

Was the Battle of Hastings Really Fought on Battle Hill? A GIS Assessment

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ABSTRACT: Fought on a hillside in southern England in the fall of 1066, the Battle of Hastings has long been regarded as a seminal moment in British history, due to the profound changes the invading Norman conquerors brought to the British Isles. As such, the conflict has been the subject of significant historical analysis. One aspect of the battle that has not drawn much attention in academic accounts, however, relates to its location. To this point, observers have generally accepted that the site of the conflict was “Battle Hill,” pointing as evidence to the nearby presence of Battle Abbey, erected by the Norman leader, William the Conqueror, to commemorate his victory. Yet to this point, no archaeological evidence has been found to support the fact that a battle once occurred here. Furthermore, there are some local historians who believe that other sites are plausible. This study retests the case for Battle Hill as the site of the Battle of Hastings through a re-examination of historical data using a GIS-based multicriteria decision analysis (MCDA) model. The results indicate that while Battle Hill is indeed a likely site for the conflict, another nearby location – Caulbec Hill is an equally if not more plausible contender. The study concludes by discussing the implications of this investigation for interdisciplinary research.

Introduction

The Battle of Hastings, fought on a hillside in southern England in the fall of 1066, has long been regarded as a seminal moment in British history. As such, it has been subject over the years to intensive historical investigation, and rightly so, given the profound changes that this victory of the invading Norman forces brought to the British Isles in the years afterward – whether in terms of customs, language, economy or politics. For nearly 1000 years, almost every element of the conflict, from its origins in England’s succession crisis, the composition of the Norman and English armies, and the military tactics of the combatants, have been subject to significant scrutiny and analysis. Thus, in the view of contemporary historians, evidently, “there is little more to be said” about the battle.¹

However, one aspect of the battle that has drawn little or no attention in academic historical accounts is related to its location. Most observers generally accept that the site was “Battle Hill,” as it is known, just to the south of the present-day town of Battle. Their evidence is Battle Abbey, erected by the Norman leader, William the Conqueror to commemorate his victory over the defending English forces. At the same time, there is at least some reason to doubt this as the only possible site of the conflict. On the one hand, to this point, no archaeological evidence has been found that would support the fact that a large-scale battle once occurred here. In addition, there are at least some local historians who believe that other sites, at nearby locations such as Caulbec Hill, are equally plausible.

Given this contention, using advanced geographic techniques, this article retests the case for Battle Hill as the primary candidate for the site of the Battle of Hastings. Based upon a review

of existing historical literary and cartographic sources, the analysis is conducted through the use of GIS-based multicriteria decision analysis (MCDA) and cartographic modeling using the simple additive weighting (SAW) technique.

The study opens with a discussion of the historical context of the battle. Following this, a series of criterion maps are developed, along with a criterion weighting exercise. The SAW technique is then applied by multiplying the criterion maps by their respective weights and then summing them together. Based on this analysis, the article concludes with an overall assessment of the likelihood of the Battle Hill site along with a discussion on the potential sources of error in the model.

Historical Context for the Battle of Hastings

Following the death of King Edward,² Harold II Godwineson, was named king of England in 1065.³ Unfortunately for Harold, however, he was almost immediately confronted with two other claimants to his throne. One of these was Harald Hardrada, King of Norway, who had long had his sights on the conquest of England. The other was William, Duke of Normandy who, as the historical account relates, believed himself, and not Harold Godwineson, to have been promised the English crown by the late King Edward.

On September 25, 1066, Harold defeated his first contender, Harald Hardrada, at the Battle of Stamford Bridge in Yorkshire. He was not so lucky with the other. On September 28 or 29, William, Duke of Normandy landed his army in the south of England, at Pevensey. Harold subsequently rushed south to meet him, thus setting the stage on October 14 for one of the most epic battles in British history. The Battle of Hastings, as it was known, saw Harold's forces decimated by the invading Normans, and the King himself killed, leaving William "the Conqueror" as the sole inheritor of the English Kingdom.

There are a large number of both contemporary and modern accounts of this key conflict in British history. Best known contemporary accounts include the *Anglo-Saxon Chronicle*, *Bayeux Tapestry*, *Carmen de Hastingae Proelio*, William of Poitiers' *Gesta Guillelmi*, or William of Jumièges' *Gesta Normannorum Ducum*. Twelfth century writers include Henry of Huntington, William of Malmesbury, Orderic Vitalis, Wace, and John of Worcester. These sources are listed below in Table 1 along with the year they are believed to have been written, source location, and a brief description.

Modern accounts include Gravett's illustrated popular history, *Hastings 1066: The Fall of Saxon England*.⁴ One of the most thorough accounts has been produced by Lawson, in his *The Battle of Hastings: 1066*,⁵ followed by Morillo's edited book entitled *The Battle of Hastings: Sources and Interpretations*.⁶ Other useful studies include Bradbury's *The Battle of Hastings*,⁷ Grehan and Mace's *The Battle of Hastings 1066 - The Uncomfortable Truth: Revealing the True Location of England's Most Famous Battle*,⁸ and Wood's *The Battle of Hastings: The Fall of Anglo-Saxon England*.⁹

Virtually all such work affirms categorically that the location of the battle site is Battle Hill, as evidenced by the presence of Battle Abbey (see Figure 1). Lingered doubts about this assertion do exist, however, particularly among local historians. In all, at least three alternative sites have been suggested. The first is Caulbec Hill. Grehan and Mace, present convincing arguments linked to the local geography as to why this could indeed be the actual site on which the Battle of Hastings was fought.¹⁰ Although not generally accepted by the academic community, Austin has proposed a site further south of Battle.¹¹ A third site has also been proposed to the northeast of Battle near Sedlescombe by Tyson, an amateur linguist.¹²

It is doubtful that history, in and of itself, can provide a definite resolution to this dispute. By applying a geographical lens to the question, however, greater insight may be gained as to

Table 1: Table of Sources

	Source	Year	Location	Description
English	<i>Anglo-Saxon Chronicle</i> (ASC)	Yearly since 9th century	Various	Provides an account year by year since the late ninth century until the mid-twelfth century. ¹
	Norman	<i>Carmen de Hastingae Proelio</i> (CHP)	1066-8?	Amiens?
<i>Gesta Normannorum Ducum</i> (GND)		1070 – 1	Jumièges	The <i>GND</i> “is almost certainly the earliest of the Norman literary sources.” ³
<i>William of Poitiers</i> (WP)		1070’s	Norman Court	Poitiers’ was “a well informed, well connected and very well educated contemporary in the 1070’s.” ⁴
Anglo-Norman	<i>Gesta Regum</i> (GR)	Early 12th Century	Malmesbury Abbey	William wrote “carefully planned histories based on wide research and seeking to reach the unbiased truth.” ⁵
	<i>John of Worcester</i> (JW)	Early 12th Century	Worcester	“The work was begun at Worcester . . . and continued as a contemporary history down to c. 1140.” ⁶
	<i>Orderic Vitalis</i> (OV)	Early 12th Century	St. Evroult Monastery	Orderic “knew the Anglo-Norman world . . . [by] researching . . . all the extent histories he could find.” ⁷
	<i>Brevis Relato</i> (BR)	Early 12th Century	Battle, Sussex	Discusses “Normandy and England from about 1035 to the early twelfth century.” ⁸
	<i>Historia Anglorum</i> (HA)	Early 12th Century	Huntingdon	Henry was an archdeacon at Huntingdon and his work, <i>Historia Anglorum</i> was widely known and copied. ⁹
	<i>Battle Abbey</i> (BA)	12th Century	Battle, Sussex	The chronicle is “two . . . anonymous chronicles of St Martin’s [abbey] at Battle . . . Both date from the last third of the twelfth century.” ¹⁰
	<i>Roman de Rou</i> (RR)	12th Century	Normandy	Examines “the deeds of the Norman dukes from the earliest, the tenth century Rollo, down to the battle of Tinchebrai.” ¹¹

(See next page for notes.)

Notes for Table 1.

1. Michael Swanton, trans., *The Anglo-Saxon Chronicle* (New York: Routledge, 1998).
2. J. Bradbury, *The Battle of Hastings* (Stroud, UK: Sutton Publishing Limited, 1998), 116; Frank Barlow, trans., *The Carmen de Hastingae Proelio of Guy, Bishop of Amiens* (New York: Clarendon Press, 1999).
3. R. Allen Brown, *The Norman Conquest of England: Sources and Documents* (Woodbridge, UK: The Boydell Press, 1995), 1-2; E. M. C. Van Houts, trans., *The Gesta Normannorum Ducum of William of Jumièges, Orderic Vitalis, and Robert of Torigni* (Vol. II) (New York: Oxford University Press, 1995).
4. Brown, *The Norman Conquest*, 15; R. H. C. Davis and M. Chibnall, trans., *The Gesta Guillelmi of William of Poitiers* (Oxford: Clarendon Press, 1998).
5. Brown, *The Norman Conquest*, 114; R. Y. Mynors, R. M. Thomson and M. Winterbottom, trans., *Gesta Regum Anglorum: The History of the English Kings* (Vol. I) (Oxford: Oxford University Press, 1998).
6. Brown, *The Norman Conquest*, 52; J. Bray, and P. McGurk, trans., *The Chronicle of John of Worcester: The Annals from 450 to 1066* (Vol. II) (Oxford: Clarendon Press, 1995).
7. Brown, *The Norman Conquest*, 99; M. Chibnall, trans., *Historia Ecclesiastica* (Vol. II) (Oxford: Oxford University Press, 1969).
8. M. K. Lawson, *The Battle of Hastings: 1066* (Stroud, UK: Tempus Publishing Ltd., 2003), 112; E. M. van Houts, trans., "Brevis Relatio de Guillelmo nobilissimo comite Normannorum," in *Chronology, Conquest and Conflict in Medieval England* (Vol. 10) (Cambridge: Camden Fifth Series, 1997), 1-48.
9. Bradbury, *The Battle of Hastings*, 119; D. Greenway, trans., *Henry, Archdeacon of Huntingdon Historia Anglorum: The History of the English People* (Oxford: Oxford University Press, 1996).
10. Brown, *The Norman Conquest*, 121; E. Searle, trans., *The Chronicle of Battle Abbey* (Oxford: Oxford University Press, 1980).
11. Lawson, *The Battle of Hastings*, 114; G. S. Burgess and E. M. C. Van Houts, trans., *The History of the Norman People: Wace's Roman de Rou* (Woodbridge, UK: Boydell Press, 2004).

whether or not Battle Hill is the most probable site of the conflict, or if not, which others might be likely candidates. In pursuit of this line of investigation, the study first develops a number of criteria—both quantitative and qualitative—for presentation and analysis. Employing these criteria, it then moves to cartographic analysis of all possible sites with reference to the broader Hastings region. The analysis concludes with a more detailed reconsideration of the two sites arguably with the strongest historical justification, Battle Hill and Caulbec Hill.

Criterion Definition

In order to undertake this analysis, this study applies a GIS-based MCDA or multicriteria decision analysis, based upon existing historical and cartographic information. As part of this exercise, various criteria were required to evaluate the site.

Through careful review of each of the historical accounts (as presented in Table 1), the frequency of place descriptors was first examined to isolate key locational variables. The terms recorded in the documents within an appropriate period of recency to the battle—defined in this instance as 20 years—are displayed in Table 2. The numbers in parenthesis indicate the number of times a specific word appears in the texts, and thus its overall importance as a locational description. The definitions selected for the words are derived from the *Dictionary of Medieval Latin from British Sources*.¹³ Non-Latin words are cited from the *Anglo-Norman Dictionary*,¹⁴ *Dictionary of Old English*¹⁵ or the *Anglo-Saxon Dictionary*.¹⁶

To aid in the spatial understanding of the documents, Figure 1 provides a geographical context for the Battle area. This map depicts the local elevations from a digital elevation model (DEM) and an eighteenth century map. Important locations marked on the map include Battle Hill, Caulbec Hill, Hechelände and Telham Hill.

Table 3 presents a summary of landscape descriptors originating in later sources, written in the twelfth century and often based upon earlier accounts. Here again, the numbers in parenthesis

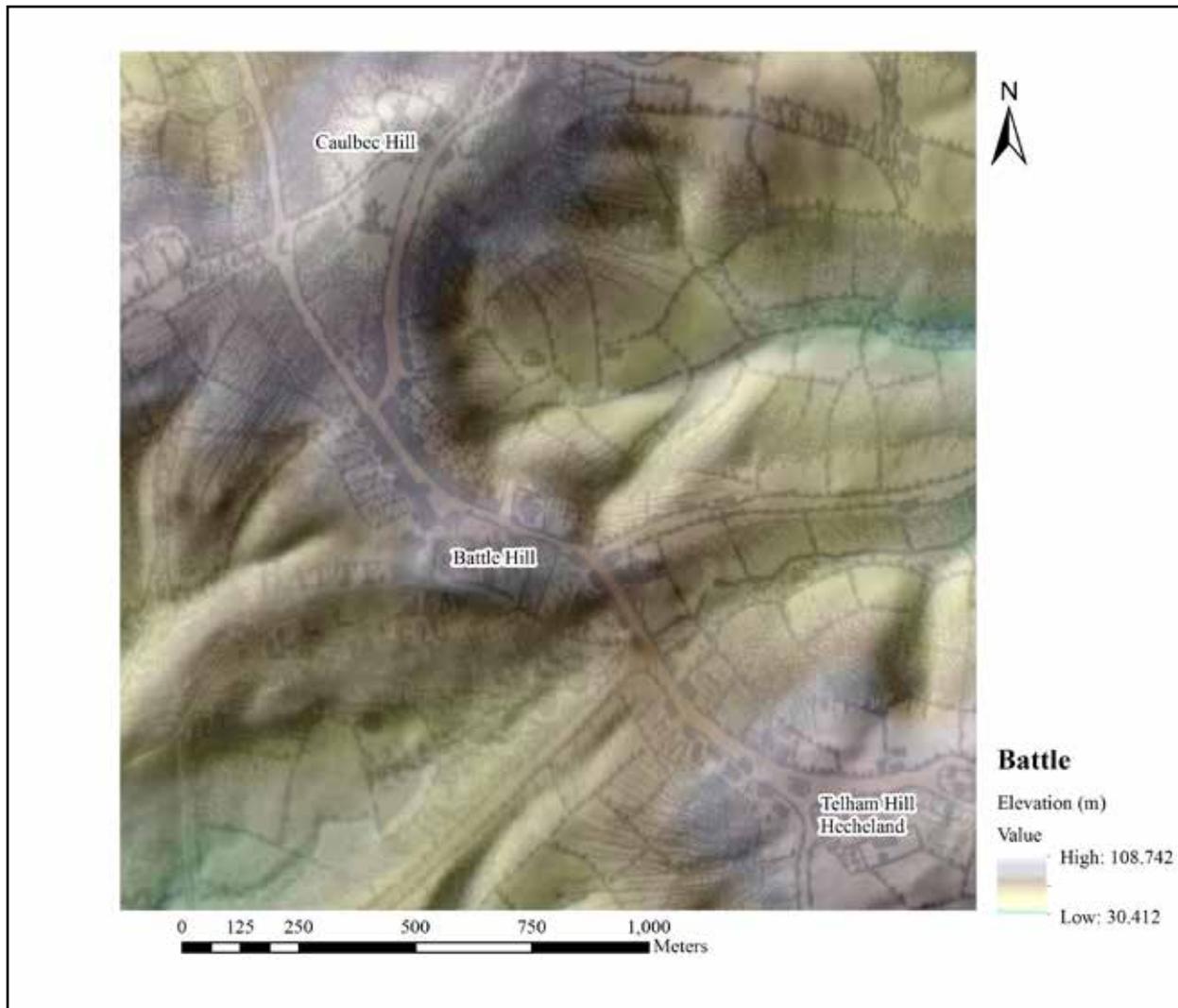


Figure 1: Battle Area DEM (2012) with Yeakell and Gardner Map (1783).¹⁷

indicate the frequency of a word in the texts.

In order to proceed with the application of the MCDA model, these terms were classified into seven categories. The classification was as follows: apple tree = apple tree; Battle = Battle Abbey; higher ground, hill or steep = elevation; Hechelande = Hechelande; Senlac = Senlac; terms suggesting difficult terrain = terrain; and wood or forest = wood. The counts by source per factor are presented in Table 4. The sums per criterion include: an apple tree (1), Battle Abbey (8), elevation (19), Hechelande (1), Senlac (2), terrain (22), and wood or forest (8).

Criterion Maps

In order to calculate MCDA, criterion maps were developed to spatially represent the variables presented in Table 4. This information was supplemented, as appropriate, by the detailed descriptions provided in the relevant historical accounts. To initiate investigation of variables associated with broader landscape features, including terrain, and elevation, two maps, Figures 2 and 3, were generated.¹⁸ Figure 2 is a slope map that graphically depicts the topography of the battleground in degrees. Figure 3 depicts the Pennock land classification, which is “a classification of distinct, three-dimensional landform elements.”¹⁹

Table 2: Location Terms from Documents written within 20 Years of Battle

	WP	GND	ASC	CHP
Descriptor Words	Higher ground (<i>locum editiorem / superioris loci</i>) ¹	Ancient rampart (<i>antiquum aggerem</i>) ⁹	grey apple tree (<i>haran apuldran</i>) ¹⁰	Forest / Wood (<i>silva / e</i>) (2) (<i>nemus / nemoris</i>) (3) ¹¹
	Hill (<i>montem</i>) ²			Hill (<i>mons / montem / montis</i>) (5)
	Wood (<i>silvae</i>) ³ (2)			Valley (<i>vallis</i>)
	Steep slope (<i>ardua cliui</i>) ⁴			Rough ground (<i>non cultus ager asperitate</i>) ¹²
	Rough ground (<i>loci asperitate</i>) ⁵			Steep hill (<i>ardua montis</i>)
	Broken rampart (<i>prae-rupti valli</i>) ⁶			Summit (<i>summo</i>) ¹³
	Ditches (<i>frequentium fossarum</i>) ⁷			
	unfavourable ground" (<i>adversitate loci</i>) ⁸			

Notes for Table 2.

1. *Locum* is a place. *Editorem* suggests a form of statement or declaration. *Superioris* is simply superior. These and all subsequent translations taken from R. E. Latham, D. R. Howlett, and R. K. Ashdowne, *Dictionary of Medieval Latin from British Sources*. II vols. (Oxford, UK: Oxford University Press, 1975-2013).
2. This term can be translated as either a mountain or hill but it could also be a cliff, mound or heap.
3. Woodland and related land uses such as pasture. It could also refer to use of wood as well.
4. *Ardua* refers to something being steep or with a height. *Cliui* indicates a slope.
5. *Asperitate* refers to something rough.
6. The first term indicates attack or that something is abrupt or steep. *Valli* is as it sounds a valley. A suffix with a "u" such as "*um*" would indicate a palisade or earthwork. Lemmon suggests the text could be spelled incorrectly and could either mean ravine or steep bank. See C. H. Lemon, *The Field of Hastings* (Heathfield, UK: Errey's Printers Ltd. 1970), 52.
7. *Frequentium* can be of high density, a large amount or frequent use. *Fossarum* refers to a ditch but it could also refer to an embankment, dike, trench or moat.
8. *Adversitate* indicates something is hostile. *Impedita* suggests difficulty or to reduce movement. This term implies hostile place that was difficult to traverse.
9. The phrase appears to suggest an old hill or earthwork. According to Lemmon, this term "may also mean an old mud wall or ancient causeway." See Lemmon, *The Field of Hastings*, 52.
10. *Apuldran* means apple tree and *haran* indicates that it was grey, hoary or old. See Angus Cameron, Ashley Crandell Amos, and Antonette DiPaolo Healey, *Dictionary of Old English: A to G Online*. (Toronto: Dictionary of Old English Project, 2007). The original Old English text is from Cubbin's edited version of ASC (D). G. P. Cubbin, ed., *The Anglo-Saxon Chronicle: A Collaborative Edition* (Vol. 6) (Cambridge: D. S. Brewer, 1996), 80.
11. This word does not appear to indicate a forest but instead underwood or scrub for pasture, hunting or fuel.
12. *Non* means negative. The next term is defined as cultivation, crops or ploughland, however, it could also mean care, costume, or religion.
13. With the word *montis*, *summo* indicates highest summit.

Table 3: Location Terms from Documents written in the Twelfth Century

BA		BR	GR
Battle (<i>Bellum</i>) (3) Hedgland (<i>Hechelande</i>) hill (<i>collis, collem</i>) ¹ (2) natural clef (<i>naturali telluris hiatu</i>) ² valleys (<i>convalles</i>) waste ground (<i>vastitate</i>) ³ rivulets / river (<i>rivus, fluvii</i>) ⁴ deep pit (<i>baratrum</i>) ⁵		Battle (<i>Bellum</i>) (2) hill (<i>collem</i>) (2)	knoll (<i>tumulo</i>) ⁶ lower ground (<i>vallem</i>) slope (<i>acriter ad superiora nitentes</i>) ⁷ precipitous ditch (<i>fossatum quoddam preruptum</i>)
HA	JW	OV	RR
ditch (<i>foueam</i>) ⁸ (2) Battle (<i>Belli</i>) (2) flat land (<i>planis</i>) ⁹	Nine miles from Hastings (<i>nouem miliaris ab Heastinga</i>) narrow place (<i>arto in loco</i>)	Senlac (2) Ancient rampart (<i>antiquum aggerem</i>) Broken rampart (<i>praerupti valli</i>) Ditches (<i>frequentium fossarum</i>)	open country (<i>champaigne</i>) ditch (<i>fossé</i>) (4) ¹⁰

Notes to Table 3.

1. This term has been translated as hill but in general it appears to mean a collar or neck.
2. Natural and not man-made. The second term, *telluris*, refers to land. The main Latin word for land, *terra* has an extensive description as well. The final word, *hiatu* refers to an opening.
3. This term indicates destruction and waste land.
4. *Rivus* refers to flowing water but in particular a river bank, waterway or stream. *Fluvii* could be a river or a flood.
5. *Baratrum* is a religious reference to a pit or Hell.
6. This term could mean a tomb or internment.
7. *Acriter* indicates something is fierce, severe or harsh. The next term, *ad* is a connecting word. *Superiora* was defined above. *Nitentes* suggests “to make violent physical efforts . . . struggle.” However, the term could also mean shining, to excel, to “be notable”, to support or “to strive”.
8. It could also mean a deep hole or pit.
9. The dictionary suggests this term indicates flat and/or open ground “level or open [land].
10. The original Old French comes from the edited version by A. J. Holden, *Le Roman de Rou de Wace* (Vol. II) (Paris: Société des Anciens, 1971), 185-6. *Champaigne* appears to indicate open land while *fossé* is a ditch. However, a *fossé* could also be a defensive feature such as a moat or a grave. It has even been used to describe a creek. See Aberystwyth University and Swansea University, *Anglo-Norman Dictionary*. Accessed May 2015. www.anglo-norman.net.

Table 4: Frequency of Terms by Category and Document

Criterion	Documents Written within 20 Years of Battle				Documents Written in the Twelfth Century							Total
	ASC	CHP	GND	WP	BA	BR	GR	HA	JW	OV	RR	
Apple Tree	1											1
Battle	1				3	2		2				8
Elevation		7		4	3	2	2			1		19
Hechelande					1							1
Senlac										2		2
Terrain		2	1	4	3		2	3	1	2	4	22
Wood		5		2	1							8
Total	2	14	1	10	11	4	4	5	1	5	4	61

As previously indicated, terrain was the most common concept cited in the literature, with 22 occurrences in the texts analyzed. The graphic representation associated with this variable was determined by first calculating the slope and Pennock landscape classification for the DEM of the Hastings and Battle areas. The slope function was run on the Pennock classification to indicate where the landscape was changing the most. It was assumed that more change would imply a rougher terrain as suggested in the sources. Both the slope and transformed Pennock maps were standardized to a scale of 0 to 1 using a linear transformation as benefit attributes, which means higher values equal higher benefit.²⁰ The standardized maps were then combined by adding them together as the terrain map. This way the roughest, steepest areas would have a value close to 1 and the least rough or flattest areas would have a value close to 0. The terrain map was then standardized as a benefit attribute.

The second most important concept related to topography is elevation (frequently described as proximity to a hill). This concept appeared a total of 19 times in the texts. For the analysis, its value was determined by directly standardizing the DEM as a benefit attribute.

In order to operationalize the woodland variable, the local land uses were investigated to identify forested as well as open areas where the battle was likely fought. The data for the historical land use map came from historical maps and East Sussex's historical environmental record (ESHER). The ESHER is a GIS database that records the historical period of every landscape feature in the area.²¹ As a criterion, proximity to woodland occurred eight times in the texts and was based on a land use map. This variable was considered as a linear cost attribute, which means the standardized values near 1 were assigned to lower values.²² In terms of the land uses, by carefully examining later land uses and errors associated with them,²³ workable land use maps were generated for the Hastings and Battle areas, respectively (see Figures 4 and 5).

For the broader Hastings area, it has been generally assumed that approximately 80 percent of the 1086 acreage as recorded in the *Domesday Book* was still considered arable land

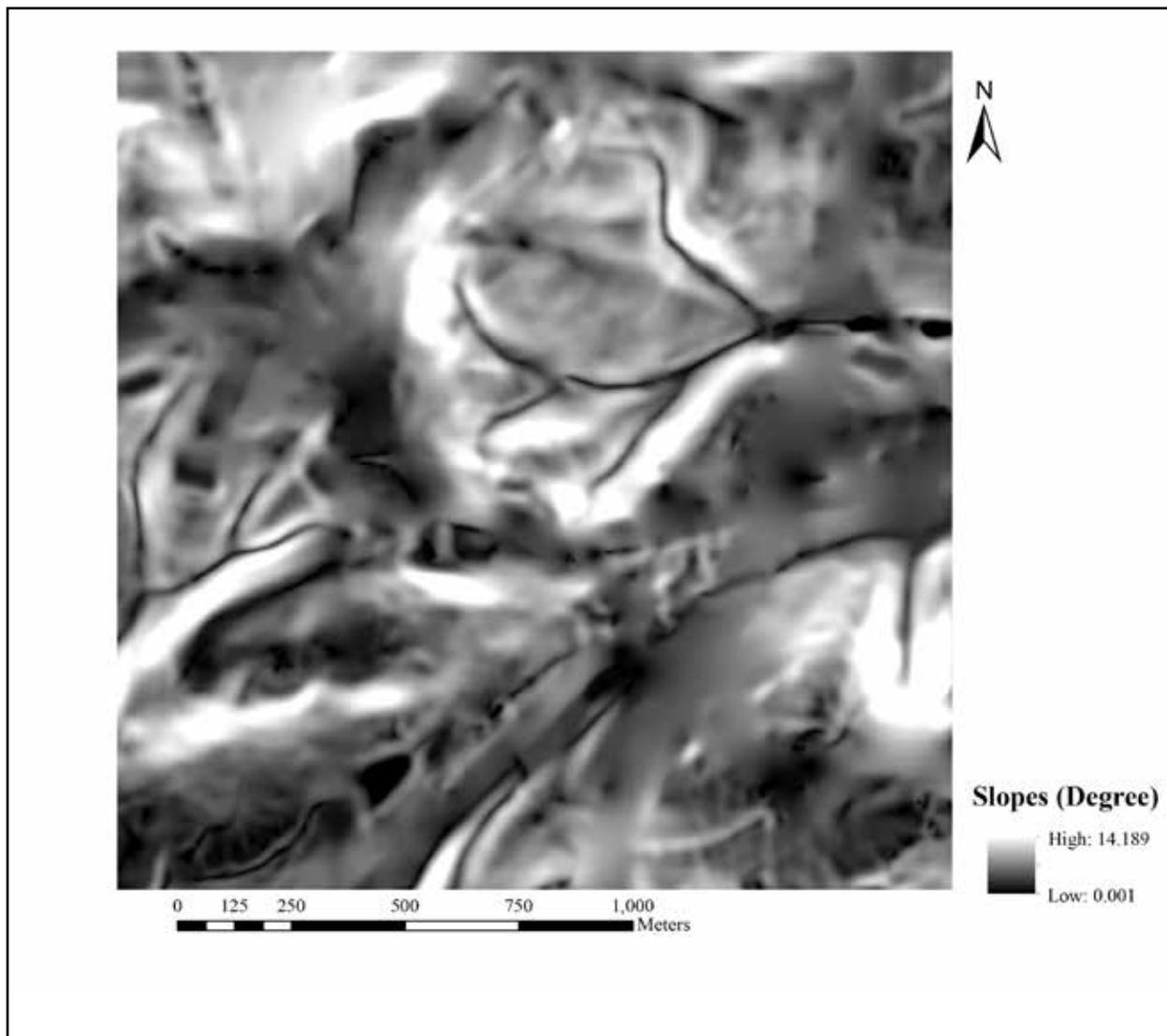


Figure 2: Battle Area Slope Map in Degrees at 5 m Resolution.

in 1914.²⁴ This knowledge provides a starting point from which the medieval land use can be deduced. However, these data represent only an approximation, as the actual ratio of arable land from 1086 to 1914 would have varied throughout the region with the value lower in the wooded area north of Battle, known as the Weald.

The land uses presented in Figure 4 consist of coastal, fieldscapes (crop land), and woodland. The coastal land use would have consisted of beaches and extensive marshes or tidal flats. It has been estimated that both the Pevensey and Rye areas were extensive salt or freshwater marshlands with river channels throughout.²⁵

In terms of woodland, according to the authors of the *Victoria History of the County of Sussex* (V.C.H.), the woodland would have stretched along a piece of land known as the “Forest Ridge” from northeast of Hastings to the far side of the county. Several existing forests are considered the last vestiges of the original forest.²⁶

For the Hastings area, as presented in Figure 4, a number of techniques were used to estimate the extent of woodland around the time of the Battle. One method was to examine the areas labeled as parks. These areas were classified as designed landscapes in the ESHER although a review of the entries in the V.C.H. *Sussex* I and IX was required before labeling them woodland.

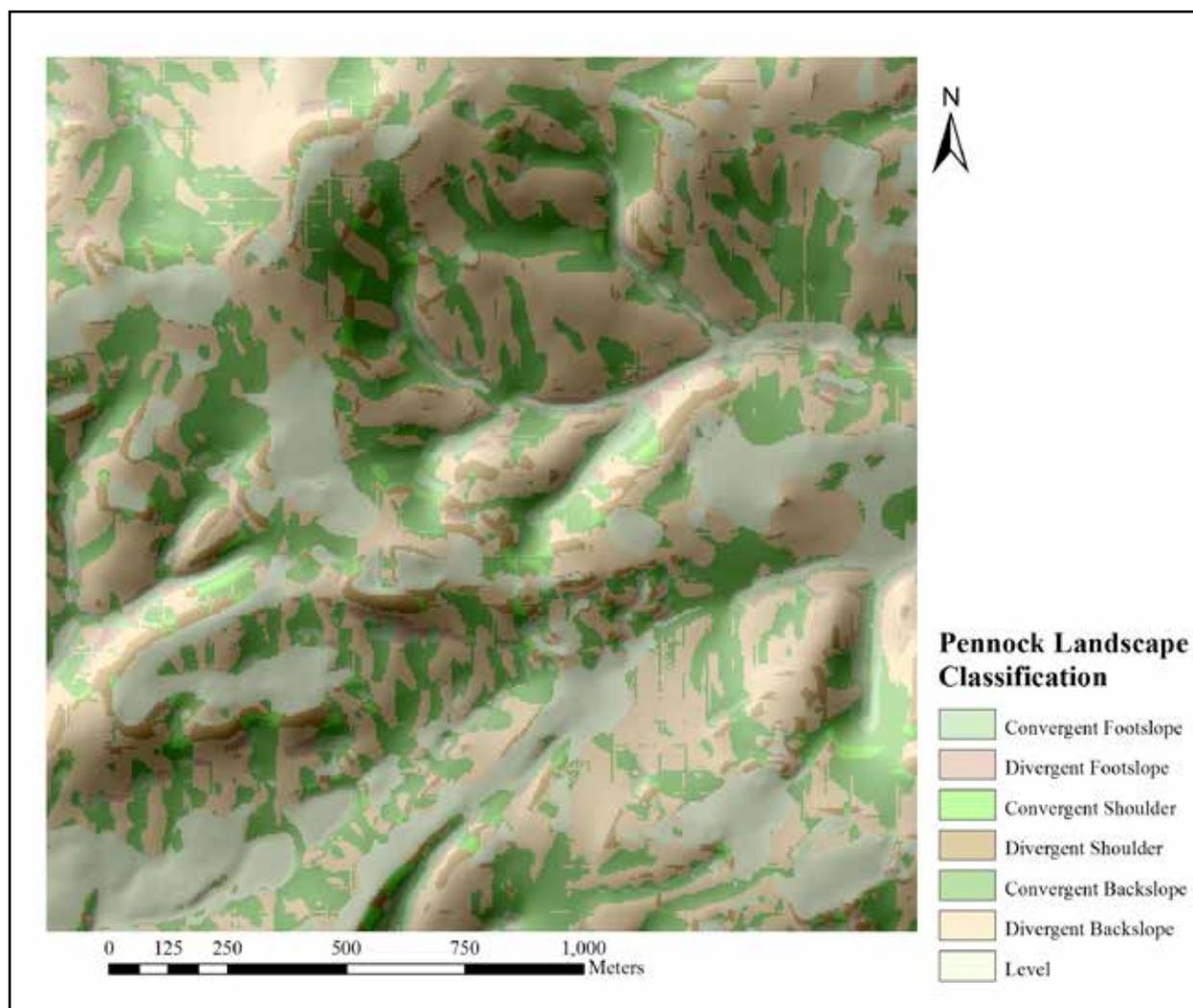


Figure 3: Battle Area Pennock Landscape Classification with Shaded Relief at 5 m Resolution.²⁷

An additional method of classifying woodland was through the ESHER areas classified as assarts.²⁸ The term assart is Middle English, and means forest cleared for agriculture.²⁹ Approximately 86 percent of the areas listed as assarts in the ESHER database were dated to the medieval period (1066 to 1499) with none dated before 1066.³⁰ Therefore, they were begun after 1066. Thus, by including areas designated as assart, in addition to the areas already classified as woodland, a sense can be achieved from Figure 4 of how extensive the woodland might have been when William arrived in the Hastings area.

Overall, the land uses in the Battle area, as reproduced in Figure 5, consisted of woodland, and fieldscapes. The woodland tended to be on the marginal sections of the landscape such as the small valleys or on the steeper slopes.³¹ The remainder of the landscape was fieldscapes. One historian has indicated that the original hill would have been covered in local grasses.³² This finding is consistent with claims by a battlefield archaeologist who indicated that battles in the medieval world and before occurred in open fields with few if any impediments to the conflict.³³ In all probability then, this reconstruction was the landscape that Harold and William would have seen when they arrived in 1066.

The remaining variables required somewhat less analysis and were more easily operationalized as they refer to specific locations in the regions. For example, references to

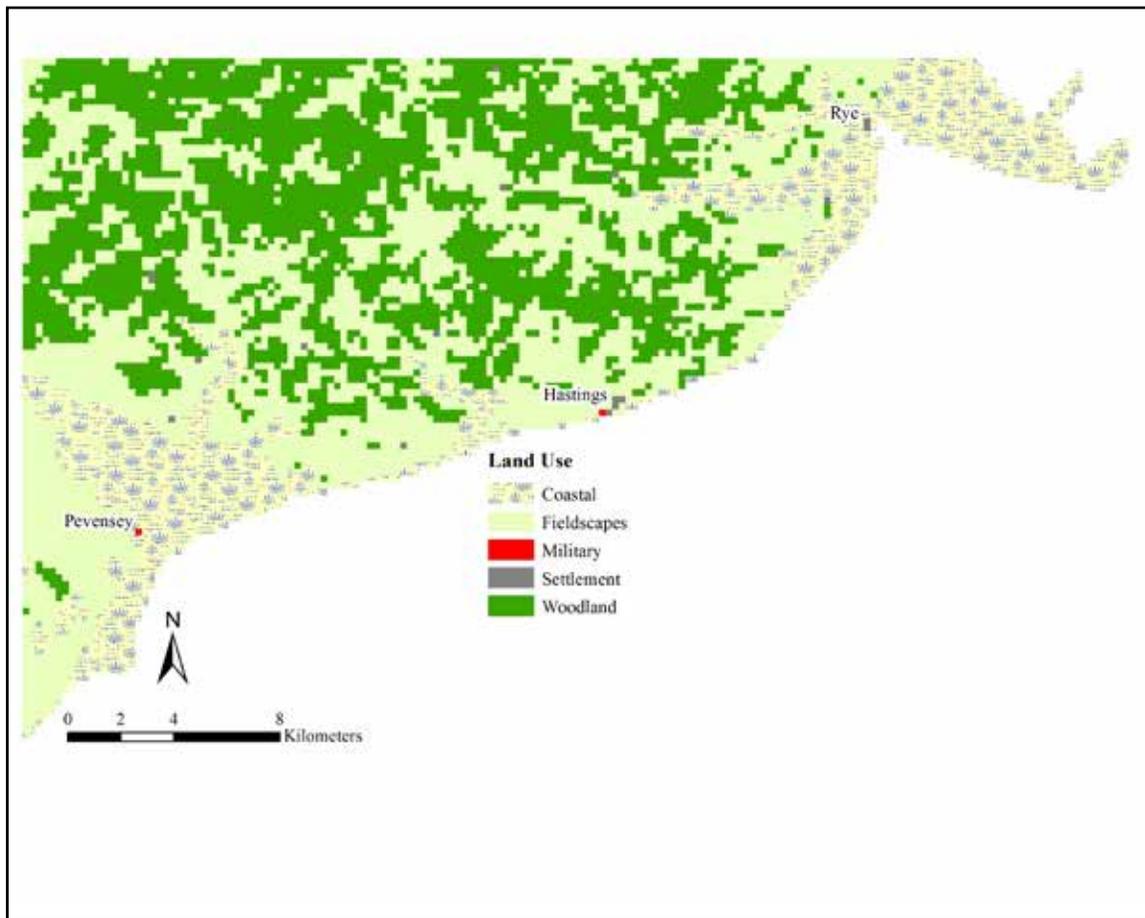


Figure 4: Estimated Hastings Area Land Use in c. 1066.³⁴

proximity to Battle Abbey occur eight times, which promoted its importance (cost attribute).³⁵ The abbey was the only location recorded by the writers that is still known today. The “proximity to Senlac” factor was calculated as a stream network using the method as defined by Lindsay³⁶ solely for the Battle DEM (cost attribute). The locations of Hechelände and the apple tree were estimated from discussions in the literature and the sources themselves (cost attributes). A final factor regarding the battle is that it was fought on open land as mentioned by Wace. This factor is integrated into the model as a true/false variable with the fieldscapes labeled as “1” and all other areas as “NoData.” Therefore, only open areas were selected as the possible battle site.

Criterion Weights

In assessing the more likely sites of the battle based upon the confluence or colocation of these key variables, one might simply apply a face-value cumulative model. As was observed in Table 4 above, however, certain criteria were more important in the description of the battle than others. In addition, the totals presented in the table are based on the counts in each document that could include bias in favour of one description over another (for example, one source might include most of the references to “woodland”). In order to minimize potential bias, the documents from which the categories were drawn were first weighted by their time period and origin. For example, sources written closer to the time of the battle were given higher weights than those published significantly later. Specifically, a weight of 50 percent (.50) was selected for all sources within 20 years of the battle, and the remaining 50 (.50) percent for documents

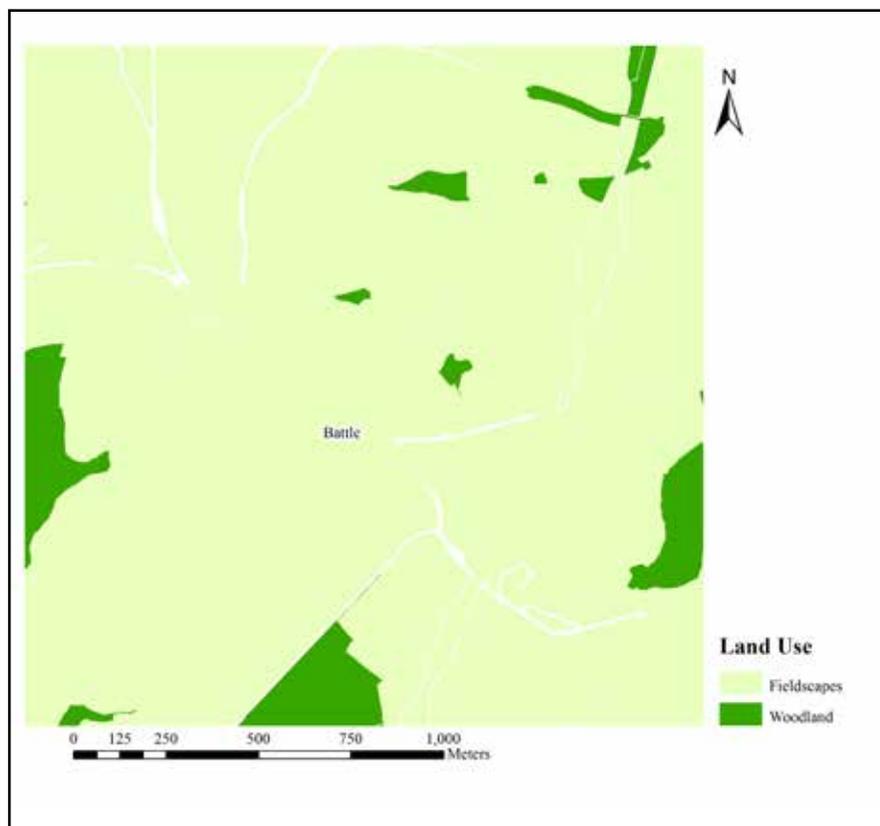


Figure 5: Estimated Battle Area Land Use in c. 1066³⁷

written in the twelfth century. Of the sources written within 20 years of the battle, they were either English or Norman based. To account for this fact in the model, each side (i.e. English or Norman) was assigned equal weighting, at 25 percent. Specifically, of the four documents written within in this period, one was English while the others were attributed to the Normans and their allies. Therefore, the value for the ASC (of English origin) was 0.25 or 25 percent while the three Norman chroniclers were weighted at 0.083 each totaling to 0.25 or 25 percent. The twelfth century accounts were all Anglo-Norman based. As there were seven Anglo-Norman accounts, they were weighted at 0.071 or 50 percent in total.

These source weights were then multiplied by the respective values in Table 4 and summed by criterion in Table 5 (column 2). Columns 3 and 4 contain the variable weights for the two distinct MCDA analyses to be undertaken in the sections that follow: the first to examine the viability of all proposed sites within the context of the broader region (the Hastings area), and the second for a more focused analysis of the leading site contenders in the area more immediately proximate to the Battle Abbey site. For the Hastings area, only those four variables with more tangible locational value were selected. For the more detailed Battle model, the three remaining, more abstract variables were also included. These include the apple tree as mentioned in the ASC as well as Hechelande from the BA and Senlac as recorded by OV.

Model Evaluation

General Location of the Battle over the Hastings Area

Based upon the criterion maps and weights developed in the previous sections, the MCDA for the Hastings area was calculated and is depicted in Figure 6, which also includes local non-

agricultural land uses (from Figure 4). Specifically, the MCDA provides a graphic representation of the region with color coding to show areas with a high, or alternatively low degree of fit with the locational criteria.

Figure 6 indicates that the most likely locations for the battle (as indicated by a darker shade of brown) were along the ridge running northwest up from the coast and particularly along the eastern side of the ridge. The four locations identified in the literature as potential battle sites are marked with "X"s on the map, with Battle Hill labeled as the traditional site. All are positioned along a ridge in areas of higher locational probability.

This map, however, represents only one set of weights. By applying different weights, such as an equal weight across all sources (0.250) or a higher weight for one variable (0.4) with the others kept at a set weight (0.2) then five other scenarios may be created. The average of all of these various permutations is presented in Figure 7. In the end, Figure 7 reaffirms the findings of Figure 6, indicating that a site along the ridge was the most likely for the battle.

As a further test, the initial findings were further recalculated based upon the standard deviation of the weighted results at each pixel. The results are presented in Figure 8, which demonstrates that the proposed sites remain in areas of higher probability, but also subject to a slightly higher degree of locational variability.

All in all, then, the figures tend to support all of the existing locational proposals as to where the battle took place. There are however, sound historical reasons to discount at least two of the four possibilities. In this study the alternative sites suggested by Austin and Tyson do not withstand historical academic scrutiny. In regards to the site proposed by Austin, he contends the Norman army was camped at Wilting manor and that the battle took place at Crowhurst.³⁸ Crowhurst is approximately two and a half kilometers south of Battle. There are, however, a number of arguments that have been presented that contradict this view. For example, Austin asserts that Crowhurst is "*Herste*" as mentioned in *BA*.³⁹ Yet, a few pages later, in the *BA*, Crowhurst is mentioned as "*Crohurste*."⁴⁰ *The Place-Names of Sussex*⁴¹ and the *V.C.H.*⁴² both confirm that Crowhurst was named Croherst or Crohurst in the eleventh and twelfth centuries. Thus, they cannot be the same place.⁴³ The main argument against this site, however, is that it "is simply too close to the Norman camp" for William to have allowed combat to take place. Therefore, this site can likely be discounted.⁴⁴ The fourth site, proposed by Tyson, is located approximately four kilometers to the northeast of Battle. Tyson published her own translation and commentary on the *CHP*, which she titled the "*Carmen de Triumpho Normannico*." She labels Sedlescombe as the site of the battle.⁴⁵ However, there are number of concerns about the reliability of this study with respect to its interpretation of the campaign. For example, other studies such as the *V.C.H.*⁴⁶ or Brandon⁴⁷ do not support the presentation of the local geography in Tyson's book.⁴⁸ Brandon's study, which would be the closest in supporting Tyson's interpretation, indicates the area was settled by the *Haestingas* tribe but does not call the area *Haestingas* or *Pevenisel*⁵³ as does Tyson.⁵⁴ Additionally, upon searching the name Pevensey in *The Place-Names of Sussex*, *Pevenisel* was among the historical names for the region, hundred and site of Pevensey.⁵⁵ Therefore, the area slightly north of the Brede basin that she has labeled as *Pevenisel* is incorrect. Furthermore, the Norman chroniclers do not mention either Winchelsea⁵⁶ or Rye, which they would have had they landed where Tyson suggests. Most importantly, the lack of references and limited consideration of other scholars leads one to question the credibility of Tyson's study.⁵⁷

Given the historical and locational inconsistencies associated with the third and fourth options, arguably this leaves just two sites as the most likely site for the Battle of Hastings. The question remains, however, as to whether both of these pass scrutiny when re-examined at the local level and subject to the application of all seven available criteria.

Table 5: Total Score and Weights by Factor

Criterion	Sum	Hastings Area Weight	Battle Area Weight
Apple Tree	0.250	-	0.050
Battle	0.750	0.165	0.150
Elevation	1.488	0.327	0.297
Hechelande	0.071	-	0.014
Senlac	0.143	-	0.029
Terrain	1.655	0.364	0.330
Wood	0.655	0.144	0.131
Total	5.012	1.000	1.000

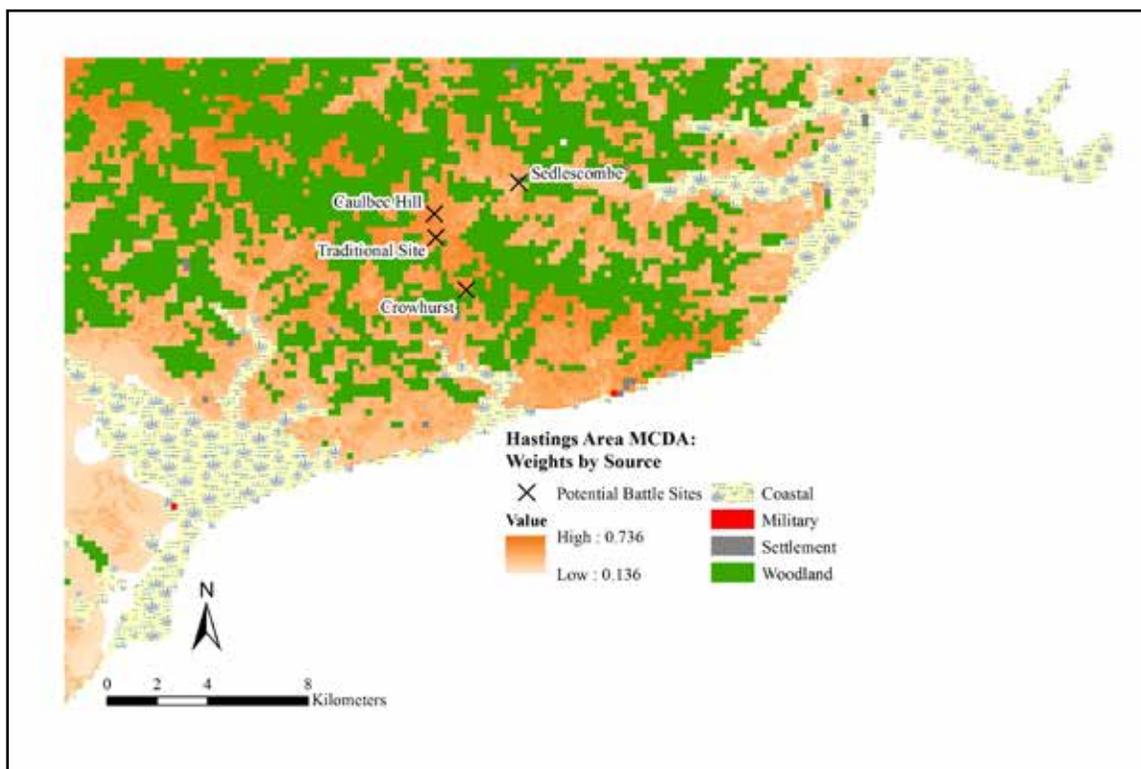


Figure 6: Battle Site in Hastings Area – MCDA Weighted by Source at 50 m Resolution (c. 1066).⁴⁹

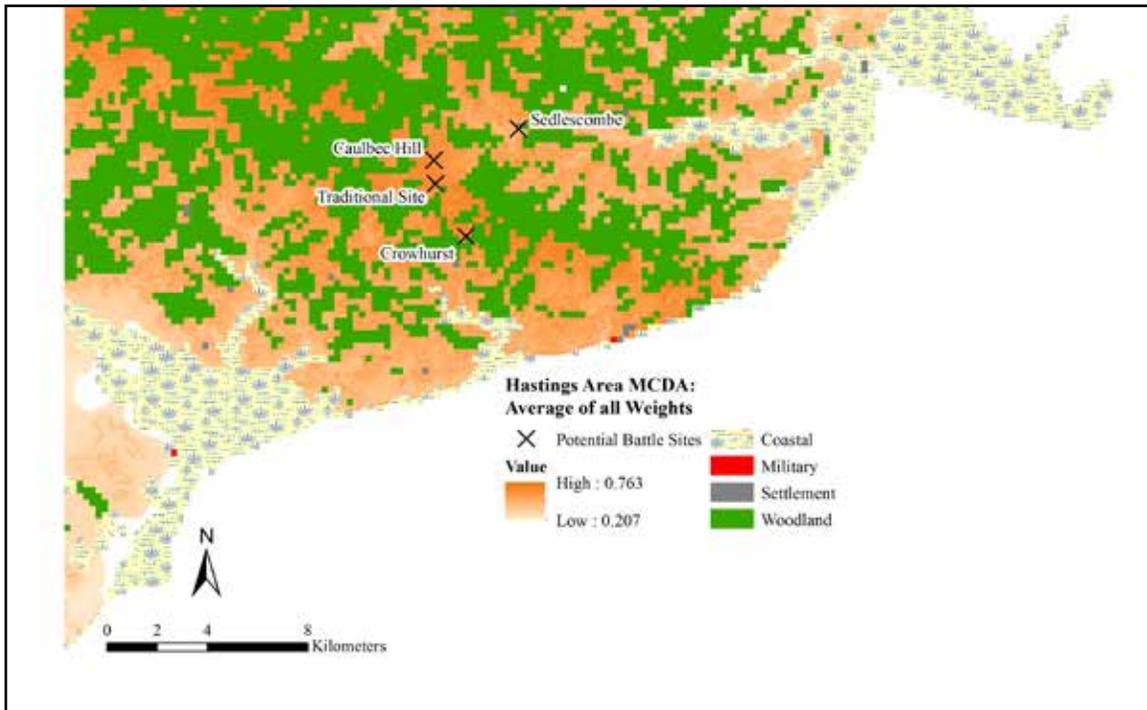


Figure 7: Battle Site in Hastings Area – MCDA Average across all Weights at 50 m Resolution (c. 1066).⁵⁰

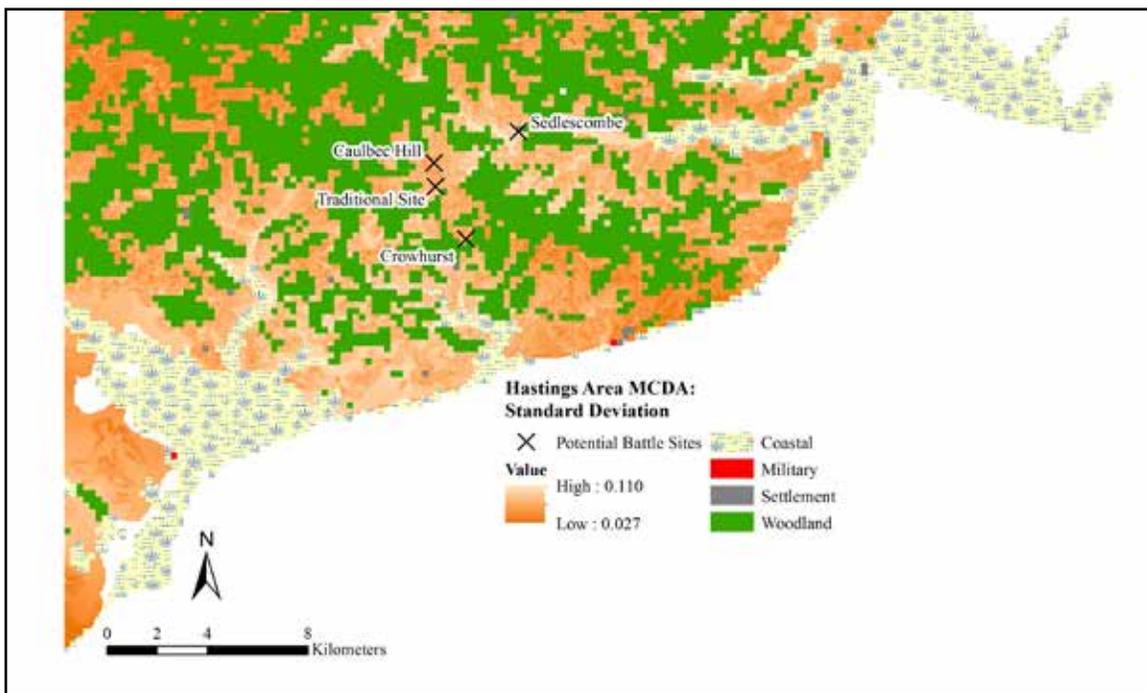


Figure 8: Battle Site in Hastings Area – Standard Deviation of MCDA Results at 50 m Resolution (c. 1066).⁵¹

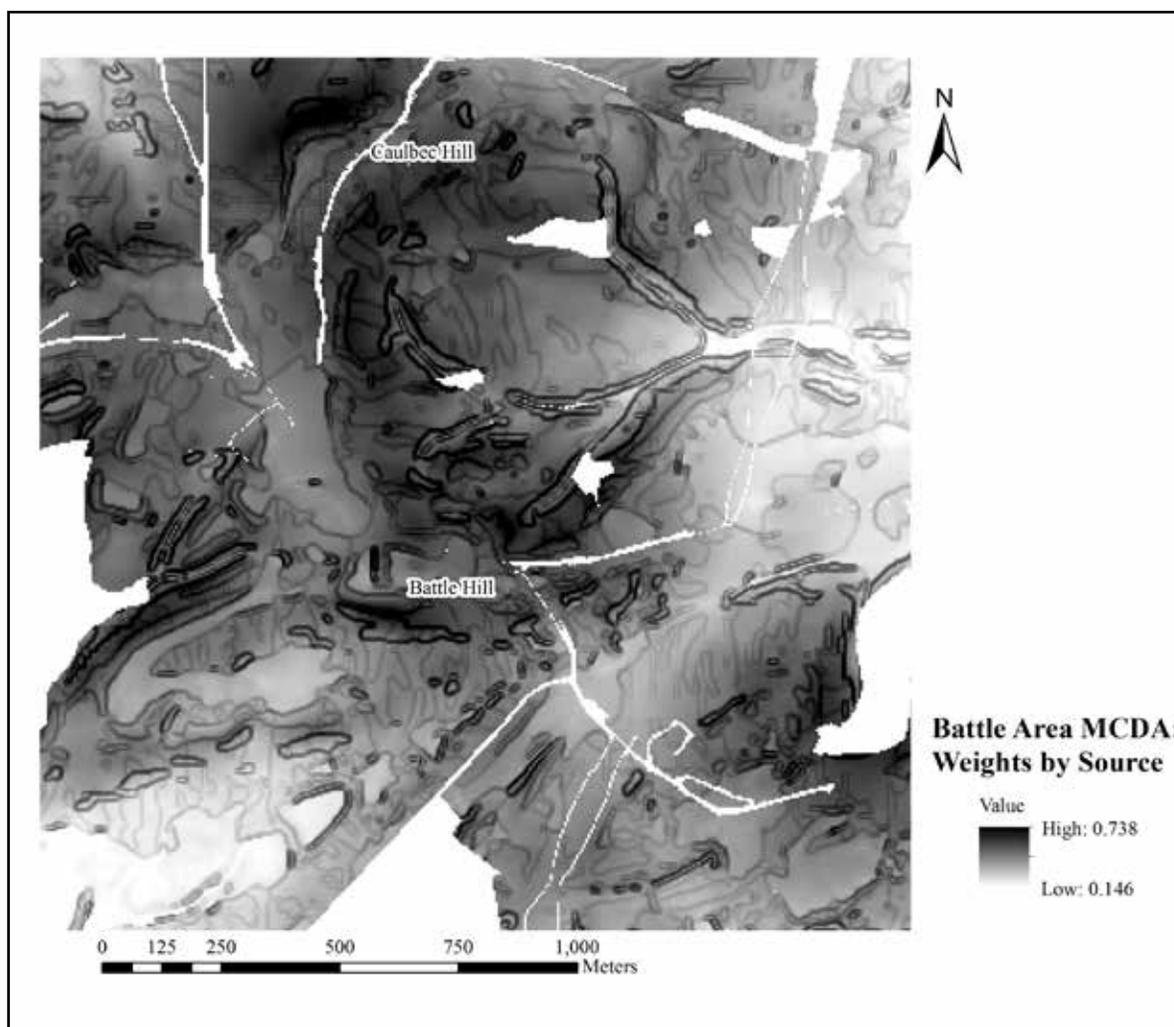


Figure 9: Battle Site in Battle Area – MCDA Weighted by Source at 5 m Resolution (c. 1066).⁵²

Location of the Battle in the Battle Area

To address this question, the results of the MCDA model specific to the Battle area, where both the Caulbec and Battle Hill site are located, are presented in Figure 9, which depicts the results based on variable weights for the sources taken from Table 5. The figure indicates that the highest values on the map, and hence the area most likely for the engagement to have occurred is just to the north of the official site Battle Hill, and in fact, is in close proximity to the site identified by Grehan and Mace, known as Caulbec Hill.⁵⁹ The map further indicates several smaller areas to the west, east and north of Battle Hill as possible locations, none of which, however, has been postulated in historical or other writings as possible battle sites.

Here again, however, these results are based on one set of weights. By considering multiple sets of weights (equal set at 0.143 or one variable set at 0.4 with others equal 0.1), a more comprehensive model for predicting the location of the battle may be generated.

Figure 10 presents the average of nine possible outcomes generated using the selected weights. This finding once again confirms the viability of the alternative site, Caulbec Hill, as postulated by Grehan and Mace.⁶⁰ Finally, Figure 11, which presents the analysis based on a standard deviation of the results per pixel, again supports the site identified above with low variations noted in that area.

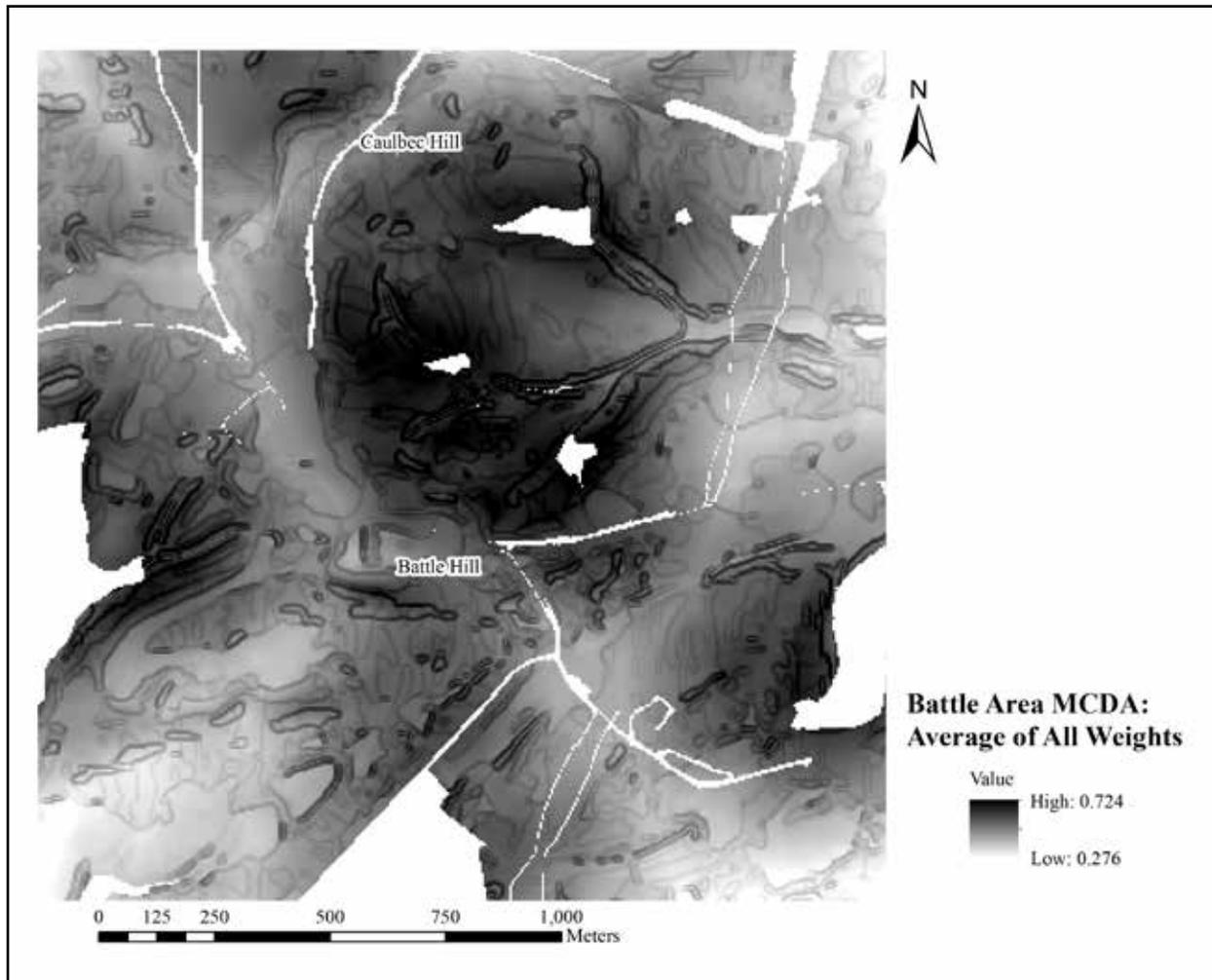


Figure 10: Battle Site in Battle Area – MCDA Average across all Weights at 5 m Resolution (c. 1066)⁵⁸

In conclusion, the findings presented above do certainly confirm Battle Hill as a possible site of the Battle of Hastings. Perhaps more importantly, however, they provide additional support not only for the existence of, but the enhanced likelihood of an alternative site just to the north at Caulbec Hill.

Discussion and Sources of Error

Given the obvious implications of this finding for the historical record, questions may arise as to the accuracy of the model as depicted in Figures 6 to 11. Some of this may relate to the assumptions on which variable placement has relied. For example, it was assumed the grey apple tree was on Caulbec Hill and Hechelande was on Telham Hill. However, this assumption may have not been the case and as such these variables are abstract and not definitive. Another factor that could influence the results is the standardization of the criterion maps. In these models, the criterion maps were standardized with a linear transformation. However, as Malczewski discusses, there are additional standardization methods such as non-linear calculations that could have been employed. In these approaches, certain variables could have been enhanced or suppressed.⁶² For example, if it were known at what angle medieval warhorses could not charge up, those areas

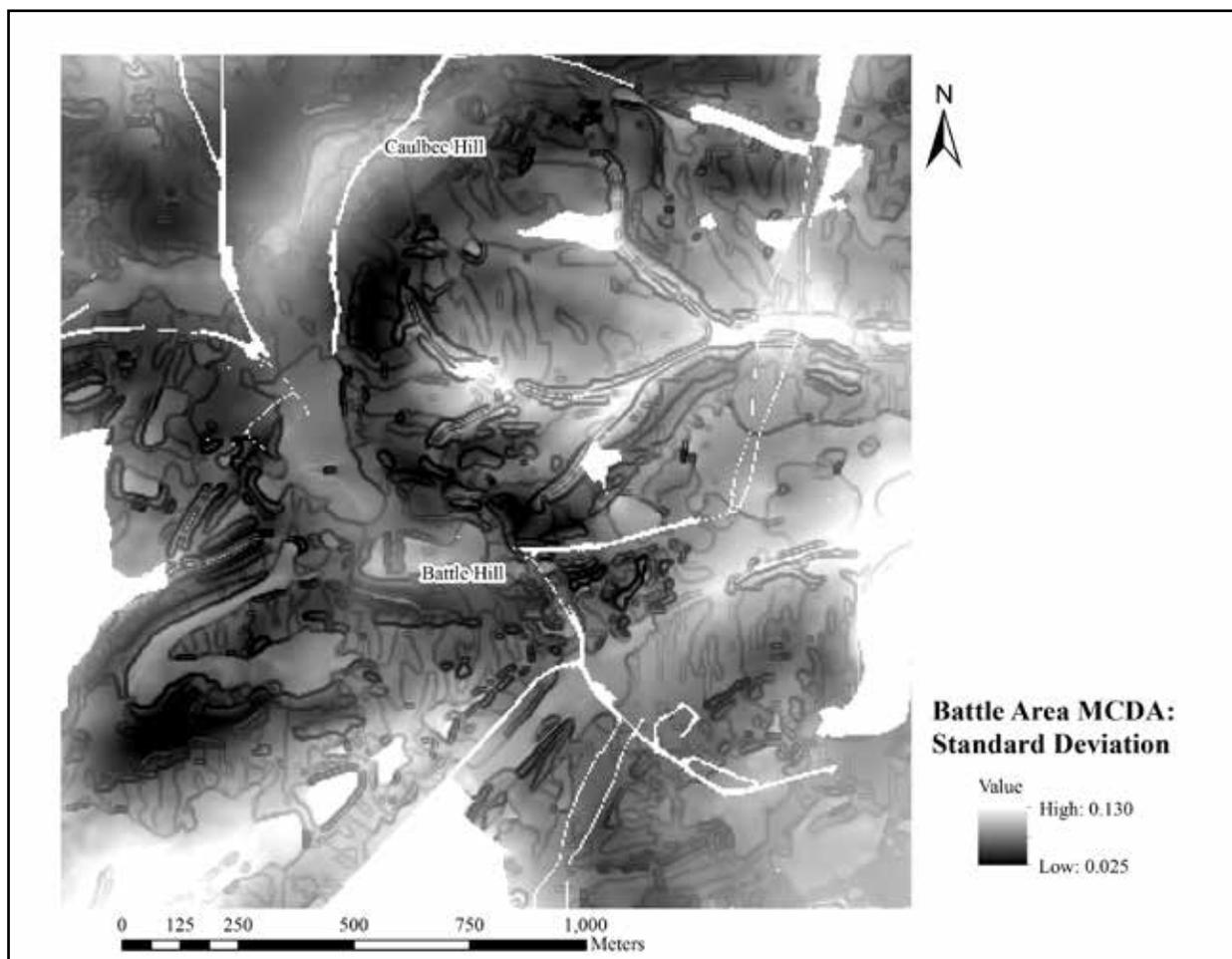


Figure 11: Battle Site in Battle Area – MCDA Standard Deviation at 5 m Resolution (c. 1066)⁶¹

could have been minimized in the model.⁶³ Therefore, with a different standardization method, there is a potential that different areas could have been selected as possible sites of the battle.

In addition, the placement of Battle Abbey would in and of itself seem to rule out Caulbec Hill as an option, again suggesting model error. The fact is, however, that the construction of Battle Abbey was not begun until several years after the battle in the early to middle 1070s. The first abbot did not arrive until 1076, ten years after the fact.⁶⁴ Furthermore, in the *BA*, the monks debate the site of the abbey despite King William's firm insistence on the location of the battlefield. Specifically, according to the *BA*, the monks complained:

that the place where he [William] had decided to have the church built was on a hill (*colle*), and so dry of soil (*gleba*),⁶⁵ and quite without springs (*aquarum*),⁶⁶ and that for so great a construction a more likely place nearby should be substituted... [This decision was also made because of] the lack of water...[and] stone (*lapides*) fit for building.⁶⁷

However, William insisted on the site and promised a large amount of wine for the monks and plenty of stone from Normandy for construction. Although, in a twist of fate through a vision, the

monks “found such a supply of good stone (*lapidum*) that it was quite apparent that the Lord had laid up a hidden treasure of stone (*lapidem*) . . . for the predestined work.”⁶⁸ However, given the political climate in the period following Hastings, it is uncertain as to how much of a priority the founding of the abbey was for William.⁶⁹ Furthermore, there is some debate about the authenticity of the documents on which the *BA* is based.⁷⁰ Therefore, the abbey may have been built on the site for a number of reasons as opposed to being built on the actual site of the battlefield.

Conclusion

Based upon the geographic analysis undertaken in this study, a number of important findings have been presented, each of which speak directly to claims made in the existing historical literature on the Battle of Hastings. To begin with, the broader Hastings area model indicated that the battle was indeed likely fought in the area around the town of Battle, as virtually all observers have suggested. When the viability of the four current proposed sites is subject to further historical validation, however, only two sites remain possible contenders. Of these, the Battle area MCDA suggests that the site overwhelming affirmed in the literature as the sole battle venue is indeed a possible candidate. At the same time, however, and in contradiction to the vast majority of historical accounts, the analysis clearly positions Caulbec Hill as the most likely site of the Battle.

This finding has significant implications for the field of medieval history as it has always been assumed in academic circles that the battle was fought on Battle Hill. In effect, the finding lends at least some support to those few accounts that have dared to suggest alternatives, particularly that undertaken by Grehan and Mace.⁷¹ This will hopefully reopen the debate regarding the site of the Battle, and lead to further research on this critical question.

More broadly, the study has shown unequivocally the value of applying transdisciplinary approaches to issues and challenges that have in the past been investigated in purely disciplinary terms. In this case, geographic analysis, based on both quantitative data and data derived from qualitative historical sources, has in effect forced a reconsideration and reconceptualization of an historical question that was believed to be long settled within the literature. Hopefully this study will encourage further challenges across the disciplinary array.

NOTES

1. M. K. Lawson, *The Battle of Hastings: 1066* (Stroud, UK: Tempus Publishing, 2003), 18.
2. Michael Swanton, trans., *The Anglo-Saxon Chronicle* (New York: Routledge, 1998), 194-5, 197.
3. R. Huscroft, *The Norman Conquest: A New Introduction* (Harlow, UK: Pearson Education Limited, 2009).
4. Christopher Gravett, *Hastings 1066: The Fall of Saxon England* (Oxford: Osprey Publishing, 1992).
5. Lawson, *The Battle of Hastings*.
6. Stephen Morillo, *The Battle of Hastings: Sources and Interpretations* (Woodbridge, UK: The Boydell Press, 1996).
7. J. Bradbury, *The Battle of Hastings* (Stroud, UK: Sutton Publishing Ltd., 1998).
8. John Grehan and Martin Mace, *The Battle of Hastings 1066-The Uncomfortable Truth: Revealing the True Location of England's Most Famous Battle* (Barnsley, UK: Pen & Sword Books Ltd., 2012).
9. H. H. Wood, *The Battle of Hastings: The Fall of Anglo-Saxon England* (London: Atlantic Books, 2009).
10. Bradbury, *The Battle of Hastings*, 132-5; Grehan and Mace, *The Battle of Hastings 1066*, 148-51.

11. Grehan and Mace, *The Battle of Hastings 1066*, 118-119.
12. Kathleen Tyson, trans. *Carmen de Triumpho Normannico: The Song of the Norman Conquest. Granularity*, 2014, lxii-iii.
13. R. E. Latham, D. R. Howlett, and R. K. Ashdowne, *Dictionary of Medieval Latin from British Sources*. II vols. (Oxford, UK: Oxford University Press, 1975-2013).
14. Aberystwyth University and Swansea University, *Anglo-Norman Dictionary*. Accessed May 2015. www.anglo-norman.net.
15. Angus Cameron, Ashley Crandell Amos, and Antonette DiPaolo Healey, *Dictionary of Old English: A to G Online*. (Toronto: Dictionary of Old English Project, 2007).
16. J. R. Clark Hall, *A Concise Anglo-Saxon Dictionary*, 4th ed. (Cambridge: Cambridge University Press, 1960).
17. This map is based on the study area digital elevation model (DEM). See Stanfords Business Mapping, *Digital Terrain Model 5 Metre – DWG* (Manchester, UK, 2009) and the Yeakell & Gardner map (1783). ©West Sussex Records Office available on Old Sussex Mapped website. http://www.envf.port.ac.uk/geo/research/historical/webmap/sussexmap/Yeakell_36.htm.
18. Stanfords Business Mapping, *Digital Terrain Model 5 Metre - DWG*.
19. D. J. Pennock, B.J. Zebarth, and E. de Jong, "Landscape Classification and Soil distribution in Hummocky Terrain, Saskatchewan, Canada," *Geoderma*, 40 (1987): 297-315. The Pennock landscape classification analyzes a DEM based on whether it is convergent or divergent or level. The model also indicates if the terrain is the backslope, shoulder or footslope, 303.
20. Standardized value= (value-minimum value)/(range of values). This equation ensures higher values have a standardized score close to 1. See Jacek Malczewski, *GIS and Multicriteria Decision Analysis* (New York: John Wiley & Sons, Inc., 1999), 118.
21. East Sussex County Council, *East Sussex Historical Environment Record (ESHER)* (Lewes, 2013).
22. Standardized value= (maximum value-value)/(range of values). This equation ensures lower values have a standardized score close to 1. See Malczewski, *GIS and Multicriteria Decision Analysis*, 118.
23. P. D. A. Harvey, "Mapping the Village: The Historical Evidence," in Della Hooke, ed., *Medieval Villages* (Oxford: Oxford University Committee for Archaeology, 1985), 33-45.
24. Leonard Cantor, "Introduction: The English Medieval Landscape," in Leonard Cantor, ed., *The English Medieval Landscape*, (Philadelphia: University of Pennsylvania Press, 1982), 17. It was also indicated that the proportions of arable were higher in the Sussex plains, 17.
25. Brian Moffat, "The environment of Battle Abbey estates (East Sussex) in medieval times: a re-evaluation using analysis of pollen and sediments" *Landscape History* 8 (1986): 84-85. Scott Timpany, *Geoarchaeological Regional Review of Marine Deposits along the coastline of Southern England* (English Heritage, 2009): 32-34. A historical map depicting the area in the sixteenth century is located at: <http://www.bl.uk/onlinegallery/onlineex/unvbrit/a/001co-taugi00001u00017000.html>.
26. L. F. Salzman, ed., *The Victoria History of the County of Sussex* (Vols. I and IX) (London: University of London, 1937) Sussex I, 49-50.
27. This map was derived from the Battle area DEM. See Stanfords Business Mapping, *Digital Terrain Model 5 Metre - DWG*.
28. East Sussex County Council, *ESHER*.
29. John Field, *English Field-Names: A Dictionary* (Newton Abbot, Devon: David & Charles Ltd., 1972), 267.
30. Brandon discusses the amount of woodland in the Weald. Peter Brandon, *The Sussex Landscape* (London: Hodder and Stoughton, 1974).

31. Alan R. H. Baker, "Field Systems of Southeast England," in Alan R. H. Baker and R. A. Butlin, eds., *Studies of Field Systems in the British Isles* (Cambridge: Cambridge University Press, 1973), 263-4.
32. Bradbury, *The Battle of Hastings*, 142.
33. John Carman Patricia Carman, *Bloody Meadows: Investigating Landscapes of Battle* (Stroud, UK: Sutton Publishing Limited, 2006), 21.
34. This map is primarily derived from the East Sussex Historical Environmental Record. See East Sussex County Council, *ESHER*.
35. Factors labeled as in proximity to a location are calculated with the Euclidean distance raster function.
36. John B. Lindsay, *Tutorial 3: Streams and Watershed Extraction* (Guelph, Ont.: The Centre for Hydrogeomatics, The University of Guelph, 2010).
37. This map comes from East Sussex County Council, *ESHER*.
38. N. Austin, *The Secrets of the Norman Invasion* (Crowhurst, UK: Ogmium Press, 2012).
39. E. Searle, trans., *The Chronicle of Battle Abbey* (Oxford: Oxford University Press, 1980), 42.
40. *Ibid.*, 48; see also Austin, *The Secrets*, Chapter 64.
41. A. Mawer, F. M. Stenton, and J. E. B. Gover, *The Place-Names of Sussex: Part II The Rapes of Lewes, Pevensey and Hastings*, Vol. VII (Cambridge: Cambridge University Press, 1930), 502.
42. Salzman, *The Victoria History, Sussex IX*, 77.
43. Grehan and Mace, *The Battle of Hastings 1066*, 119.
44. *Idem.*
45. Tyson, *Carmen de Triumpho Normannico*, lxii.
46. Salzman, *The Victoria History*.
47. Brandon, *The Sussex Landscape*.
48. Tyson, *Carmen de Triumpho Normannico*, xxxvi-lxiv.
49. This map is primarily derived from East Sussex County Council, *ESHER* and Ordnance Survey, *Maps of Britain from Ordnance Survey*. Accessed February 2012. <http://www.ordnance-survey.co.uk/oswebsite/index.html>.
50. This map is primarily derived from the East Sussex County Council, *ESHER* and Ordnance Survey, *Maps of Britain*.
51. *Idem.*
52. This map is based on the study area DEM and the estimated land use for 1066 (Figure 5). East Sussex County Council, *ESHER* and Stanfords Business Mapping, *Digital Terrain Model 5 Metre - DWG*.
53. Brandon, *The Sussex Landscape*, 70, 79.
54. Tyson, *Carmen de Triumpho Normannico*, lxiii.
55. Mawer, et al., *The Place-Names of Sussex*, 327, 443.
56. Tyson translates the *De Viis Maris* - "Concerning routes by sea" as "[n]ext is Hastings . . . but there is no port there; it is seven miles distant at Winchelsea." Tyson, *Carmen de Triumpho Normannico*, lvii. Hughes' more rigorous academic accounts states however that "there is the town and castle of Hastings, though there is no port there, and it is seven miles away from Winchelsea." See Paul Hughes, "Roger of Howden's Sailing Directions for the English Coast," *Historical Research* 85 (2012): 576, 592.
57. Tyson, *Carmen de Triumpho Normannico*.
58. FIGURE 10 This map is based on the study area DEM and the estimated land use for 1066 (Figure 5). East Sussex County Council, *ESHER* and Stanfords Business Mapping, *Digital Terrain Model 5 Metre - DWG*.
59. Grehan and Mace, *The Battle of Hastings 1066*, 148-151.
60. Grehan and Mace, *The Battle of Hastings 1066*, 148-151.

61. This map is based on the study area DEM and the estimated land use for 1066 (Figure 5). East Sussex County Council, *ESHER* and Stanfords Business Mapping, *Digital Terrain Model 5 Metre - DWG*.
62. Malczewski, *GIS and Multicriteria Decision Analysis*, 116.
63. The author searched for evidence regarding the steepness of terrain which a line of horses could charge up but none was located.
64. Eleanor Searle, *Lordship and Community: Battle Abbey and its Banlieu, 1066-1538* (Toronto: Pontifical Institute of Mediaeval Studies, 1974), 21-23.
65. This term means soil however; it could also indicate church land, coal, or peat for fuel.
66. *Aquarum* suggests the presence or lack thereof of a watering hole.
67. Searle, *The Chronicle*, 43-45.
68. *Ibid.*, 45.
69. Searle, *Lordship and Community*, 21-3.
70. Bradbury, *The Battle of Hastings*, 120.
71. Grehan and Mace, *The Battle of Hastings 1066*.