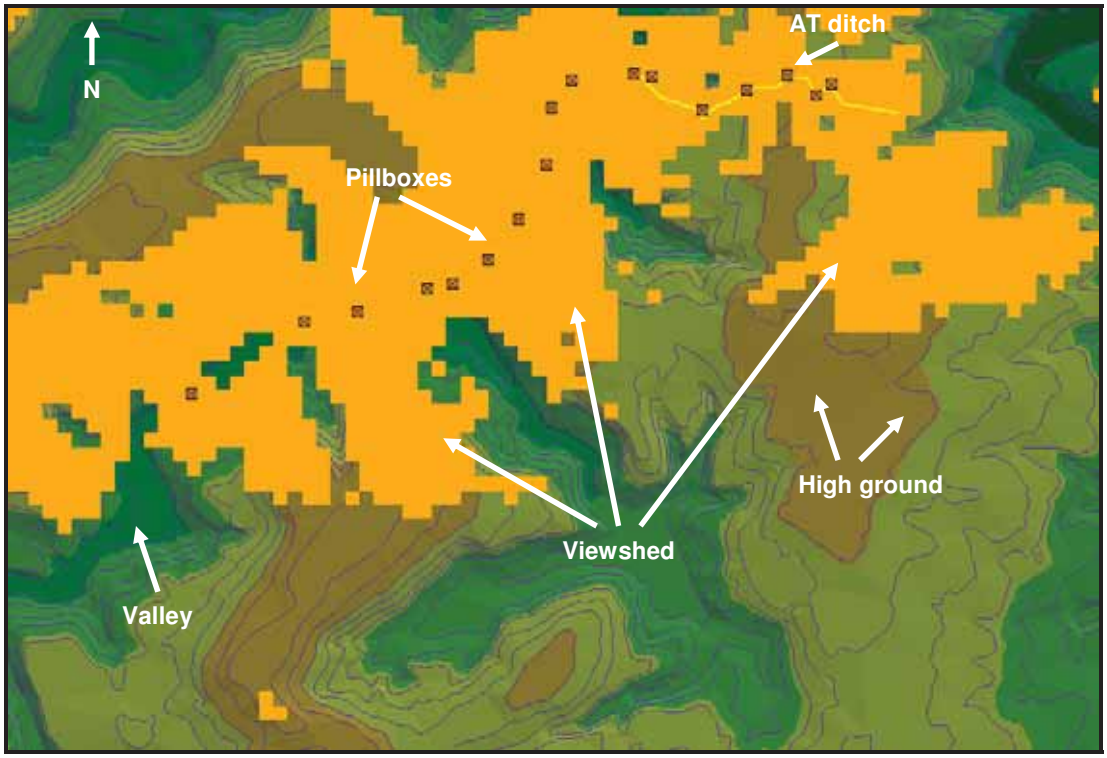

Fig.44 – GIS Topographical model displaying the SLG's defence's viewshed (© ArcView 3.3).

Cartographically calculated measurements for the viewshed [1], markedly demonstrates that the visual viewshed distances involved would enable all the defensive positions to engage any northwardly advancing enemy formations from effective maximum range**,** whilst obscured from their view by the local river valley flora. One point of note, as previously stated at footnote 2 (P51), though appearing to have a state of intervisibility between the defended localities, as revealed during the field survey, not all pillboxes had a view of each others position. To confound the issue further, the ability to engage targets from within the pillbox would have been hindered by the limited visibility afforded by the narrow loopholes (**Fig's 46 / 47**). That said, these possible problems would have been easily subjugated by the positioning of troops outside the pillbox (see **APPENDIX I**), providing the required interlocking frontal fields of fire across the valley, using the pillbox only as a shelter from artillery or close quarters fighting.

Analysis of **Fig.48**, a GIS 3D raster viewshed of the same area with additional topographical features incorporated, further illustrates the effective strategic use of the landscape by military

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1 See **APPENDIX Q** for **TABLE C**

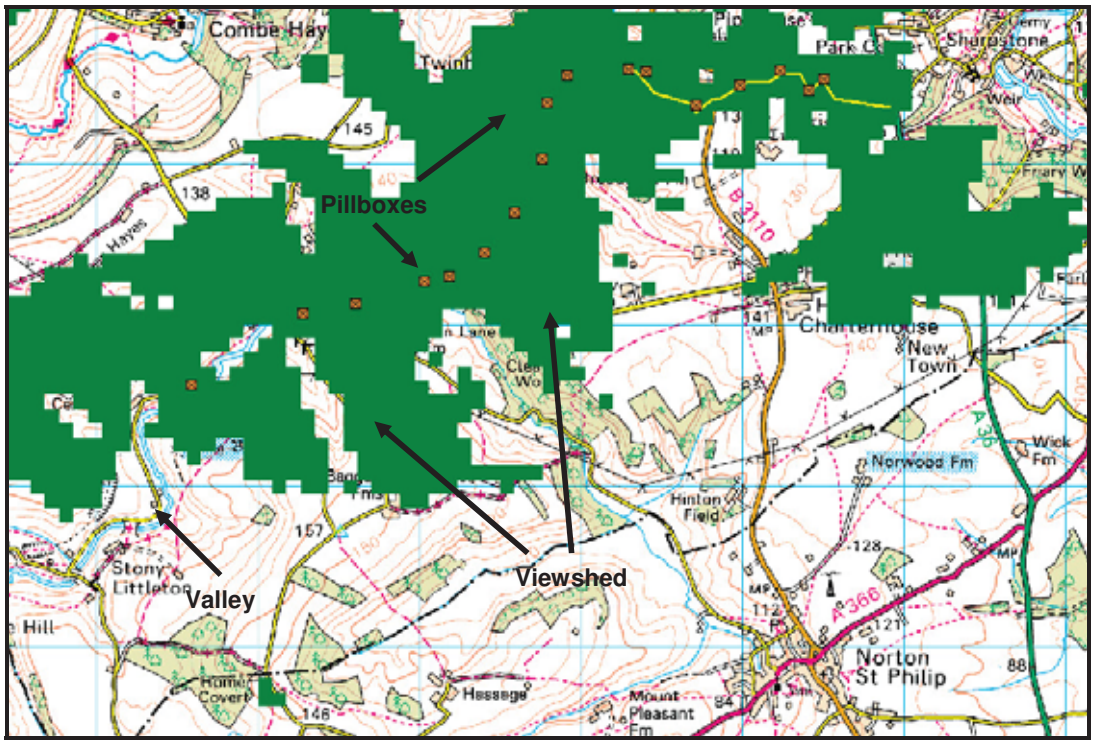

Fig.45– GIS Viewshed analysis of the SLG's defences overlaid base map (© ArcView 3.3).

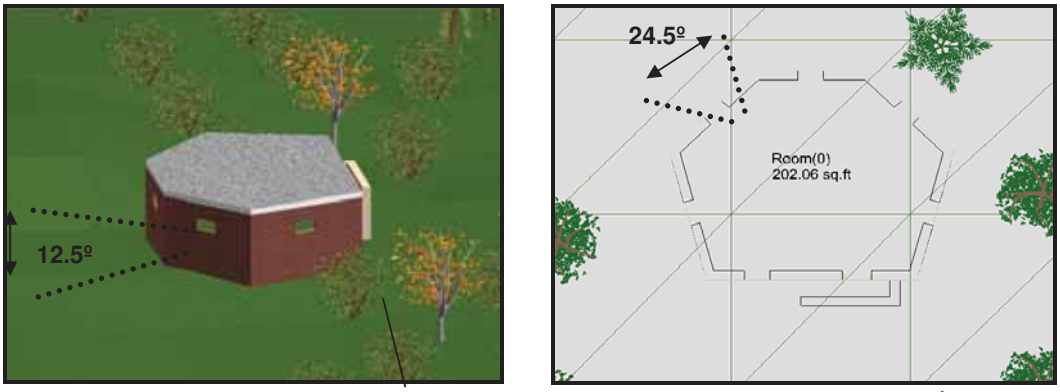

Fig.46 – FW3 / 24SP pillbox displaying visibility angles afforded by the loopholes [1]
(© IMSI TurboCAD Deluxe v9)

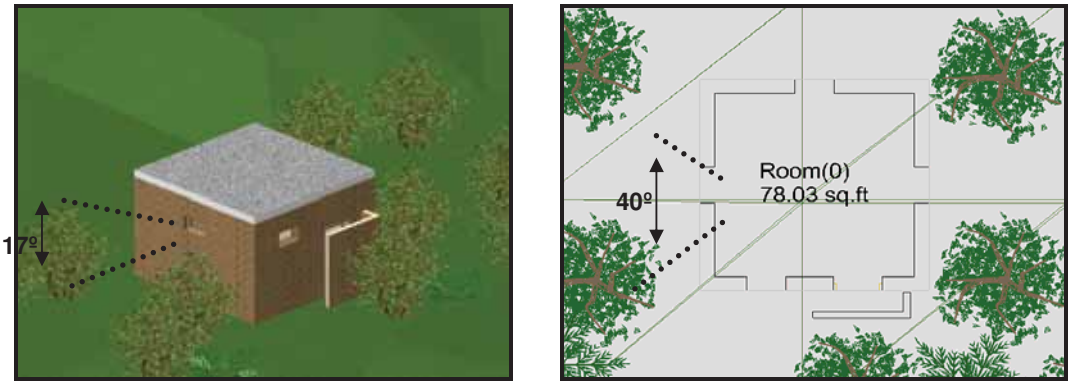

Fig.47 – FW3 / 26 pillbox displaying visibility angles afforded by the loopholes [2]
(© IMSI TurboCAD Deluxe v9)

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1 Loophole angles obtained from Pillbox Q (FW3 / 24 SP) during field survey (Electronic Total Station GTS 210 series)

2 Loophole angles obtained from Pillbox O (FW3 / 26) during field survey (Electronic Total Station GTS 210 series)

planners. With the addition of road, rail, river and crossing points onto the base map tile, the viewshed raster, when calculated and displayed, clearly demonstrates that the location of the SLG defences did provide cover for all these important topographic features. Factors of crucial importance that had to be considered when planning / construction of the stop line within the landscape was completed, with the road routes / river crossings being where the SLG would have been at its most vulnerable to attack [1].

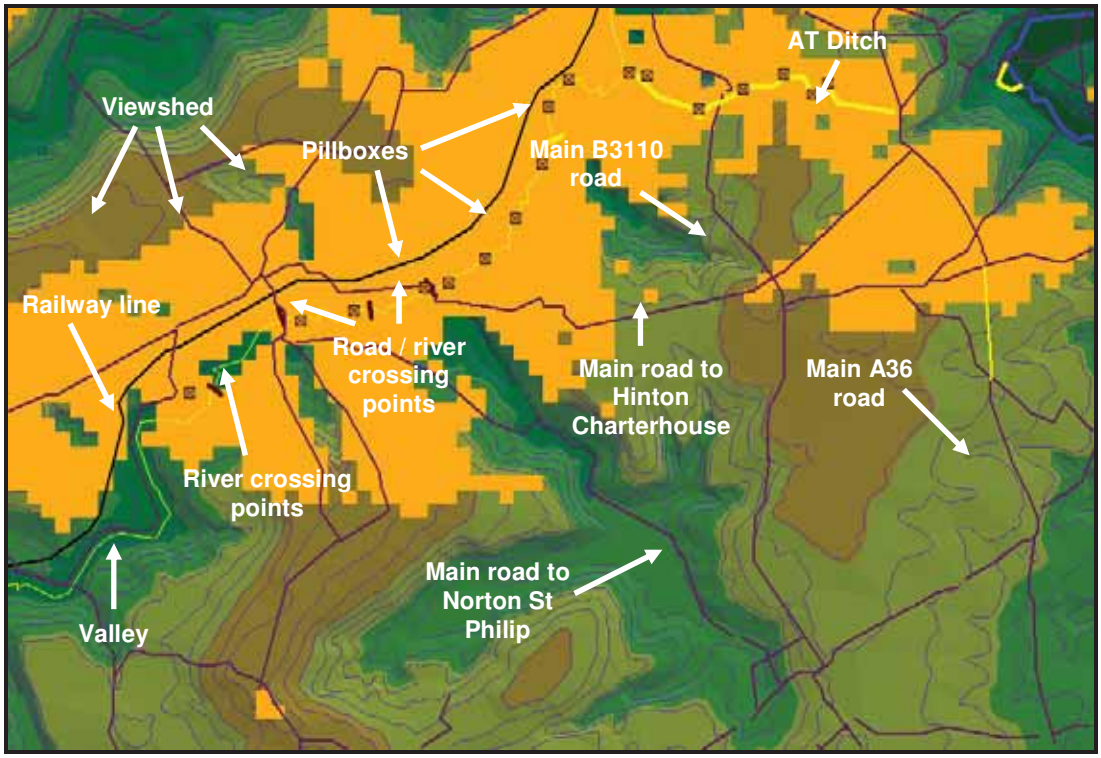

Fig.48– GIS Viewshed analysis displaying the relationships between SLG's defences and road, rail, river and crossing points (© ArcView 3.3).

To enhance the SLG's field of view over the local topography, local church towers would have been utilized as observation posts, providing the defending forces with a basic early warning system (the ringing of church bells). Drawing comparable photographic evidence from other study areas (**Fig's.49 /50**) where this system was used, information regarding any church use within the case study area was not available [2] during the field survey. With this in mind, the calculated raster viewsheds, as detailed in **Fig's.51 / 52,** are therefore purely speculative. However, it is reasonable to suggest that the churches used in the visibility analysis presented would have conceivably been used by the local Home Guard as observation posts.

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1 See 5.3 for the military tactics conceivably employed on the SLG that intentionally channelled the German armour towards road routes / crossings and the killing zones of the defended nodal strongpoint roadblock.

2 Information as to the possible use of the local churches was not available when the field survey was conducted. It is therefore recommended that further research should be made to establish as to whether the church towers were indeed used.

Fig.49– Church sign detailing the use of the church bell (Longmate: 2004).

Fig.50 – LDV volunteers manning a church tower observation post (Carroll: 1999).

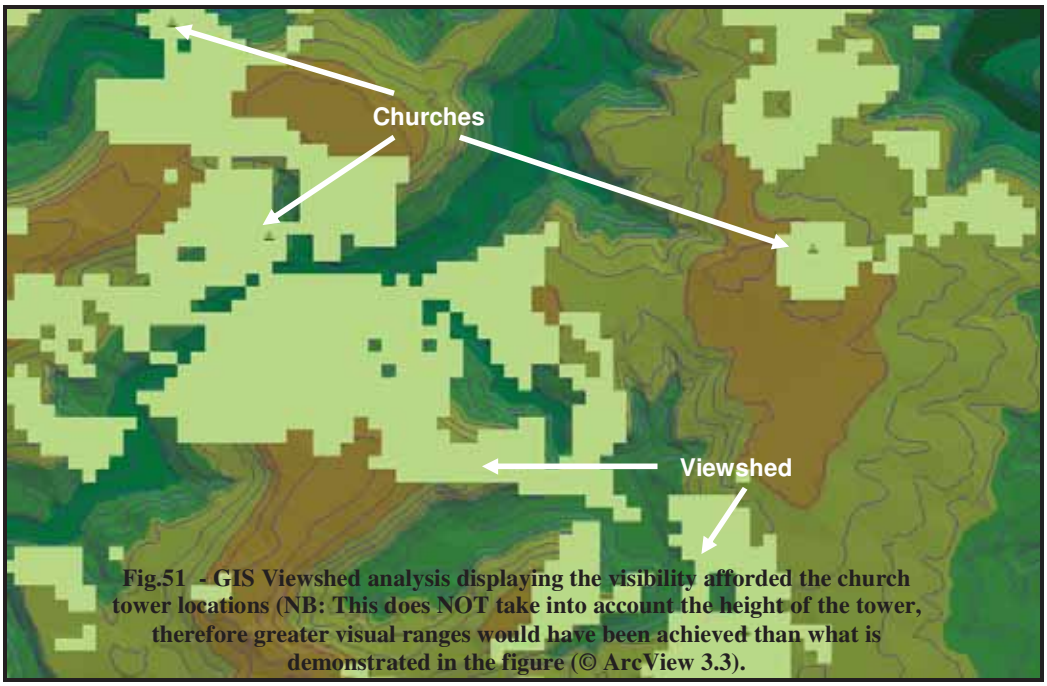

Fig.51 - GIS Viewshed analysis displaying the visibility afforded the church tower locations (NB: This does NOT take into account the height of the tower, therefore greater visual ranges would have been achieved than what is demonstrated in the figure (© ArcView 3.3).

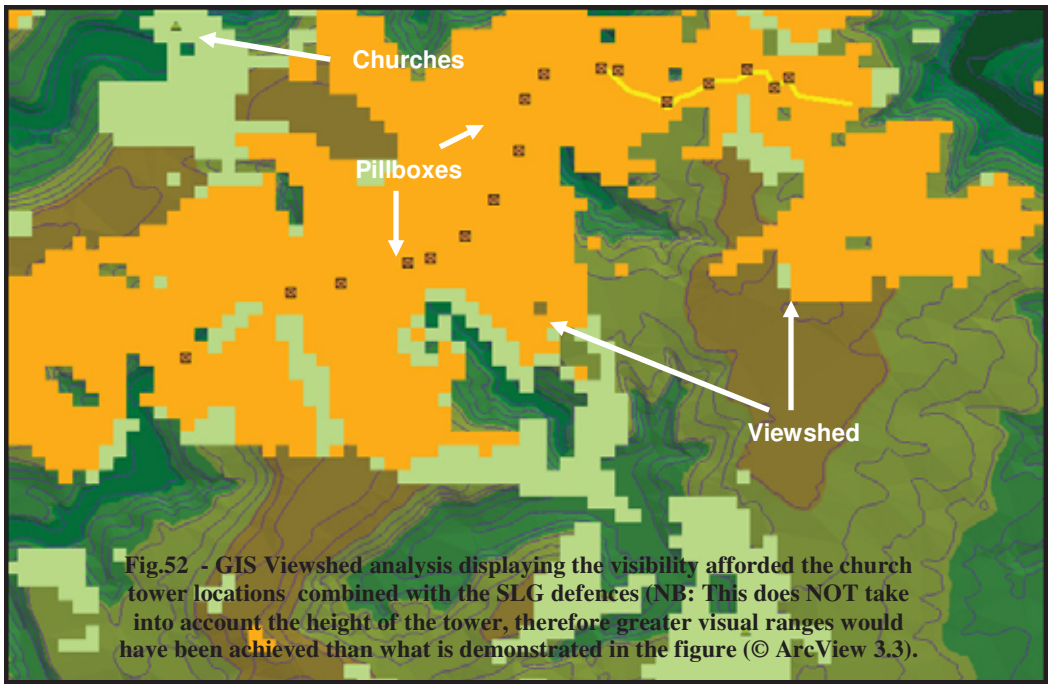

Fig.52 - GIS Viewshed analysis displaying the visibility afforded the church tower locations combined with the SLG defences (NB: This does NOT take into account the height of the tower, therefore greater visual ranges would have been achieved than what is demonstrated in the figure (© ArcView 3.3).

5.4.4 CONCLUSION

When considering the question '*Would the Stop Line linear defence have halted an invasion force?*, the first factor to bear in mind is that the debate structured within this paper regarding its success or failure is purely speculative and is one that can never be precisely answered. With so many differing components that could have easily influenced the outcome of an invasion attempt [1], the conclusions drawn from the documentary as well as archaeological evidence presented must be considered against this background factor.

That said, by taking into account the evidence offered by the aerial photographic, cartographic and GIS visual analysis within this paper, it is unbiased to conclude that the *Stop Line Green* defence line would have had limited success in stopping an invasion force.

In support of this statement, the aerial photographic evidence presented (**5.4.2**) strongly suggests that the defences were adequately camouflaged from *Luftwaffe* aerial reconnaissance and conceivably ground forces / reconnaissance. Denoting a deliberate attempt to conceal the SLG from the enemy, rather than as a visual deterrent as proposed by Green (1999), the line of pillboxes utilized the Wellow Brook valley, intimating good strategic use of the local topography. In reinforcement of this notion, AP comparisons between immediate post war and modern satellite imagery highlight the fact that land use has changed, with many hedge lines and field boundaries disappearing. Presenting a modern day analysis of the SLG positioning within the landscape as being flawed [2], when reviewing the defensive tactics conceivably employed during 1940 (**5.3**), it becomes apparent that the hedge line / field boundary within the landscape was important in channelling advancing enemy armour along predicted routes (predominately roads).

3D cartographic evidence for the case study area substantiates the notion of a strategically well-planned topographic location, demonstrating that good use of the local landscape was made (**5.4.3**). Making its way up the Wellow Brook valley before crossing the narrowest part of a plateau to join the River Avon valley, the defences are seen to occupy low-lying positions, providing good concealment for the strongpoints, whilst providing protection from both aerial and artillery bombardment (difficult to target).

GIS visibility analysis (**5.4.4**) further illustrates the good fields of view / fire afforded to the defences by their location within the landscape, verifying the notion of a strategic use of the

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1 Possible influencing factors could have been the repelling of an invasion force by the Royal Navy, the successful holding of an invasion on the beaches (coastal crust level) or even the driving of invasion forces back towards the coast by mobile reserve forces PRIOR to engagement by stop line defences. Conversely, the landing of even larger numbers of tanks / infantry than anticipated, overwhelming all defence attempts ,or even the premature surrender of the home forces prior to the stop lines being tested.

2 When reviewing the SLG defences in a modern context, some pillboxes appear stranded in the middle of fields etc suggesting a poor strategic positioning. Additionally, the thickening / thinning of flora around the defences can lead to the incorrect assessment of poor visibility afforded to the position or inadequate camouflage from Luftwaffe aerial reconnaissance / ground forces.

local topographical features within the case study landscape. By calculating a raster based line-of-sight map (viewshed) for the given defensive locations, figures **44-48** undeniably demonstrate that good visibility was provided, substantiating further the opinion that the SLG was strategically well placed when planned by military surveyors. Though not taking into account the location of the flora when calculating viewsheds, the field survey / cartographic analysis does however suggest that the flora coverage would not have hindered the visual coverage of the defences to any great degree.

The distances calculated between both the pillboxes and the viewsheds (**APPENDIX P & Q**), further support the strategic placement of the SLG defences, with the coverage of the crucial road network as well as river crossing areas all well within effective small arms range. Supported by a possible church tower 'early warning' network (**Fig's 49-52**), viewshed analysis of the visibility from the church locations gives credence to the notion of well planned stop line, by affording the defenders additional visual coverage of the perceived direction of an invasion force.

Combing conclusive evidence of a strategically well-placed defence line with the perceived military tactics (**5.3**) deployed by the defenders, and the effective use of the limited weaponry available, it is my opinion that should an invasion force have advanced on Bristol and the *Stop Line Green*, the defences would have held sufficiently long enough for reinforcements to launch a counterattack. Alternatively, if the country had been overrun and the home forces reduced to just pockets of resistance, then the defence of Bristol would have been crucial, with its deep-water port at Avonmouth vital for evacuation and reinforcement purposes. With this in mind, the siting of the SLG by military surveyors would have been critical, suggesting the need for all local topographic conditions to be carefully analysed. A factor that when reviewing the evidence that supports the strategic locating of the SLG within the landscape, was evidently adhered too.

A landscape study into the perceived effectiveness of the '*Stop Line Green*' anti-invasion defence.

By Philip R Rowe.

APPENDICES

APPENDIX A – To quote Lowry (2004), the five most prominent innovative assault methods employed by '*blitzkrieg*' are: -

(1) seeking out weak spots in defences by the use of fast, motorised reconnaissance parties and light reconnaissance aircraft;

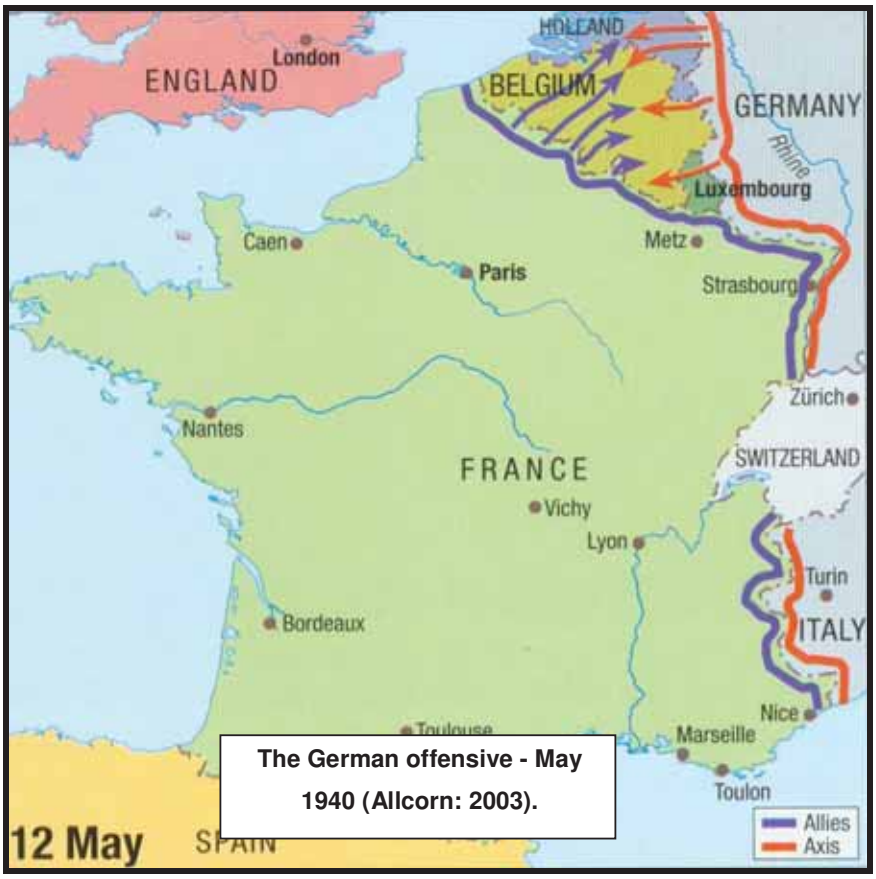
(2) effective co-operation between tanks and infantry, and the encouragement of a flexible command structure;

(3) tactical co-operation between the Luftwaffe and Wehrmacht, especially using the Junkers Ju 87 Stuka, to eliminate strong points, command centres, armour and troop concentrations;

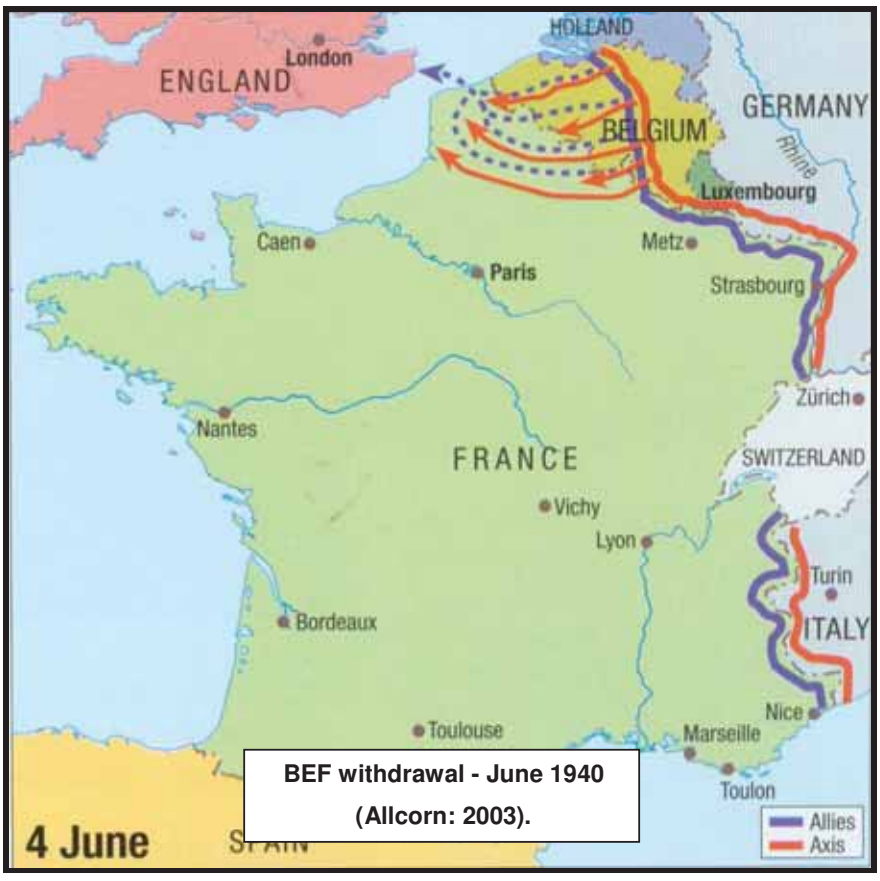
(4) the deliberate bombing of civilian centres in order to block Allied movements and to terrorise the civilian population who would, in fleeing, further obstruct troop movement along main roads;

(5) Using aircraft to psychologically destabilise the enemy by delivering troops behind their lines (by parachute, glider, seaplane, or by landing Junkers Ju 52/3m transport aircraft on roads and even airfields). Small parties of troops for special missions had also been implanted behind the lines by the use of Fieseler Fi 156 Storch short take-off aircraft.

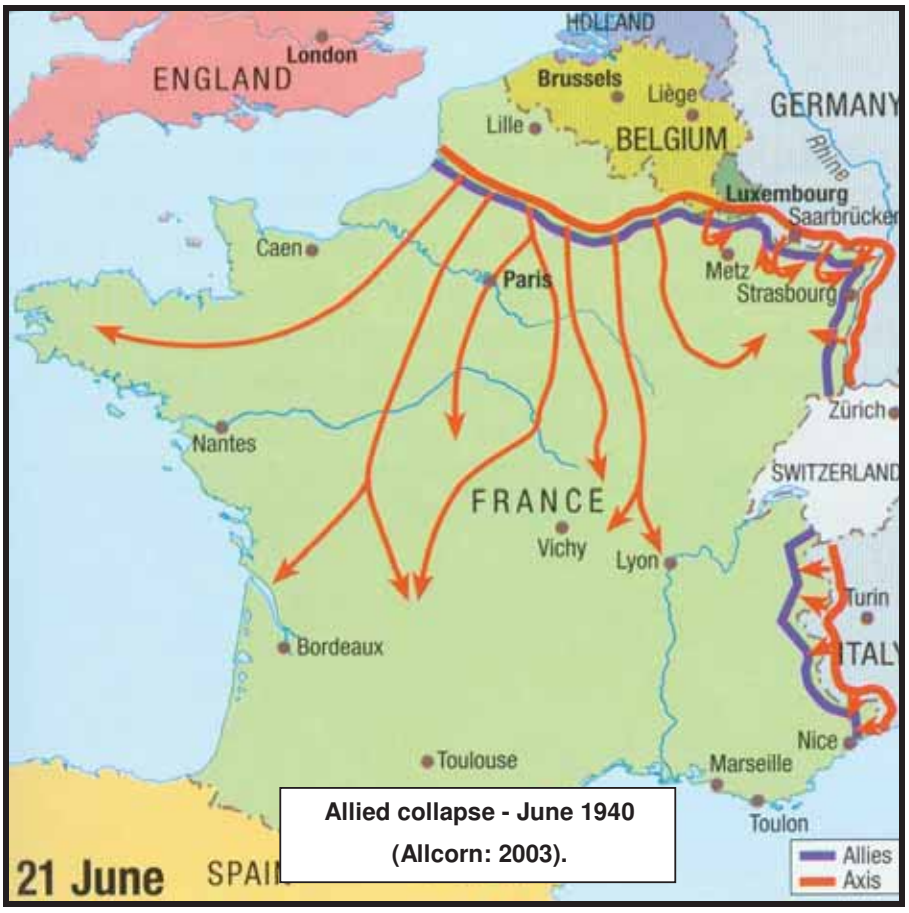
APPENDIX B – Maps detailing the German offensive of France 1940



The German offensive - May 1940 (Allcorn: 2003).



BEF withdrawal - June 1940 (Allcorn: 2003).



Allied collapse - June 1940 (Allcorn: 2003).

Surrender of France - June 1940 (Allcorn: 2003).

APPENDIX C – Translation of the OKH Operation Instruction for Sealion – 30th August 1940 (Wheatley: 1958).

The Commander-in-Chief of the Army H.Q. OKH, 30 August 1940 General Staff/Operations Branch (la)

No. 480/40 g. Kdos.

Instruction for the Preparation of Operation Sea Lion

1. *Task*

The Supreme Commander has ordered the Services to make preparations for a landing in force in England. The aim of this attack is to eliminate the Mother Country as a base for continuing the war against Germany, and, if it should be necessary, to carry out a complete occupation.

The order for execution depends on the political situation. Preparations are to be made in such a way that the operation can be carried out from 15 September.

While continuing with its occupation duties in France and maintaining the security of the other fronts, the task of the Army will be to land strong forces in southern England, defeat the British Army, and seize the capital. Other areas of Britain will be occupied as opportunity permits.

2. *Code word*

The operation will bear the code name 'Sea Lion'.

3. *The course which the operation will take is dependent on a number of unpredictable circumstances. Therefore preparations for embarkation, crossing, and initial landing must be flexibly made, so that the High Command can meet unforeseen alterations in the situation without loss of time. Commanders and troops must realize that the peculiar conditions of sea transport render the disintegration of formations unavoidable and that unusual situations will crop up which can only be mastered by very great initiative on the part of all commanders.*

4. *Proposed method of execution*

(a) *The Luftwaffe will destroy the British Air Force and the armament production which supports it, and it will achieve air superiority. The Navy will provide mine-free corridors and, supported by the Luftwaffe, will bar the flanks of the crossing-sector.*

(b) *The Army's landing forces will first win local bridgeheads with the specially equipped forward echelons of the first-wave divisions. Immediately afterwards, they will widen these bridgeheads into a connected landing-zone, the possession of which will cover the disembarkation of the following troops and ensure early uniform control on the English shore. As soon as sufficient forces are available, an offensive will be launched towards the first operational objective, i.e. Thames estuary-heights south of London-Portsmouth.*

As the British will make counter-attacks against the German troops who have landed first, and as they will resist with every means further German gains in terrain, bitter fighting is to be expected. Command and organization of troops must be equal to the decisive significance of these initial actions.

(c) After gaining the first operational objective, the further task of the Army will be as follows: to defeat the enemy forces still holding out in southern England, to occupy London, to mop up the enemy in southern England, and to win the general line Maldon (north-east of London)-Severn estuary. Orders concerning further tasks will be issued at the proper time.

(d) The current enemy situation, as before, will be periodically forwarded to army groups and armies.

5. Command and organization of forces

At first, Army Group A (with 16th and 9th Armies) will be entrusted with the execution of the tasks allocated to the Army. Whether elements of Army Group B will also be employed as operations proceed depends on the development of the situation.

For order-of-battle of forces allotted for Operation 'Sea Lion', see Appendix 1 [not included here].

The former tasks of the army groups (coastal defence, occupation duties, security of the Demarcation Line) remain in force.

6. Tasks of army groups and armies

(a) Army Group A's task. Starting on orders from OKH, the Army Group will force a landing on the English coast between Folkestone and Worthing; and it will, first, take possession of a beachhead, where the landing of further forces, aided by artillery fire in the direction of the sea, can be ensured and where it will be possible to create the preliminary conditions for continuing the attack. Early utilization of dock installations on the enemy coast is desirable for the rapid disembarkation of following forces.

After the arrival of sufficient forces on English soil, the Army Group will attack and secure possession of the line Thames estuary-heights south of London-Portsmouth. As soon as the situation permits, mobile formations will be pushed forward to the area west of London in order to isolate it from the south and west and to capture crossings over the Thames for an advance in the direction of Watford-Swindon.

(b) Initial tasks of armies. 16th Army will embark in the invasion ports situated between Rotterdam (incl.) and Calais (incl.). Landing on a broad front on the Folkestone-Hastings (incl.) section of coast, the Army will occupy an area at least as far as the line: heights halfway between Canterbury and Folkestone-Ashford-heights 20 km. north of Hastings. Speedy capture of the dock installations at Dover is important. The Ramsgate-

Deal section of coast, which, for naval reasons, can only be approached when the coastal defence is eliminated, must be taken from the landward side as soon as possible.

Arrangements will be made to use paratroops for the speedy capture of the high ground north of Dover: this operation will take place at the same time as the landing.

9th Army, landing simultaneously with 16th Army between Bexhill and Worthing, will occupy a beachhead at least up to the line: heights 20 km. north of Bexhill to heights 10 km. north of Worthing. It must be realized that only the first echelons of three first-wave divisions can be shipped across the Channel for the Army direct from Le Havre; the fourth division and the later echelons and waves, starting from Boulogne, must cross under the screen cover of 16th Army's better protected crossing-sectors, and must be disembarked east or west of Eastbourne as the situation dictates.

The use of paratroop units for the capture of Brighton will be arranged.

Boundary line between 16th and 9th Armies: Boulogne (9)-Hastings (9) Reigate (16)

Separate orders will be issued regarding the time of landing on the English coast. The intention is to land at daybreak. Dependence on weather and tides, however, may necessitate a landing in broad day light. In this case, extensive use of smoke is ordered (with the aid of aircraft, vessels, and artillery).

(c) Army Group B's task. Army Group B will not participate in the initial phase of the operation. If the naval situation develops favourably, the Army Group, starting from Cherbourg, may be employed later to force an air and sea landing in Lyme Bay, and to occupy, first, Weymouth and the high ground 20 km. north of Weymouth-15 km. north of Lyme Regis. From here, an advance would, on instructions from OKH, be made in the direction of Bristol. Later, elements of Army Group B may receive the task of occupying the counties of Devonshire and Cornwall.

Army Group B will, in conjunction with the naval authorities, decide on embarkation ports and determine their capacity. Its landing troops will be assembled in readiness, so that, on orders from OKH, they can be brought up for embarkation within five days. The following instructions for assembly and organization of forces, which primarily concern Army Group A, are also valid, where applicable, for Army Group B.

7. Organization of forces

Detailed organization will be determined by army groups and armies to suit their various embarkation areas and their initial tasks on English soil.

Apart from the separate instructions already issued on this subject, the following points should be observed.

(a) The composition of the first echelon of the first wave, as laid down in OKH Organization Branch Instruction No. 1084/40 g. Kdos. Dated 20.7.40, is only a suggestion. Men and weapons should be ferried across as rapidly and in as large numbers as possible without

paying scrupulous attention to organic cohesion. The essential point is to form battle groups in accordance with the task to be carried out.

(b) Units of panzer and mobile formations, especially U-tanks, will be included early in the landing echelons.

(c) Arrangements must be made to send on troops of medium artillery for use as coastal artillery on the far shore, so that the stretches Calais-Deal and Boulogne-Hastings are covered as early as possible by artillery on both coasts (Artillery Commander 106's Group, and, later, 1st Battery/84th Artillery Regiment). For use of Flak units, see Appendix 3 [not included].

(d) Engineers' tasks

(aa) Support of troops during embarkation, especially when taking place outside ports.

(bb) Support during the initial landing on a broad front (assault boats, motor-boats, pneumatic boats).

(cc) Support during disembarkation of men, vehicles, and horses from transports, especially on open coasts.

(dd) Provision of assistance to the troops first landed during removal of shore obstacles, especially mines; support of infantry as the attack continues.

(ee) Assembly of the forces and equipment required to support the troops defending the bridgeheads gained.

The forces used for tasks (aa) and (cc) will in general remain where they are as static units, in order that the embarkation and disembarkation of later waves may be carried out under the control of special staffs.

(e) Special measures to provide a curtain of fire against land targets during the landing will be vigorously improvised by all commands in accordance with the pamphlets, &c., issued.

(f) Each landing unit in the foremost echelons must be so organized that, after the landing has taken place, it is suited for independent combat tasks even on the smallest scale. The commanders of all units will accompany their front-line troops.

(g) Loading of shipping space for the second and subsequent journeys cannot be rigidly determined in advance. By means of an organization working closely with the naval commands, it must be possible to arrange loading' of the available shipping quickly and flexibly in every case. To this end the establishment of a reliable signal network is indispensable.

(h) As far as the transport situation permits, the requirements of the Deputy Quartermaster-General—England (0. Qu. England) must be borne in mind by the armies in determining priorities. (See Appendix 4) [Not included here].

7. [Sic] Assembly of forces

(a) First wave. Forces destined for the first wave will be assembled near the embarkation ports prepared by the Navy.

These 'embarkation ports' are:

For 16th Army: Rotterdam

Antwerp

Ostend

Dunkirk

Calais

For 9th Army: Boulogne

Le Havre (the latter only for the first echelons of three divisions).

Nieuport and Gravelines will serve as 'auxiliary ports' (which are not to be used for embarkation purposes).

Further embarkation on the open coast, in river mouths, or in small harbours will be possible only to a modest extent.

Details of place, type, and sequence of initial loading will be fixed immediately by the armies ('Liaison Officers') with the competent naval authorities (who have received instructions). It must be axiomatic that as much equipment as possible (including supplies) is loaded beforehand, as the time taken to embark troops and horses must, when it finally takes place, be cut down to a minimum.

To procure, equip, and assemble transportation is the task of the Navy and will be regulated by special instructions from the Naval (War) Staff.

It is the troops' responsibility to arm barges and even tugs with weapons of all kinds, in so far as the naval authorities have not done this: this task will be carried out on an extensive scale in accordance with the pamphlets issued. The curtain of fire from the sea covering the landing troops will be supplemented by the guns of armed naval vessels (mine-sweepers, &c).

(b) Second wave. At the proper time armies will move up, by road, the mobile formations destined to cross with, or following, the first wave, and will assemble them in the area of the embarkation ports. Rotterdam and Antwerp can be considered for use as loading points by 16th Army, Boulogne by 9th Army. Preparations to bring up these forces must be so arranged that from 15 September onwards they can be assembled within three days. Corps, divisions, and regiments of mobile formations allocated to 16th and 9th Armies are immediately placed under command of both armies for these preparatory tasks.

(c) Third wave. The third-wave formations which are not provided with railway transport will be moved forward near the coast by early morning on 15 September. Where and when it will be possible to ship them will not be known at first. Their grouping must

therefore be such as to enable their forward elements to reach the most suitable army ports in three moves.

With regard to the formations which OKH will bring up by rail (see Appendix 1) [not included], Army Group A will report desired time of arrival and detraining area.

(d) Fourth wave. The OKH Reserves will, at first, remain in their previous areas and will be moved up as required by OKH.

(e) During the approach and assembly of forces belonging to all waves, care must be taken to avoid unnecessary crowding; provision of the A. A. defence required must be ensured in conjunction with the competent Luftflotten [Air Fleet] H.Q.s.

8 Luftwaffe operations

(a) Operational Luftwaffe—see Appendix 3 [not included].

(b) Army Air Formations—see Appendix 3 [not included].

9. Security

Preparations for the landing planned require especial secrecy. The fact that a landing in England is being prepared cannot be concealed. It is thus all the more important to use every means to keep the time of the proposed landing and [the location of] the crossing-sectors secret.

10. Deception measures

Measures have been introduced to give the appearance of a projected landing on the east coast of England and in Ireland. Details have been passed to the commands concerned.

11. Reports

Army Group A is requested to furnish the following information by 3 September:

(a) Intended approach and assembly of the first wave (Map). Use of paratroops, &c.

(b) Intended assembly of the second wave (Map).

(c) Intended battle H.Q.s of Corps H.Q.s and below.

(d) Estimate of the probable time required for ferrying across the individual echelons and waves (in conjunction with the naval authorities).

(e) Requested time of arrival and detraining area for the third-wave divisions which will move up by rail.

(f) Time of day proposed for landing.

(g) Suggestions and proposals.

(Signed) VON BRAUCHITSCH

APPENDIX D – Plans for the invasion of England taken from Directive No: 16 (Lowry: 2004).

'On preparations for a landing operation against Britain':

Since England, in spite of her hopeless military situation, shows no sign of being ready to come to an understanding, I have decided to prepare a landing operation against England and, if necessary, carry it out.

The aim of this operation will be to eliminate the English homeland as a base for the prosecution of the war against Germany and if necessary, to occupy it completely.

I therefore order as follows:

1. The landing will be in the form of a surprise crossing on a wide front from about Ramsgate to the area west of the Isle of Wight. Units of the airforce will act as artillery and units of the navy as engineers.

The possible advantages of limited operations before the general crossing e.g. the occupation of the Isle of Wight or of the county of Cornwall are to be considered from the point of view of each Branch of the armed forces and the results reported to me. I reserve the decision to myself.

Preparations for the entire operation must be completed by the middle of August.

2. These preparations must also create such conditions as will make a landing in England possible. Viz:

(a) The English Air Force must be so reduced morally and physically that it is unable to deliver any significant attack against the German crossing.

(b) Mine-free channels must be cleared.

(c) The Straits of Dover must be closely sealed off with minefields on both flanks: also the western entrance to the channel approximately on a line Alderney-Portland.

(d) Strong forces of coastal artillery must command and protect the forward coastal area.

(e) It is desirable that the English Navy be tied (town shortly before the crossing, both in the North Sea and in the Mediterranean (by the Italians).

This purpose we must attempt even now to damage English home-based naval forces by air and torpedo attack as far as possible … The attack will bear the cover name 'SEALION'

APPENDIX E - Disposition of *Wehrmacht* for Operation Sealion (First draft - July 1940) (Alexander: 1998).

CALAIS ATTACK GROUP 16th ARMY (ARMY GROUP A).

Assault Wave: XIII Corps with 2 infantry divisions.
XXXVIII Corps with 2 infantry divisions.
VII Corps with 2 infantry divisions.

Objective - To establish a beach-head between Ramsgate and Hastings.

Second Wave: XLl Corps with 2 panzer divisions plus 1 motorised division.

Objective – To break out of the beach-head and capture London.

LE HAVRE ATTACK GROUP 9th ARMY (ARMY GROUP A).

Assault Wave: VIII Corps with 2 infantry divisions.
X Corps with 2 infantry divisions

Objective - To establish a beach-head between Brighton and Portsmouth.

Second Wave: XV Corps with 3 mechanised divisions.

Objective – To break out towards Aldershot, isolating London from the west.

CHERBOURG ATTACK GROUP 6th ARMY (ARMY GROUP B).

Assault Wave: II Corps with 3 infantry divisions.

Objective - Expected to establish beach-head in Lyme Bay.

Second Wave: XXII Corps with 3 infantry divisions and other mechanized forces.

Objective - To isolate Cornwall, advance and occupy London, drawing British reserve forces away from Southeast invasion beaches.

APPENDIX F - Disposition of *Wehrmacht* for Operation Sealion (Revised draft - Aug 1940) (Alexander: 1998).

LE HAVRE ATTACK GROUP 9th ARMY (ARMY GROUP A).

BRIGHTON BAY LANDINGS.

Assault Wave: VIII Corps

8th Infantry Division

28th Infantry Division

6th Mountain Division

Second Wave: XXIV Corps

4th Panzer Division

7th Panzer Division

20th Motorised Division.

CALAIS ATTACK GROUP 16th ARMY (ARMY GROUP A).

FOLKSTONE-DUNGENESS LANDINGS.

Assault Wave: XIII Corps

17th Infantry Division

35th Infantry Division

RYE LANDINGS.

Assault Waves: VII Corps

7th Infantry Division

1st Mountain Division

BEXHILL-EASTBOURNE LANDINGS.

Assault Wave: XXXVIII Corps

26th Infantry Division

34th Infantry Division

16th Army

Second Wave: V Corps

XXXXI Corps

12th Infantry Division

10th Panzer Division

30th Infantry Division

8th Panzer Division

29th Motorised Division

APPENDIX G – Extract from Section 13 of the report HOME FORCES OPERATION INSTRUCTION No: 3 (Alexander: 1998).

'The general plan of defence is a combination of mobile columns and static defences by means of strong-points and stops. As static defence only provides limited protection of the most vulnerable points, it must be supplemented by the action of mobile columns. However mobile such columns may be they cannot be expected to operate immediately over the whole area in which it is possible for the enemy lo attempt invasion by sea or air. It is therefore necessary to adapt measures for confining his actions until such time as mobile columns can arrive to deal with him. This will he clone by means of stops and strong-points prepared for all round defence at aerodromes which are necessary to prevent the enemy obtaining air superiority, at the main centres of communications and distributed in depth over a wide area covering London and the centres of production and supply. This system of stops and strong-points will prevent the enemy from running riot and tearing the guts out of the country as had happened in France and Belgium'.

APPENDIX H – Planned Stop Lines for Southern Britain, June 1940 (Alexander: 1998).

Southern Command - Bodmin Command Line.
Oxford Command Line.
Salisbury West Command Line
Salisbury East Command Line
Taunton Command Line.
Blandford Corps Line.
Dorchester Corps Line.
Exeter Corps Line.
Meon Valley Corps Line.
Midhurst Corps Line.

Eastern Command - Eastern Command Line.
II Corps Line A.
II Corps Line B
XI Corps Line East.
XI Corps Line South.
Arun Divisional Line

APPENDIX I – An extract from an Infantry Training Manual, dated 1941 (no publisher details known), that outlined the operational procedure for the pillbox (Green: 1999).

OPERATIONAL PROCEDURES

1. *The concrete pillbox is a great aid to defence if intelligently used. It may also become a death trap.*
2. *The pillbox protects against bullets, blast, shell splinters and the weather, if properly camouflaged it is also a protection from ground and air observation.*
3. *Many pillboxes are not complete protection against a direct hit from a shell or an aerial bomb. They all have the disadvantages of limiting the field of view and the field of fire and preventing the garrison from employing the hand grenade or the bayonet.*
4. *Therefore the garrison of a pillbox will act as detailed below.*

a. *The sentry or sentries on duty will be stationed outside the pillbox where they can hear and see all around them.*
b. *Temporary cover from view, shellfire and aerial bombing may be sought inside the pillbox but beware that the enemy is not creeping towards you under covering fire whilst you are hiding inside.*
c. *When the attack comes, the garrison machine gun will fire from inside the pillbox providing it can engage the designated targets. If not it must come out to a prepared position.*
d. *Those men who cannot use their weapons from inside the pillbox due to lack of firing ports must occupy trenches outside – where they can do their duty.*
e. *If the pillbox is surrounded, with the exception of those at the firing ports, the garrison will fight outside where they can employ all their weapons to the best advantage.*

INFANTRY TRAINING MANUAL 1941

APPENDIX J – An extract from General Brooke's diary regarding concerns over the GHQ Stop Line defences, following a visit to Eastern Command in July 1940 (Alexander: 1998).

"I also discovered that much work and energy was being expended on an extensive system of Rear Defence comprising an anti-tank ditch and pillboxes running roughly parallel to the coast and situated well inland. This static rear-line did not fall in with my conception … To start with we had not got sufficient forces to man this line, even if we wanted to do so. To my mind, our defence should be of afar more mobile and offensive in nature.

Another form of defence which I found throughout the country and which I was in total disagreement consisted of massive concrete roadblocks at the entry and exit of most towns and many villages. I suffered too much from these blocks in France not to realize their crippling effect on mobility. "

APPENDIX K – Quoted details from the Reconnaissance report (18th June 1940) and the Review report dated 7th July 1940 (Green: 1999) (No reference details available).

RECONNAISSANCE REPORT ON BRISTOL OUTER DEFENCES DATED 18TH JUNE 1940

GENERAL DESCRIPTION

The right flank of the position rests on the BRISTOL CHANNEL at HIGHBRIDGE. The Forward Defence Line (FDL) follows the RIVER BRUE and tributaries as far as a point 1 mile southeast of WELLS. From there it crosses the MENDIP PLATEAU to MASBURY STATION. There is no natural obstacle across the plateau. From MASBURY to RADSTOCK the line of the Somerset & Dorset Railway is followed and thence the line of the WELLOW BROOK to the RIVER AVON at BRADFORD ON AVON.

From BRADFORD ON AVON, the AVON is followed upstream to MALMESBURY where the river ceases to be an effective anti tank obstacle. From this point to NAILS WORTH the position crosses the COTS WOLD PLATEAU. In this sector also there is no natural obstacle and an artificial ditch should be dug. It is, however, doubtful whether the excavators will be able to work in this lime stone belt owing to very little depth of surface earth. This will have to be verified by local reconnaissance.

From NAILS WORTH to STROUD, the position is sited behind the gorge and watercourse between these two places and from STROUD to the RIVER SEVERN, the FDL follows the line of the RIVER FROME and the STROUD WATER CANAL.

The position is strong on the southwest and northeast flanks and from BRADFORD ON AVON to just below MALMESBURY. The weaker sectors are from WELLS to BRADFORD ON AVON and from MALMESBURY to NA1LSWORTH where either no natural obstacle exists or the natural obstacle is only partial. At LACOCK, the position is badly overlooked from the east.

A great deal depends on whether the excavators can work in the lime stone country. If they can, there should be no difficulty in creating a continuous obstacle against tanks along the forward edge of the position.

DETAILED DESCRIPTION

Highbridge to Wells
From the sea to MEARE POOL the RIVER BRUE forms an effective obstacle being wide, deep, muddy and with vertical banks.
From MEARE POOL to UPPER GODNEY, the RIVER SHEPPEY is also an effective obstacle.
From UPPER GODNEY to DINDER the above river is only a partial obstacle and improvement will be necessary.

Dinder to Radstock
From DINDER to MASBURY STATION the FDL is sited along the southeast face of DINDER WOOD and thence up the spur to MASBURY STATION. An artificial obstacle will be required.
From MASBURY STATION to RADSTOCK the Somerset and Dorset Railway is followed. Although the line of the railway is not always sited suitably from a tactical point of view the cuttings and embankments on it, being cut out of limestone, are very steep and provide complete anti tank protection where they exist.

Radstock to Freshford
From RADSTOCK the FDL follows the general line of the WELLOW BROOK as far as the re-entrant at MIDFORD HILL. As an obstacle, the WELLOW BROOK depends on its banks, which are overgrown and at least partially effective.

From MIDFORD HILL the FDL passes across the LIMPLEY STOKE tongue and drops to the AVON VALLEY and FRESHFORD. An artificial obstacle will be required in this sector.

Freshford to Malmesbury
The line of the RIVER AVON is followed. This is a complete anti tank obstacle as far upstream as CHIPPENHAM after which it cannot be relied on and local improvement may be necessary. There is an unsatisfactory sector near LACOCK where the position is badly overlooked from the high ground at BOWDEN PARK.
In the sector from GREAT SOMERFORD to MALMESBURY the RIVER AVON is often wide, swift and shallow with indifferent banks and a hard bottom so it can not be relied on as an anti tank obstacle.

Malmesbury to Nailsworlh
From MALMESBURY the FDL leaves the AVON and runs north and north west over the COTSWOLD PLATEAU making use of the best tactical ground. The position includes WARREN TUMP and STAR FARM and drops into the NAJLSWORTH GORGE at AVENING.
This is a weak sector from the point of view of anti tank defence and an artificial ditch should be constructed if the excavators are capable of working the ground, which is limestone thinly, covered with earth.
From AVENING to NAILSWORTH the gorge is steep and is itself a complete anti tank obstacle.

Nailsworth to the River Severn
As far as DUDBRIDGE, the NAILSWORTH GORGE is a complete anti tank obstacle and from DUDBRIDGE to the RIVER SEVERN the line of the STROUD WATER CANAL also provides complete protection. This sector should not absorb many troops.

REVIEW OF RECONNAISSANCE REPORT ON BRISTOL OUTER DEFENCES

DATED 7TH JULY 1940

GENERAL

The reviewers agree with the Reconnaissance Report with the following exceptions:

(a) As the stream from LOWER GODNEY to UPPER GODNEY (River Sheppey) is a poor obstacle the line will now follow the DIVISION RHYNE from MEARE POOL, thence an artificial obstacle must be constructed. (See Note 1)

(b) The task of constructing an artificial obstacle across the COTSWOLD PLATEAU in the MALMESBURY – AVENING sector is a difficult one owing to the hardness of the ground. In order to take advantage of a natural anti tank obstacle the line will now run further west along the RIVER AVON (Tetbury Branch) as far as ESCOURT HOUSE, then TETBURY, thence to AVENING. (See Note 2)

THE OBSTACLE

Further detailed reconnaissance's have confirmed your report in general but considerable work will be required to improve the obstacle by building up the banks of rivers and streams. It is not agreed the gorge between AVENING and DUDBRIDGE is an obstacle to tanks although it will undoubtedly slow them up.

TROOPS REQUIRED

In considering the number of Divisions required to hold the line 8000 yards has been taken as an average Divisional frontage. This is, of course, too wide to repel serious attacks for any length of time.
The country is very enclosed except across the COTSWOLD PLATEAU and in parts of the sector MAS BURY to RADSTOCK. It is therefore expensive in troops even by day,

particularly where the country is dead flat and there is no observation beyond the obstacle, such as the sector HIGHBRIDGE to DINDER. In other parts of the line, although the country is enclosed it is hilly and better observation is obtained. These factors have been taken into consideration when selecting Divisional Boundaries. Sixteen Divisions will be required if the whole line is to be held.

Note 1. Both obstacles were used. Defence Works 42 and 43 conform to the River Sheppey. Defence Works 40 and 41 conform to this revision.

Note 2. This revision was not taken up. The line built swung north, away from the River Avon, east of Malmesbury.

APPENDIX L – Specifications of typical '*in service*' (1940) German armour likely to have been deployed during an invasion, as per **TABLE A** (Grove: 1975).

TABLE A

VEHICLE	PzKpfw I [3]	PzKpfw II	PzKpfw III	PzKpfw IV	PzKpfw 35 (t)	PzKpfw 38 (t)
WEIGHT	5500kg	9.35 tons	20 tons	19.7 tons	N/A	8.4 tons
LENGTH	4.02m	4.81m	5.41m	5.91m	N/A	4.62m
SIDE ARMOUR	6 – 13mm	20mm	30mm	20mm	N/A	15-19mm
UNDERSIDE ARMOUR	-	5mm	16mm	10-20mm	N/A	8mm
TRENCH CROSSING [1]	1.75m	1.7m	2.3m	2.3m	N/A	1.85m
STOPABLE [2]	√	√	√	√	N/A	√

NB: - Details for PzKpfw 35 (t) were not available at time of publication, though being an earlier model of the PzKpfw 38 (t); it is safe to assume that the specifications would have been similar.

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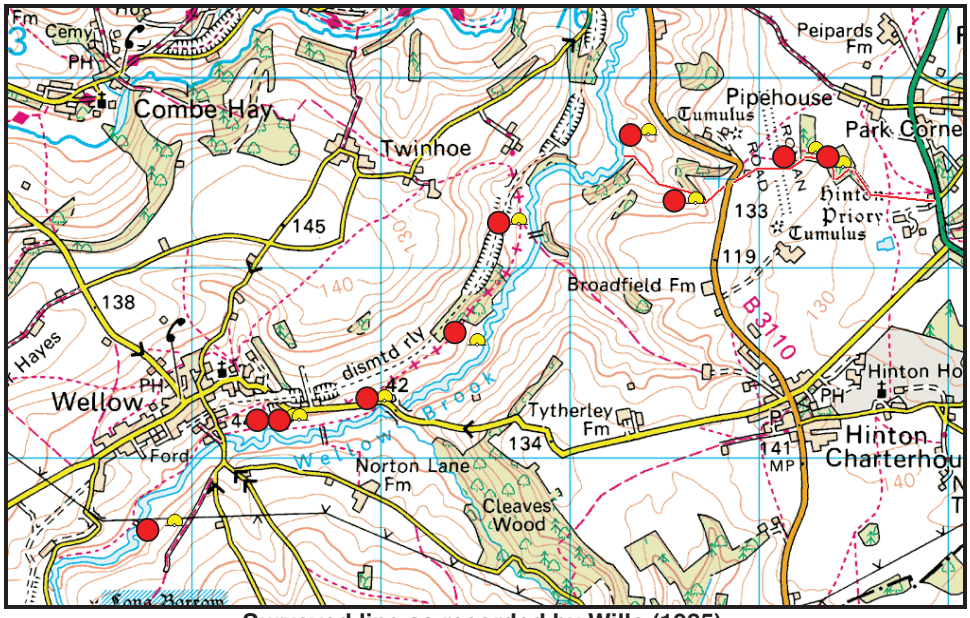
1 The average width of the Wellow Brook (cartographically measured using © Memory-Map) is 15m, whilst the average width of the AT ditch (taken from 2004 earthwork survey conducted by Rowe (200% Unpublished) is 5m.

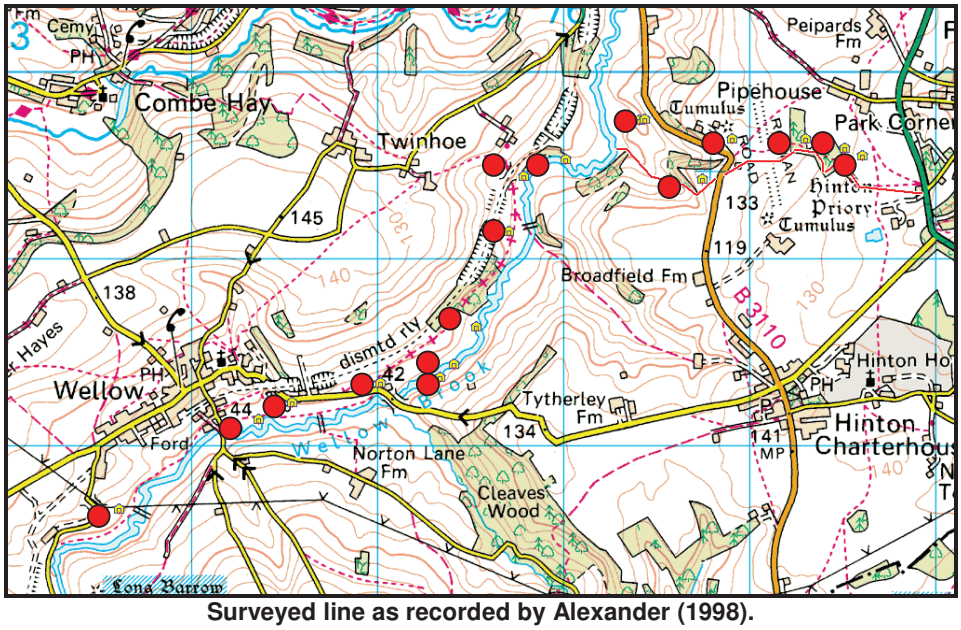
2 This column simply inquires as to whether it is feasible that the Boys AT rifle, with a penetration power of 20mm at 500m (Hogg: 1977) could of conceivable stopped the said vehicle.

3 Details taken from Trewhitt (1999). Specifications of side / underside armour not made however, maximum is 13mm suggesting AT rifle penetration highly probable.

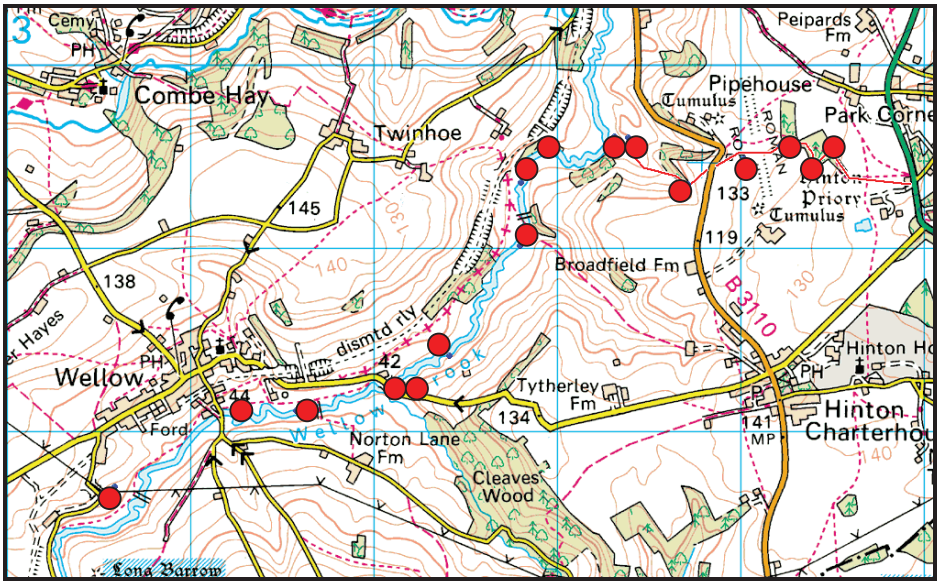
APPENDIX M – The following plotted maps represent the previous surveys conducted along the SLG case study area, compared to the May 2005 survey (Note: Though predominately similar, there are variations that when reviewing the strategic locating of the defences could provide differing conclusions. The map produced from the 2005 survey does provide a more accurate representation of the pillbox locations, HOWEVER a small part of it (displayed in green) has been reproduced from Alexander's / Green's survey as the defences could not be located on the ground.



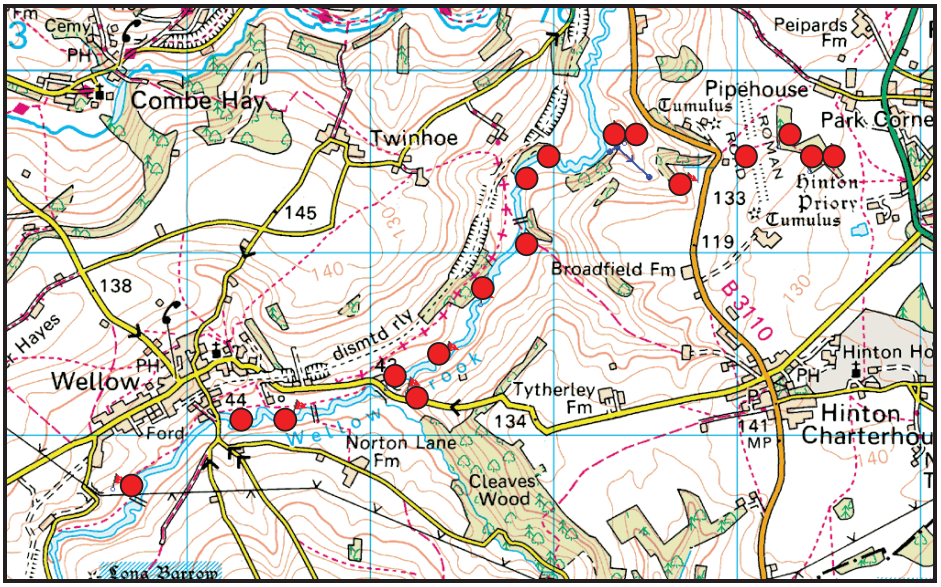
Surveyed line as recorded by Wills (1985).



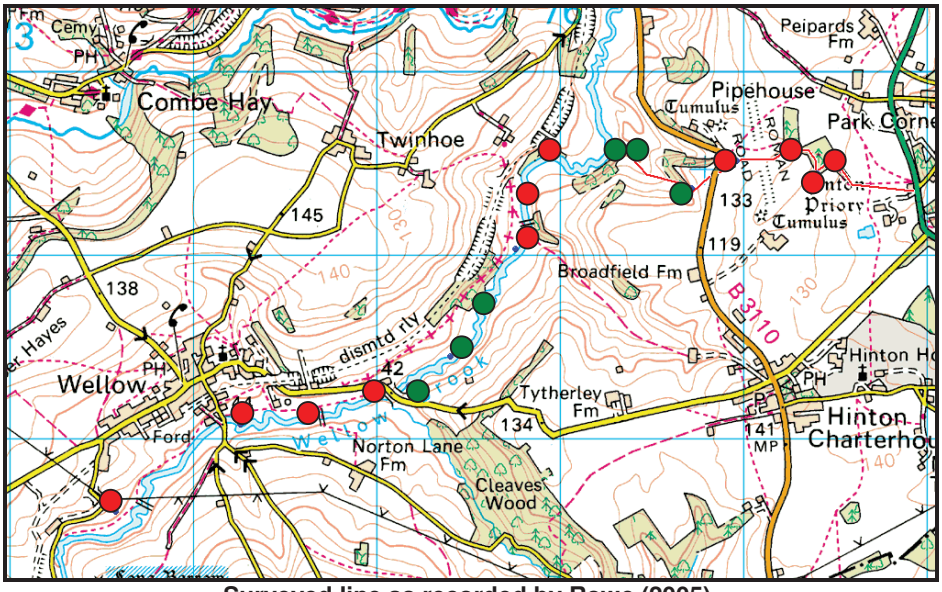
Surveyed line as recorded by Alexander (1998).



Surveyed line as recorded by Green (1999).



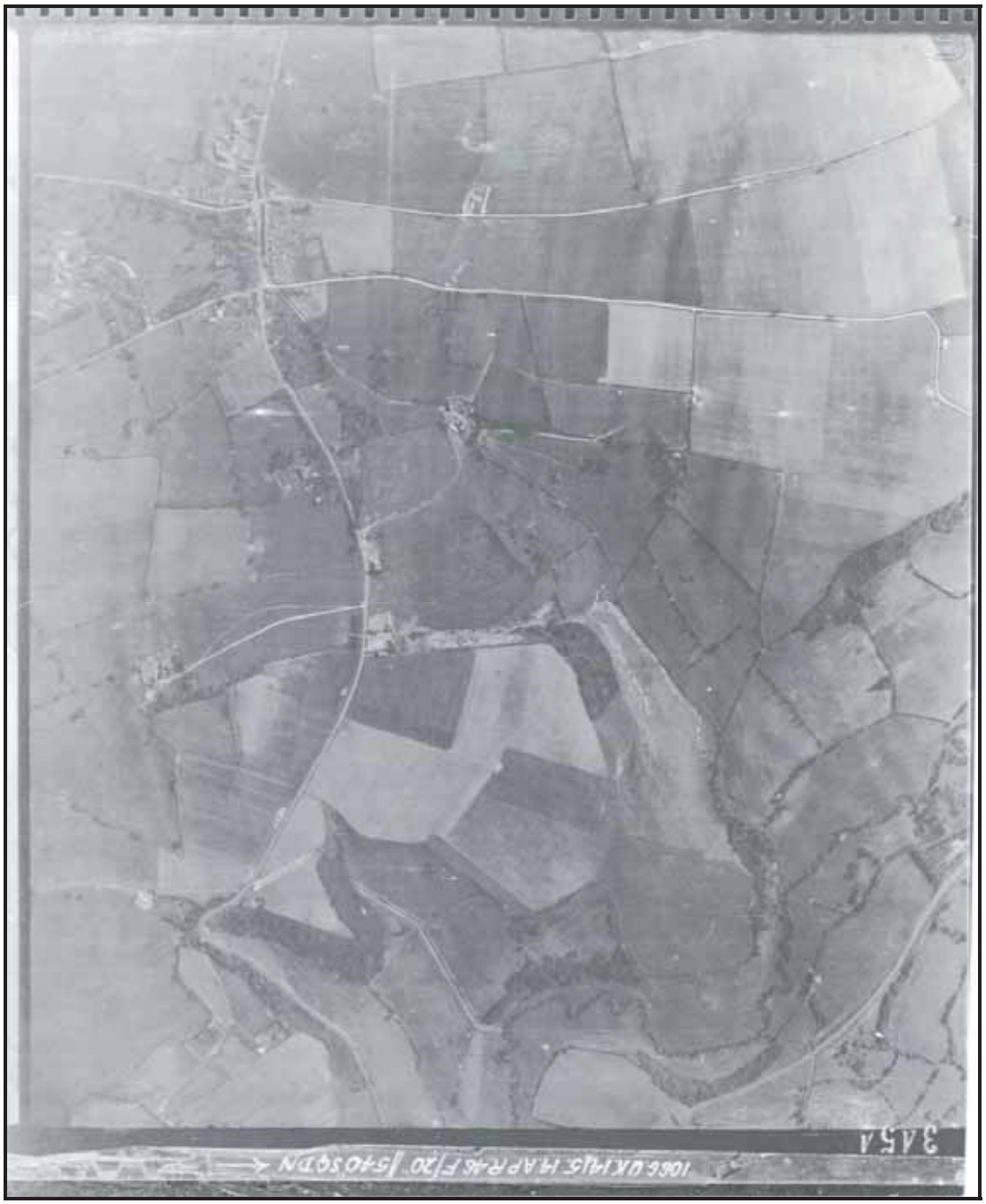
Surveyed line as recorded on the ADS *Defence of Britain* database.



Surveyed line as recorded by Rowe (2005).

APPENDIX N – AP 1946/04/14 106G UK 1415 F/20 (3453 – 3455) (© NMR – English Heritage)

AP - 106G UK 1415 F/20 No: 3453 Dated: 14th April 1946



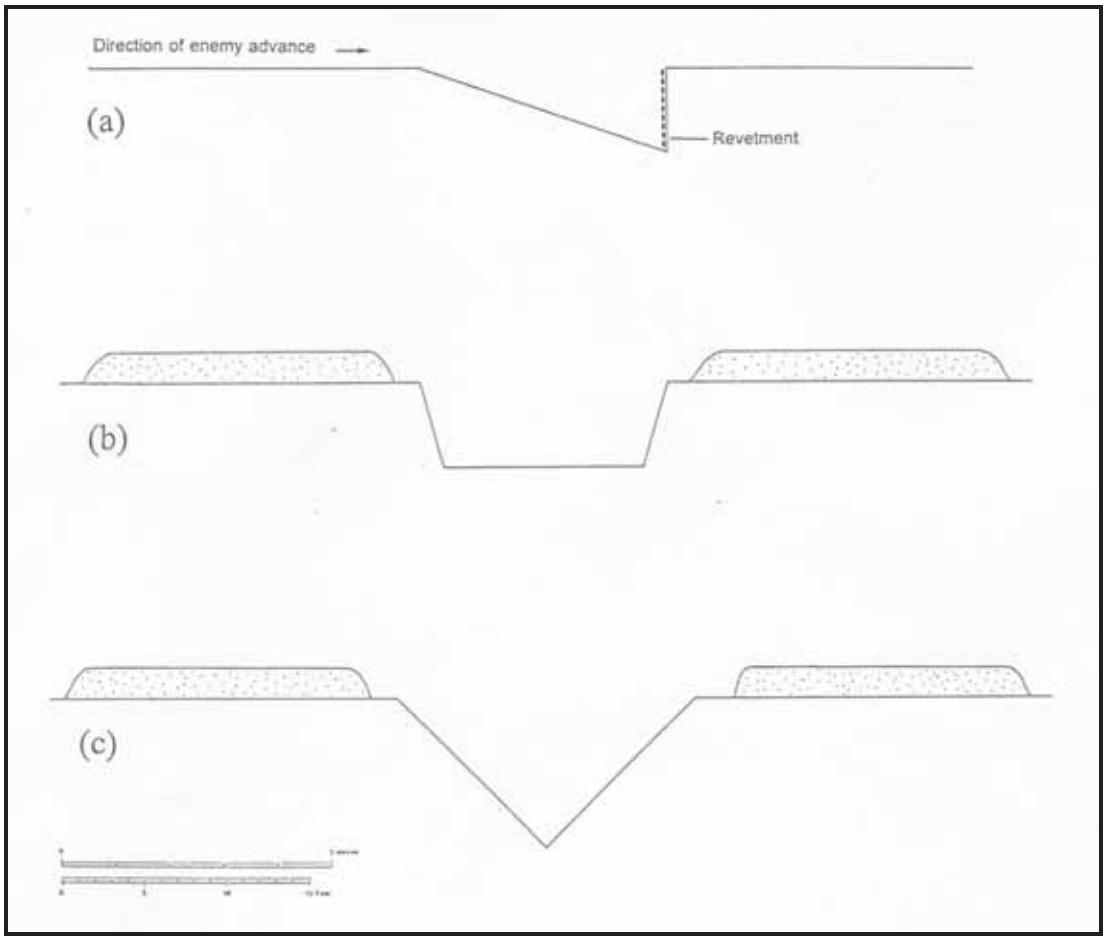
AP - 106G UK 1415 F/20 No: 3454 Dated: 14th April 1946

AP - 106G UK 1415 F/20 No: 3455 Dated: 14th April 1946

APPENDIX O – Description of a two-way AT Ditch (Rowe: 2005 Unpublished).

Used in mainly two forms by the Home forces between 1940–1941, the *two-way* ditch was intended to be used in areas where the advance of attack could perceivably come from either direction, though one side of the obstacle would almost always of been constructed to be more extensively defended than the other.

Normally measuring 4.4m wide at the top and 2.4m deep, though soon revised to 1.5m depth for normal ground and 2.1m in difficult, thus avoiding the expense of revetting the ditch faces with much needed wood (Dobinson: 1996). The ditch seen in Hog wood is that of a typical two-way ditch measuring *c.*5m wide at the top / *c.*2.5m at the bottom and 2.5m – 3m deep.



AT Ditch profiles - 'Two-way' flat-bottomed anti-tank ditch profile - B (Dobinson: 1996).

APPENDIX P – Giving an average distance between pillboxes of 321.3125m, calculated cartographic measurements (© Memory-map Scale 1:50000) [1] was taken, as per detailed in **TABLE B.**

TABLE B

PILLBOX	DISTANCE (m)
A- B	825
B–C	333
C-D	434
D-E	156
E-F	268
F-G	329
G-H	381
H-I	359
I-J	210
J-K	384
K-L	108
L-M	402
M-N	289
N-O	294
O-Q	221
Q-R	148

NB: 1m = 1.0940 yards

[1] At a scale of 1:50000, accuracy discrepancy would be kept to a minimum.

APPENDIX Q – Calculated cartographic measurements of the predicted views / fields of fire taken from the viewshed analysis, as per detailed in **TABLE C**.

TABLE C

PILLBOX	SOUTH VIEW (DISTANCE m)	SOUTHWEST VIEW (m)	SOUTHEAST VIEW (m)	WEST VIEW (m)	EAST VIEW (m)
A	475	405	995	294	690
B	140	1140	1235	1892	891
C	1093	411	529	1170	1589
D	457	884	357	1853	1093
E	217	1238	961	1985	938
F	372	449	685	1054	728
G	806	679	628	1271	527
H	1458	1037	302	1319	606
I	1814	1382	805	806	279
J	1721	746	1307	814	790
K	783	1796	619	961	1705
L	775	615	517	1287	333
M	179	676	128	2008	480
N	194	241	291	2504	1077
O	186	389	385	442	759
Q	403	256	520	2876	666
R	178	392	516	2969	558

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