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“Contours on the 6 Inch
Second Revision of County Donegal”

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The Society publishes a wide range of books and booklets on historic OS map series and its journal, *Sheetlines*, is recognised internationally for its specialist articles on Ordnance Survey-related topics.

Contours on the 6-Inch Second Revision of County Donegal **Fraser Donachie**

I recently added a couple of Ordnance Survey of Ireland 6-inch plans to my collection; County Donegal Sheets 8 and 17, featuring the rugged coastal area to the west of Fanad Head. Alas, they're not the wonderful engraved first editions from c.1836 but are instead zincographed sheets published in 1905 (the 'second revision'). Compared to the first edition, the second revision 6-inch maps depict many more field boundaries and often feature contours, marked using dotted lines at; e.g. 50 or 100 feet intervals. The contours are a significant improvement over the spot heights depicted on the first editions.

As with any new acquisition, I spent time comparing the content with today's satellite imagery, marvelling at either the change or lack of it. Whilst scrutinising these sheets I noticed a strange anomaly; each of the contours ends in a '7', see *Figure 1*.

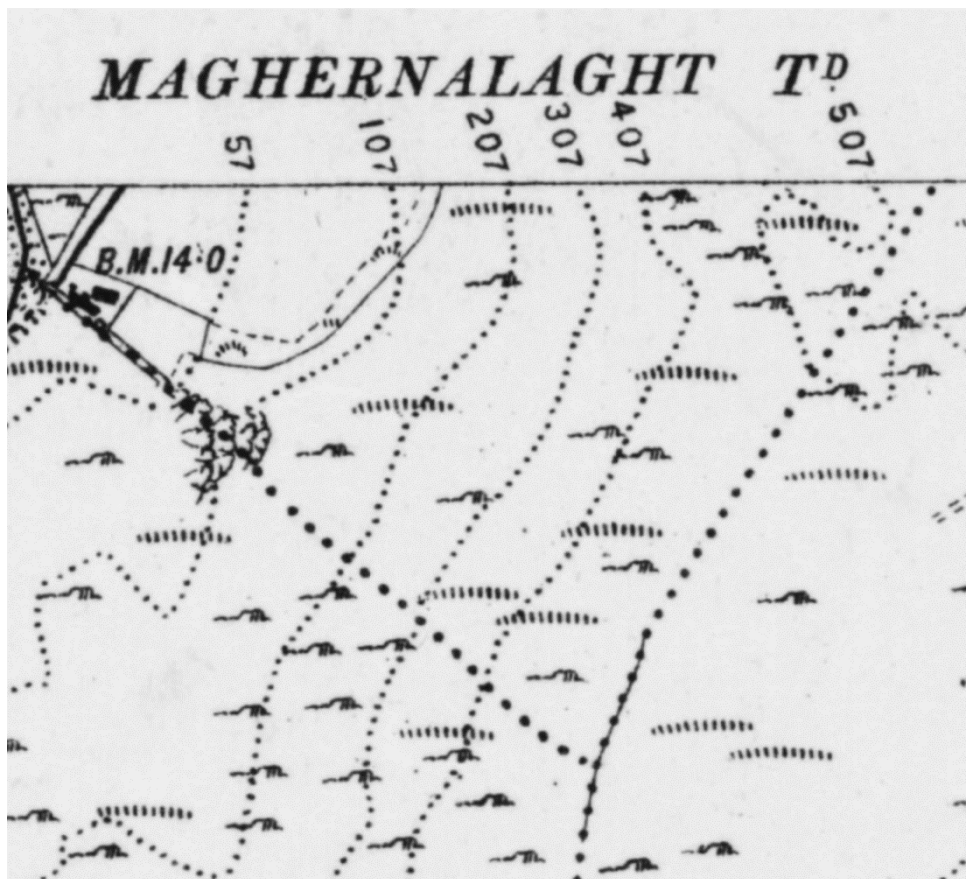


Figure 1. Contours at 57, 107, 207, etc Feet on Donegal Sheet 17

Suddenly I had a mystery on my hands. Why on earth did the contours end in a '7'? To start the investigation I firstly determined which other sheets might also feature these 57, 107, 207, etc feet contours. Using the excellent National Library of Scotland (NLS) website, I was able to discover the extent of these sheets as illustrated in *Figure 2*. Darker green sheets

depict ‘non-standard’ xx7 contours, lighter green sheets depict ‘standard’ xx0 ones and white areas indicate that no contours are present.

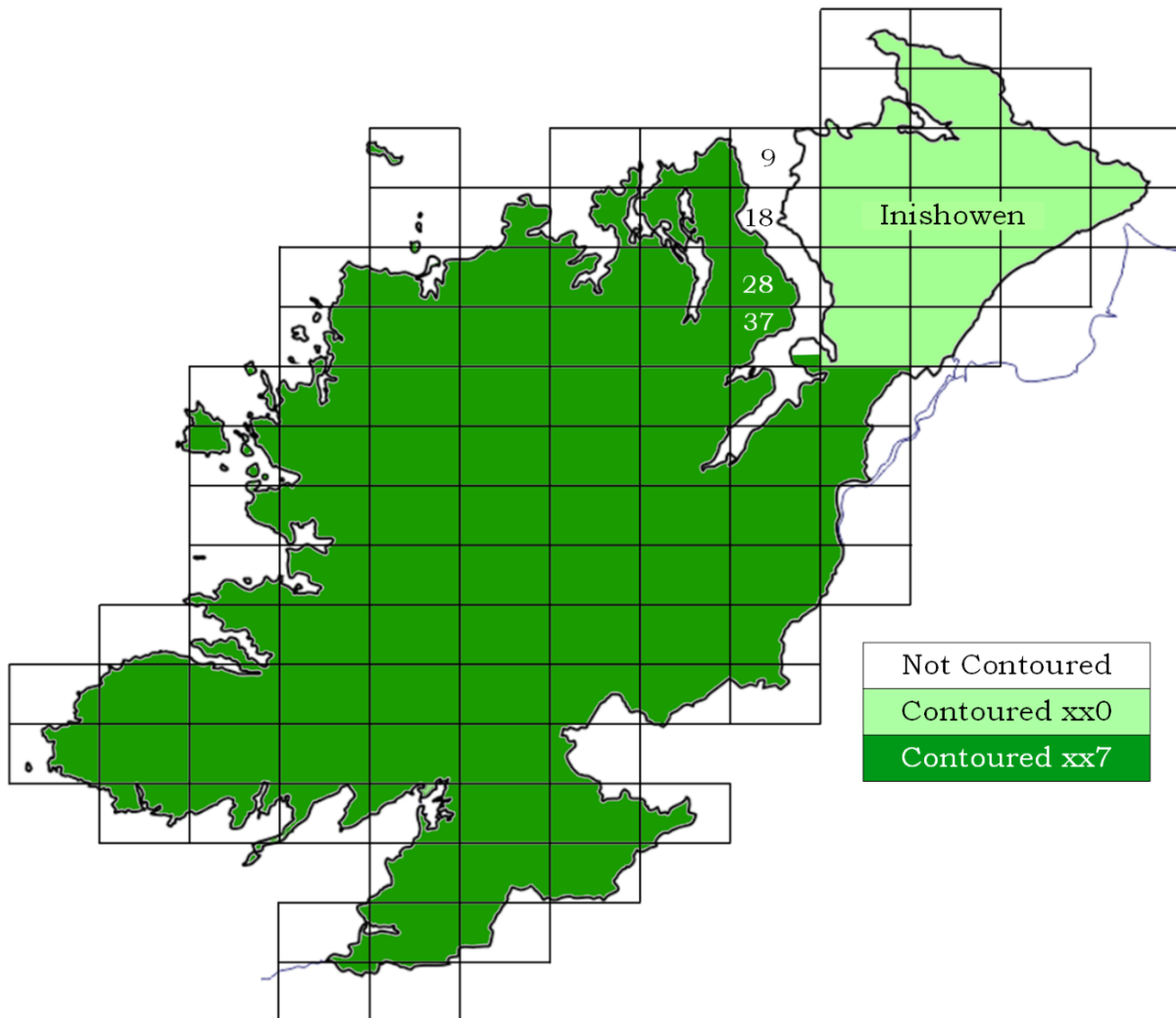


Figure 2. County Donegal 6-inch 2nd Edition Contours Assessment

The key observation is that the anomaly extends over the bulk of Donegal excluding the Barony of Inishowen. In the case of sheets depicting Lough Swilly, sheets 9 and 18 use xx7 contours on the western side of the Lough and have no contours on the eastern side, suggesting a wish to avoid confusing the user. On sheet 37 both the western and eastern sides use xx7 contours; however on the eastern side, on Inch Island, they ‘disappear’ towards the north¹ as shown in *Figure 3*.

¹ Using the University College Dublin (UCD) website I was able to determine that the ‘line’ where the contours disappear falls on a 1:2500 sheetline, confirming that the 6-inch second edition mapping is derived from the 1:2500 ‘re-survey’. However, it’s not clear why the contours on Inch Island were terminated.

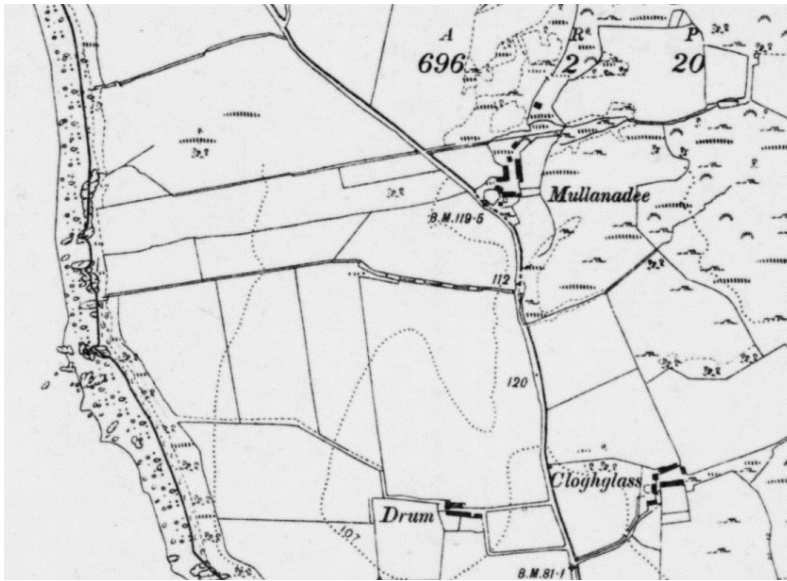


Figure 3. xx7 Contours Terminating on Inch Island

The fairly obvious hypothesis is that the additional 7 feet must be some kind of correction, obviating the need to ‘move’ the contour lines horizontally (at vast expense). The positive addition of 7 feet implies that the datum originally used for the contours was 7 feet higher than the ‘corrected’ or intended datum.

These second revision sheets state in their marginalia: ‘The Altitudes are given in Feet above the Low Water of Spring Tides in Dublin Bay, which is 21 Feet below a mark on the base of Poolbeg Lighthouse’. Even the ‘third revision’ sheets surveyed in the 1940s and published into the 1960s state: ‘Altitudes are referred to the Ordnance Survey Datum, which is a Low Water of Spring Tides observed in Dublin Bay on 8th April 1837, this datum being 8.218 feet below the Mean Sea Level’. The Poolbeg datum is also known as the Ordnance Datum Dublin (ODD). The ODD is the only datum to be defined in this very tide and time-specific way (perhaps that’s why it’s ODD).

The value of 8.218 feet is close to 7 feet but doesn’t seem close enough to be considered as an explanation. However, the closeness of these values does suggest that the original survey may have been conducted using a datum somewhere close to Mean Sea Level (MSL), as illustrated in Figure 4.

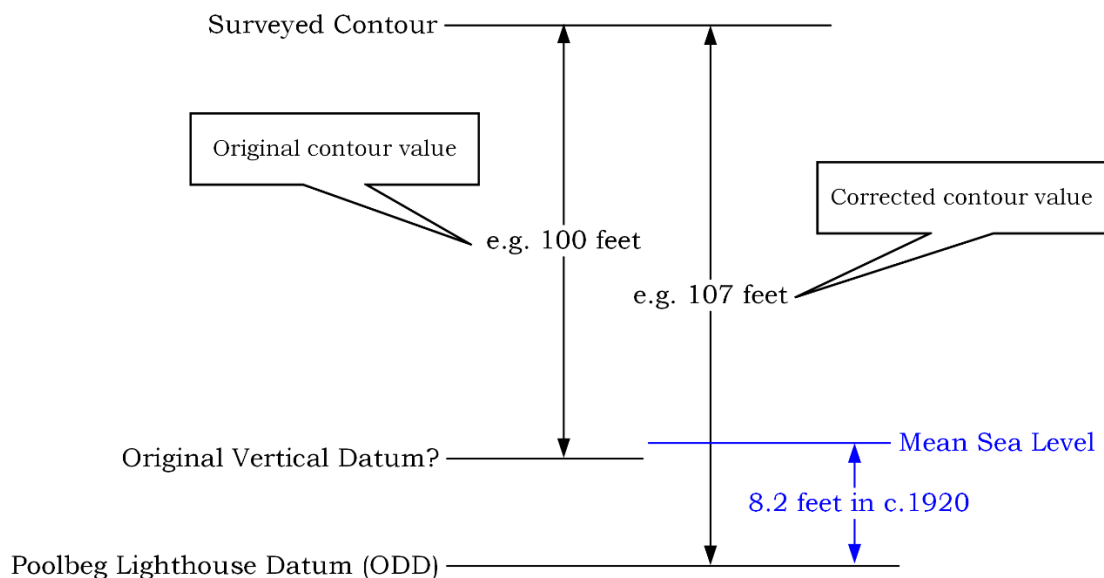


Figure 4. An Originally Surveyed Contour Assumed at e.g. 100 feet

Turning to my copy of *History in the Ordnance Map*,² I learned that many of the second edition 6-inch sheets were derived from the re-survey of Ireland conducted at a scale of 1:2500 in the 1890s. A check of some 1:2500 sheets held by University College Dublin (UCD) and available on-line confirmed that the 1:2500 plans are not contoured. Contours were only applied to the 6-inch sheets and could therefore have been added either directly during the revisions of c1890-1900 or are inherited from the earlier revisions; *i.e.* the so-called ‘railway revisions’ of the 1840s/50s which could also attract contours. Perhaps the hypothesised ‘correction’ has its origins in those earlier revisions.

At this point I recalled Dr Karen Rann’s recent article in *Sheetlines* on the subject of the Ordnance Survey’s first use of diagrammatic contour lines.³ Trials were conducted by Lt. Thomas Larcom and Lt. George Bennett in the parish of Desertegny⁴, Inishowen, in 1839. They resulted in manuscript additions to first edition sheet 18. As Karen explains, the trials were successful and contours were indeed adopted by the Ordnance Survey. However, with a degree of irony, the eastern side of sheet 18 featuring Desertegny ultimately never received printed contours. Having contacted Karen about the xx7 mystery, I’m very grateful to her for pointing me firmly towards *A Paper Landscape*⁵ for an explanation.

Consulting *A Paper Landscape* has indeed resulted in an almost-complete solution. Andrews explains that in the early- to mid-1830s levelling was conducted using vertical angle measurements and referenced to ‘local’ sea level datums around the coast. The datums were defined by low water spring tide measurements. Errors were observed in these preliminary exercises and Capt. Joseph Portlock⁶ introduced improved methods, albeit still using the vertical angle measurement technique. The 6-inch first edition sheets of County Donegal published c1836 used these initial altitude measurements, depicting them as spot heights.

In the late 1830s, the Director of the Survey, Major-General Thomas Colby,⁷ was persuaded that the spirit levelling technique should replace vertical angle measurements due to its improved accuracy. Around 1839-40

2 JH Andrews, *History in the Ordnance Map*, 2nd edition, pub David Archer 1993.

3 Karen Rann, Making History in County Donegal, *Sheetlines* 130. Note: Karen has also kindly given the CCS a talk on this subject which can be found on our YouTube channel.

4 On the first edition the parish name is split across sheets. Sheet 18 has the first half of the name: ‘Desert’. In reality it is the polar opposite!

5 JH Andrews, *A Paper Landscape - The Ordnance Survey in Nineteenth-Century Ireland*, Four Courts History Classics, Dublin, 1975 (2nd edition 2002). My copy had found its way to the charity shop long ago, so I recently purchased a second-hand example at vast expense.

6 Major General Joseph Ellison Portlock (1794– 1864).

7 Major General Thomas Frederick Colby (1784–1852).

the southern counties took advantage of this technique, eventually followed by the northern counties in the period 1841-43.

Whilst the Poolbeg Lighthouse datum had been established in 1837, it was one of several Irish tidal observation stations and it wasn't until 1841 that Colby selected Poolbeg as the single Ordnance Datum for Ireland. Sea levels and tidal ranges were now being subjected to greater scientific scrutiny and research during this period. At Colby's request, the Astronomer Royal, George Airy,⁸ conducted a series of accurate tidal measurements at 22 coastal locations "during a period of two complete lunations in the months of June, July and August, 1842".⁹ Andrews usefully reproduces the measurement results within Appendix C of *A Paper Landscape*¹⁰ enabling probability density curves to be plotted as shown in Figure 5.

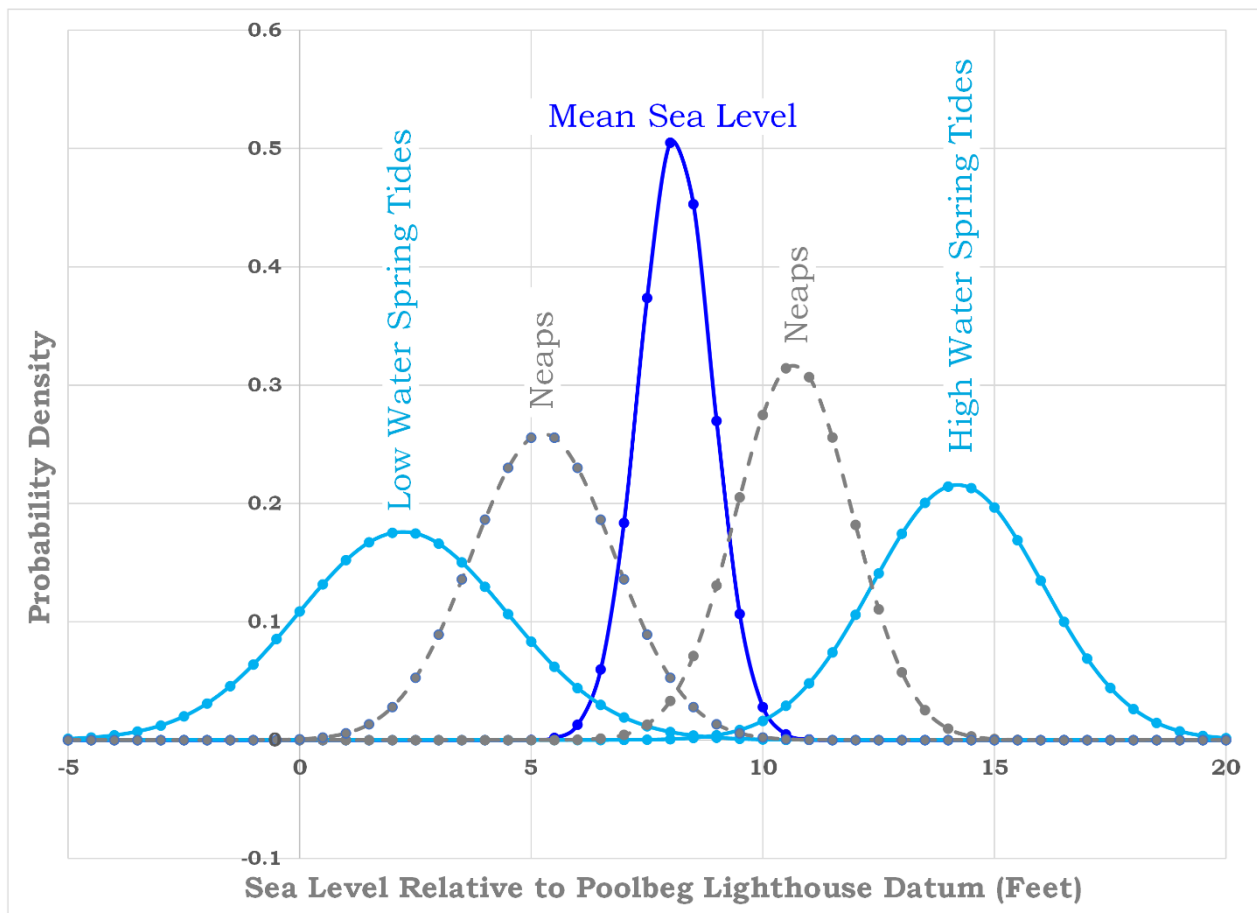


Figure 5. Probability Density Plots Using Airy's 1842 Tidal Measurement Data

Two key conclusions emerged from this work; i) the MSL is higher in the north than the south and ii) the variation in MSL is far lower than the

⁸ Sir George Biddell Airy KCB FRS (1801–1892).

⁹ Cameron, John: Abstracts of Principal Lines of Spirit Levelling in Ireland Carried on During the Years 1839 to 1843, pub. Board of Ordnance, 1855.

¹⁰ The table summarises Airy's measurements by listing the mean height values for Low Water Spring, Low Water Neap, Mean Sea Level, High Water Neap and High Water Spring tides for each of the 22 measurement locations.

variation in low water spring tide level, therefore MSL could form a more reliable basis upon which to define a datum.

By the mid-1840s the need to depict accurate field boundaries and the expansion of railways were rendering the first edition plans obsolete.¹¹ Pressure was therefore building to initiate a series of revisions to the 6-inch series (termed the ‘first revision’) and this challenging task was assigned to Lt. George A. Leach.¹² Whilst Airy’s measurements had been conducted in the summer of 1842, his formal report only emerged later in 1845.¹³ It seems that Colby received an early draft of the results and in March 1844 we reach a ‘crux’ point in the narrative. Andrews tells us that Colby “insisted on changing Irish ordnance datum from low- to mean-water level” and further that the revised datum should be “taken to lie 7.2 feet above the Poolbeg datum”. So this must be the 7-foot value that appears on the Donegal revised sheets.

Regretfully, I have been unable to determine how Colby justified the figure of 7.2 feet. The raw average of Airy’s MSL measurements taken from his 22 locations is 8.118 feet. Andrews states that Colby discounted locations that were in loughs or estuaries in order to reach his conclusion. Excluding those tidal stations (New Ross, Kilrush, Foynes Island, Limerick, Buncrana, and Carrowkeel) reduces the average MSL to 8.094 feet above Poolbeg. Perhaps the 7.2 feet value had been derived from historic data supplemented by Airy’s results. Andrews states that “Leach, like Larcom, opposed the change of datum as confusing and contradictory”, implying that Colby’s instruction caused some tension between Dublin and Southampton.

To complete the puzzle, it’s necessary to delve into the chronology of the ‘first revision’ of the 6-inch maps. Leach was aware that the first edition surveys could not always be considered fully accurate and so he selected Donegal as the first county to be revised on the basis that it was apparently more ‘accurate’ than Londonderry. The Survey Office at Mountjoy tolerated Colby’s order from Southampton and proceeded to tackle the contour surveying of Donegal (except Inishowen, that had been surveyed earlier in 1839-40) using the new MSL datum, perhaps working on the assumption that they may need to re-visit Inishowen at a future date.

In November 1846, as the last sheets of the first edition maps were being prepared for publication, Colby attained the rank of Major-General. In accordance with the newly introduced rules of service he was retired from the post of Director and, rather against his wishes, was replaced by

11 The obsolescence accelerated further in the period 1845 to 1852 when the effects of the Great Famine also re-shaped the landscape in dramatic ways.

12 Lieutenant Colonel Sir George Archibald Leach, KCB (1820–1913).

13 Airy, G. B.: On the laws of the tides on the coast of Ireland, as inferred from an extensive series of observations made in connexion with the Ordnance survey of Ireland, *Phil Trans*, Paert 1 for 1845, <https://doi.org/10.1098/rspl.1843.0033>.

Col. Lewis Hall.¹⁴ Whilst Colby's life had been described as "a course of scientific research",¹⁵ it seems that Hall took a more pragmatic approach and one of his early decisions, in 1848, was to reverse Colby's MSL diktat. Quoting again from *A Paper Landscape*, Hall decided "to refer all Irish contours to the old low-water datum at Poolbeg lighthouse. This ruling came too late to save Donegal, however: here, and also in parts of three Derry sheets, the work done under Colby's orders could be related to low water only by changing all the numerical values, so that the 25-foot contour was renumbered as the 32-foot, the 50-foot as the 57-foot, and so on; a slightly bizarre memorial to the policy changes of the 1840s".

Cameron's '*Abstract of Principal Lines of Spirit Levelling in Ireland*' published in 1855 seems to capture Hall's thinking: "Whilst, however, the consideration of these advantages of mean water, as a plane of reference, induced the late Major-General Colby, in 1842, to adopt it for that purpose in the Ordnance Survey of the north of England, then recently commenced, it has not been considered advisable to change the zero plane in Ireland by so large a quantity as the difference in height between mean and low water, since such a change would have rendered necessary an immediate alteration of all the altitudes engraved on the Irish maps". Hall must have realised that the accuracy of low water spring tide measurements would be adequate for the purpose and clearly wished to avoid moving or re-labelling any previously engraved contour.

Appendix D of *A Paper Landscape* provides a summary of the earliest contour survey and engraving dates, reproduced in *Figure 6*. This shows that the Inishowen contouring was conducted using the low water spring tide datum but that the remainder of Donegal was contoured using Colby's MSL datum. It is assumed that during the pre-publication stage Donegal (except Inishowen) received its contour value corrections to bring the printed sheets back in line with Hall's low water spring tide datum. Subsequent first revisions across other counties also adopted the low water spring tide datum, which persisted to underpin future Ordnance Survey mapping in Ireland.

14 Colonel Lewis Alexander Hall (1794-1868).

15 Contemporary obituary for Thomas Colby

www.icevirtuallibrary.com/doi/pdf/10.1680/imotp.1853.23970

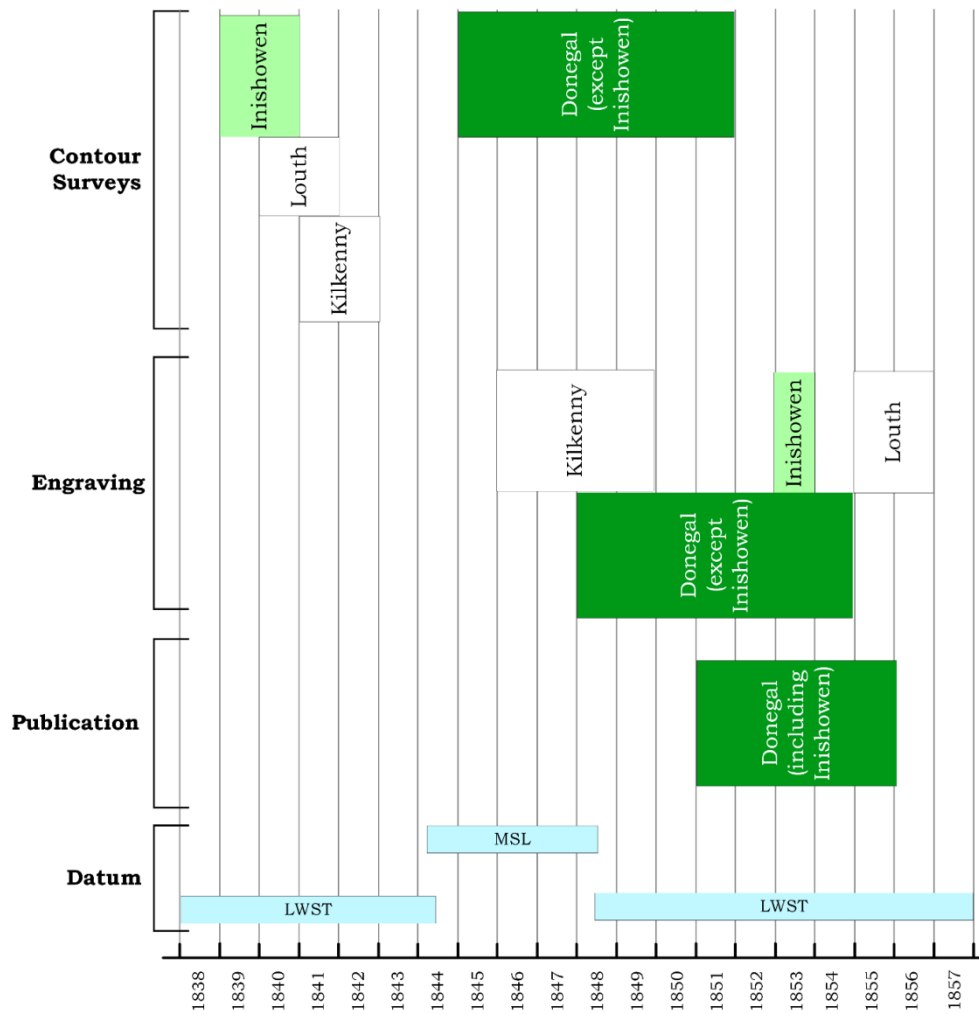


Figure 6. 6-inch First Revision Chronology (Initial Counties Only)

This episode can perhaps be characterised as a ‘tussle of the datums’, ultimately won by Hall. It is beyond my competence to judge who was ‘right’ and who was ‘wrong’ but perhaps it is a testimony to both Colby and Hall that the only lasting damage was limited to part of a single county and three adjacent sheets in County Londonderry.¹⁶

Despite not being able to consult copies of any 1850s first revision sheets for Donegal, I understand that they included contours and therefore the second and third revisions simply reproduced them. Accordingly, I feel that the Donegal xx7 puzzle has been adequately solved. This is principally thanks to the diligence and tenacity of John Andrews (1927-2019).¹⁷ I also wish re-iterate my thanks to Dr Karen Rann for pointing me towards his excellent books.

¹⁶ The three Londonderry second revision sheets on the NLS website are 14, 14A and 21. Sheet 14 is a ‘combined’ sheet that includes part of Donegal with xx7 contours and, across the Foyle, part of Londonderry with xx0 contours. A third revision sheet 14 published in 1964 shows the same hybrid contour arrangement. Sheets 14A and 21 are not ‘combined’ sheets (they only cover Londonderry) but include xx7 contours on the western side of the Foyle and xx0 contours on the eastern side.

¹⁷ John Harwood Andrews (1927-2019), obit *Sheetlines* 117.