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1872 Glenorchy debris flow

Mineral Resources Tasmania
Department of State Growth

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Historical assessment of the 1872 Glenorchy debris flow: a basis for modelling the large debris flow hazard from the Wellington Range, Hobart.

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Cover Photo: kunanyi / Mt Wellington forms the impressive mountain behind the cities of Hobart (pictured) and Glenorchy on which many debris flow scars are identified, including the 1872 Glenorchy debris flow (not visible).

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Abstract

On the night of Tuesday 4th of June, 1872, as a result of extremely heavy rainfall a very large landslide occurred on the north-western slopes of Mt Arthur at the head of Humphreys Rivulet. A large debris flow event then followed that rushed down the valley and flowed through the township of Glenorchy, which was then a relatively low density farming and industrial area, and caused considerable damage and destruction.

The understanding of this event is based on compilation of historical accounts that builds on a previous report by Mineral Resources Tasmania in 2007. A significant number of additional historical sources including rainfall records, have since been discovered along with improved location of properties and mentioned in eye-witness accounts. In addition, MRT has utilised airborne laser scanning data to allow a more detailed assessment of the topography.

The interpretation of the debris flow behaviour based on this study differs significantly from a risk assessment commissioned by emergency managers in 2007 that required the presence of a temporary debris dam. The revised interpretation has significant implications for risk assessment of future events.

Having documented the behaviour of the 1872 debris flow event, and the prevailing conditions, key parameters for modelling future potential debris flows can now be derived that will form the basis of a subsequent report.

Introduction

The city of Hobart and its suburbs on the western side of the River Derwent estuary are built around the base of dolerite-capped mountains at the eastern end of the Wellington Range (Figure 1). This range reaches an elevation of 1,270m above sea level at Mt Wellington on its relatively flat-topped eastern terminus. To the north-west of Mt Wellington this plateau terminates at a promontory known as Mt Arthur and to the south it terminates at a promontory known as South Wellington.

Mt Wellington is lined by dramatic dolerite cliffs to the north and east and forms a dominant feature of the Hobart skyline, along with Mt Arthur in the northern suburbs and South Wellington in central Hobart and the southern suburbs. Many creeks and rivulets descend from this eastern end of the Wellington Range down to the River Derwent through Hobart and its suburbs. A number of these creeks and rivulets have their sources high up on these steep slopes.

The geology, topography and climate make the steep slopes above the city of Hobart and its suburbs prone to landslides and debris flows, which are fast-moving torrents of water, mud and debris (including boulders and broken trees). A number of debris flow events are known to have occurred around Mt Wellington since European settlement, but by far the largest was a debris flow that resulted from a very large landslide that occurred in 1872 on the slopes of Mt Arthur (Figure 1 and Figure 2).

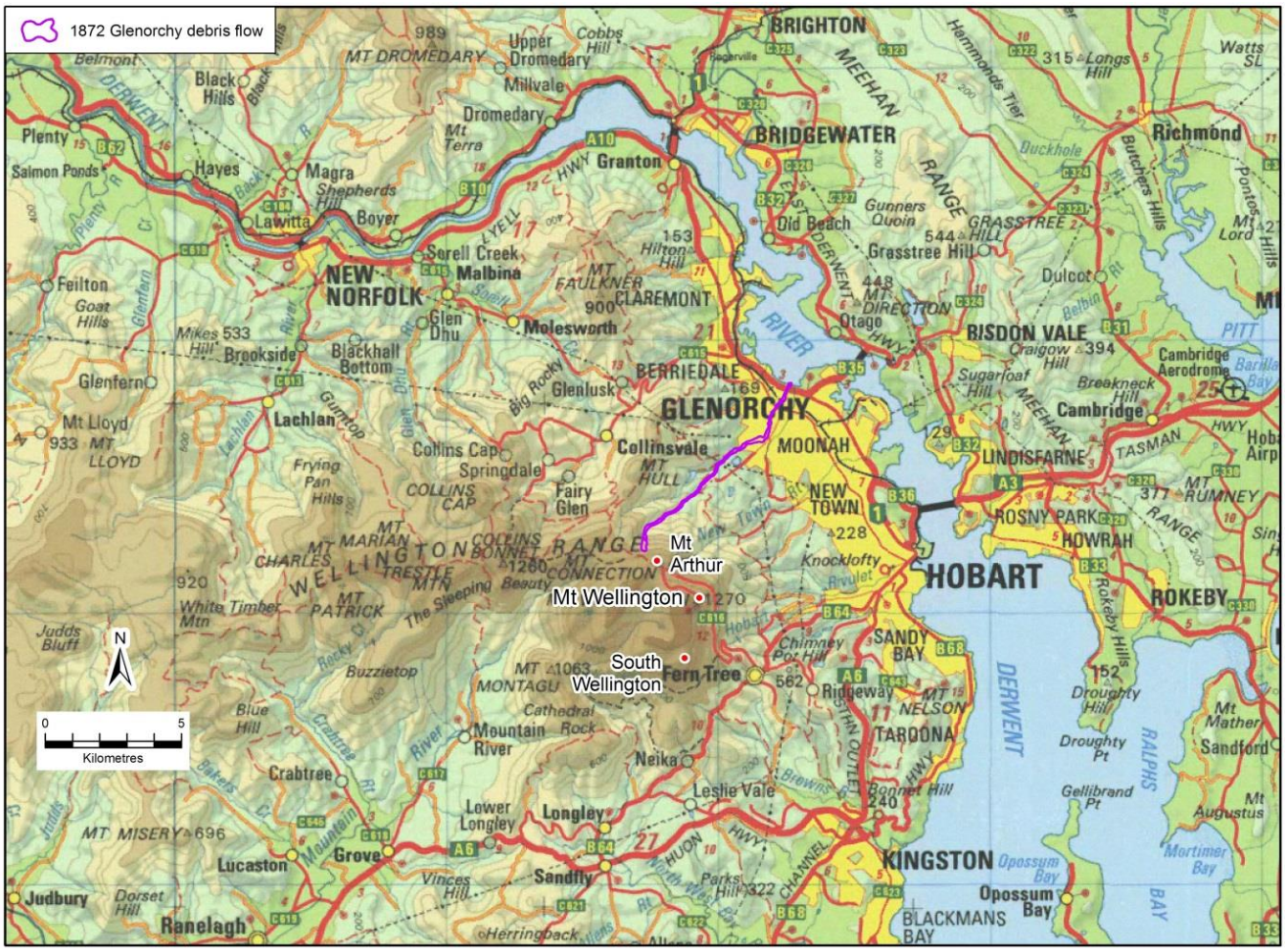

Figure 1. Location of Hobart and its suburbs in relation to the Wellington Range, showing the site of the 1872 Glenorchy debris flow.

On the night of Tuesday 4th of June, 1872, as a result of extremely heavy rainfall a very large landslide occurred on the north-western slopes of Mt Arthur at the head of Humphreys Rivulet (Figure 2). A large debris flow event then followed that rushed down Humphreys Rivulet and flowed through the township of Glenorchy, which was then a relatively low density farming and industrial area, and caused considerable damage and destruction. This significant event, along with other debris flows on the Wellington Range, serves to highlight the potential for dangerous debris flows initiating on the Wellington Range under modern climatic conditions. It is also apparent that the potential for serious consequences and risk to life of such an event are now higher due to the greatly increased housing density within these areas.

Given that this very destructive event took place nearly 150 years ago it had been largely forgotten by all except a few local historians (for example, Alexander, 1986). The knowledge of this event, and its significance as an example of the potential hazard presented by debris flows to Hobart and its suburbs, had also been lost to the earth science community and managers of natural hazards in Tasmania. After Mineral Resources Tasmania (MRT) became aware of the 1872 Glenorchy debris flow a compilation of the historical accounts discovered at that time was published (Mazengarb, *et al.*, 2007) – "A compilation of historical accounts of the 1872 Glenorchy landslide".

This present report aims to analyse all of the available historical information regarding the 1872 Glenorchy debris flow and the conditions that prevailed at the time, and includes an analysis of the evidence of that event still detectable in the landscape. This review forms the basis for an improved understanding of the behaviour of the 1872 debris flow and its impact on the settlement at Glenorchy. The compilation of historical accounts for the 1872 Glenorchy debris flow included here has built on the work of Mazengarb, *et al.* (2007). Since 2007 a significant number of other historical sources have been discovered and of particular note is the launch of the "Trove – Digitised newspapers and more" website operated by the National Library of Australia, which has

facilitated a much more thorough search for relevant newspaper articles. Appendix 1 includes transcriptions of all of the historical accounts previously published in Mazengarb*, et al.* (2007) along with those discovered subsequently. In addition, MRT has acquired airborne laser scanning data (a LiDAR survey) over the Mt Wellington area (Mineral Resources Tasmania, 2011) that allows for a much more detailed assessment of the topography.

The objective of this work is to provide as detailed an account as possible of the Glenorchy debris flow event of 4th of June, 1872, so that key parameters can be derived for debris flow hazard modelling (to be reported separately). Understanding this very large debris flow event in detail will enable us to be more reliably model the potential for, and effects of, future events that may impact Hobart and its suburbs.

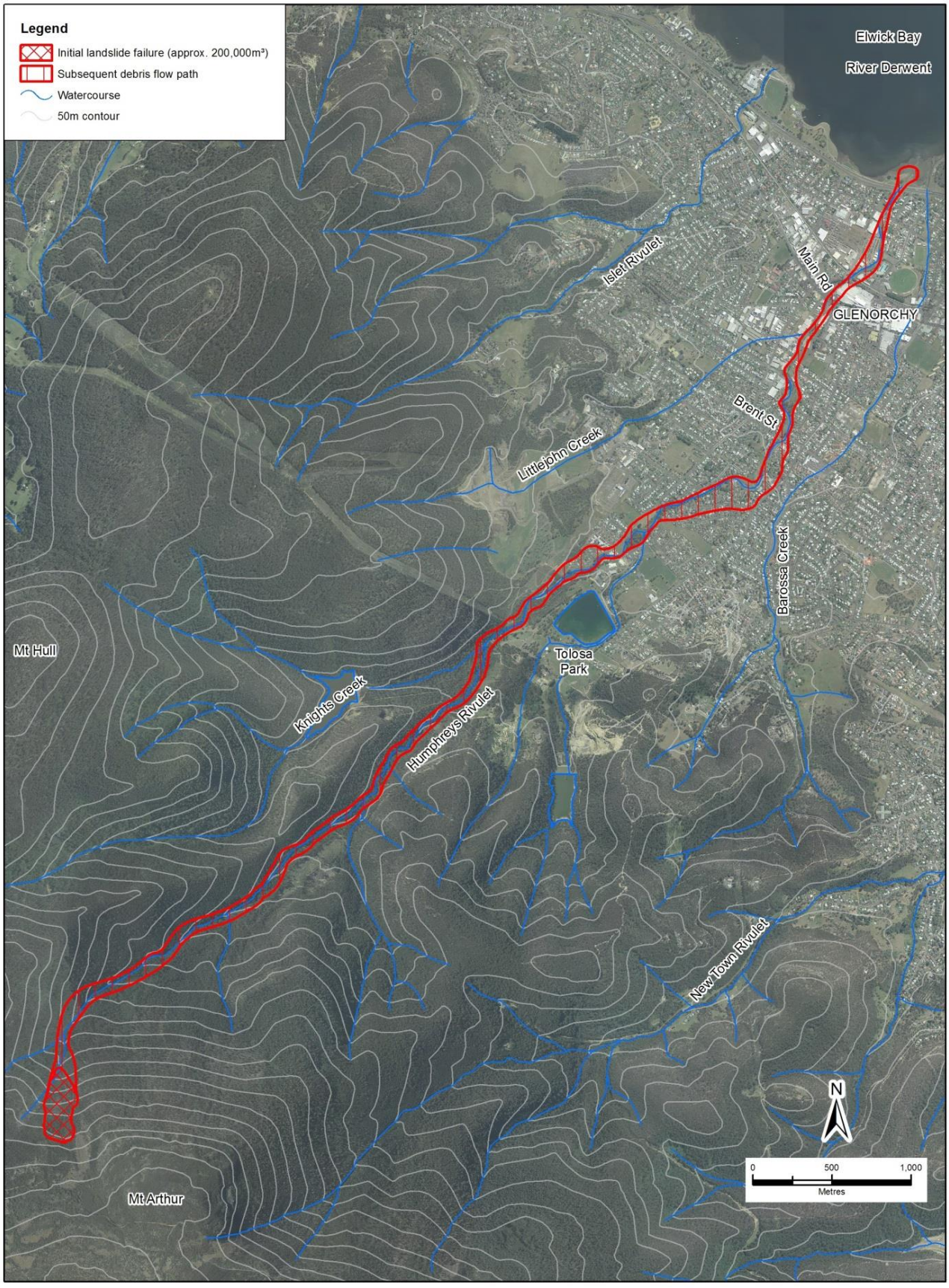

Figure 2. Location of the 1872 Glenorchy debris flow and the initial landslide source area on the flanks of Mt Arthur, Wellington Range. The debris flow travelled along Humphreys Rivulet to the River Derwent, passing through the township of Glenorchy, now a densely populated northern suburb of Hobart.

Historical Sources for the 1872 Glenorchy Debris Flow

The landslide and subsequent debris flow at Glenorchy on the night of Tuesday 4th of June, 1872, was well reported in the local newspapers and other documents of the time; as well as being the subject of two scientific papers. The very dramatic nature of this event is described in the early accounts.

The Mercury (6 Jun. 1872) reported:

> *The residents in the vicinity of O'Brien's Bridge* [i.e. Glenorchy] *were at a late hour on Tuesday* [the 4th of June] *congratulating themselves on the belief that the worst danger* [of the flood] *had passed, and hailing with satisfaction the gradual subsidence of the waters in the creek, when at about half-past ten o'clock a dreadful dull rumbling sound, a heavy smothered crash, and a deafening roar of flowing waters, gave evidence of some unusual convulsion of Nature. …… An immense wall of* [water] *was seen in the darkness to be coming on, bearing onward with irresistible force everything with which it came in contact. Eyes which had now become accustomed to the darkness, saw borne on the foaming torrent, huge masses, consisting of trees uptorn by the roots, and bearing with them branches of others, tangled undergrowth, dead timber, masses of rocks, portions of broken buildings, and other* débris *all mingled, tumbling one over another in a most grand but terrible confusion. Houses substantially built were carried away like wooden matchboxes, and the furious flood burst from the inadequate creek channel, and forced for itself new passages over the cultivated ground. Land which had hitherto had entire immunity from inundation was suddenly covered to a depth of many feet; and trees, dead timber, and other drift, finding obstructions, piled itself in gigantic heaps, resembling hastily constructed barricades.*

The colonial geologist, Wintle (1872), reported:

> *Upon arriving within a mile of O'Brien's Bridge, a large yellow tract of the northern face of Mount Wellington, reaching nearly to the summit of that part of the mountain, was visible from the main road, and which at a distance of six or seven miles presented a striking contrast to the surrounding locality, …… Although the accounts that had reached the city prepared the mind of the visitor for witnessing a scene of extensive ruin and desolation, I must confess that the mental picture that I had drawn of the scene fell very far short indeed of the reality, …… The first thing that attracted my attention from the bridge was the immense heaps of timber and gigantic boulders that strewed the bed of the rivulet, and lined its banks on either side of the bridge, ……*
>
> *Upon arriving at the base of the "slip," a sight presented itself which is not likely to be ever forgotten. A large portion of the side of a mountain thickly clothed with huge trees and undergrowth, peopled by thousands of mammals, birds, and reptiles, had been hurled with a terrible force into the gully below, and thence swept by a resistless torrent into the sea.*

A range of historical sources have been found during research. Some accounts are very detailed but there is a great variance in their level of detail, apparent reliability of the observer and in their separation from the event by time.

Newspaper Accounts (1872-73)

Many of the contemporary newspaper reports provide very detailed accounts of the debris flow that passed through the Glenorchy township, particularly in regard to the damage caused. Some also provide accounts of ascents made up Humphreys Rivulet to the source of the landslide and debris flow and provide useful descriptions of the source area as it was in 1872 (see below for further discussion). The newspaper accounts provide the greatest number of historical sources for this event.

A very useful aspect of the newspaper reports, and other sources, are the detailed descriptions of the properties affected, which usually name the owner or occupier of the property. This information has been used to reconstruct the path of the debris flow through the Glenorchy township (see below for further discussion).

The online historical newspapers available through the "Trove – Digitised newspapers and more" website (National Library of Australia), has allowed a thorough search for relevant newspaper reports. As well as the immediate reporting of the event, a number of very useful articles have been found that were published many months after the event. Some newspaper articles also referred to other documentary sources that have also proved quite useful, for example, references to published papers by the colonial geologist, Samuel Wintle (see

below), and the regular reports on the monthly meetings of the Royal Society of Tasmania. Most of the more useful newspaper reports relating to this event have been transcribed and included in Appendix 1 with links to the online copy of the articles on the "Trove – Digitised newspapers and more" website – cited articles are also included in the References section.

Scientific Papers (1872-73)

Samuel Henry Wintle (1830-1909) was a colonial geologist mainly operating in Tasmania, who had other scientific interests such as entomology and was also a published poet. Wintle was born in Hobart and received his education in Sydney and was hailed as the first Australian-born scientist to address the Mechanics' Institute. He became a member of the Royal Society of Tasmania in 1863 and published numerous papers on geology in Tasmania and other colonies – including at least two in the journal of the Geological Society of London (i.e. Wintle, 1864, 1873). Wintle was elected a fellow of the Linnean Society, London, in 1880 (Winter, 2005).

Samuel Wintle wrote two similar scientific papers on the landslide and debris flow at Glenorchy in 1872. As a trained scientific observer he provides the most reliable information on the events of the 4th of June, 1872, particularly in regard to the formation of the initial landslide and the processes of the subsequent debris flow. The first paper was published in an Australian journal late in 1872, The Australian Mechanic and Journal of Science and Art (Wintle, 1872), and the second paper was published in Britain in 1873, in the Quarterly Journal of the Geological Society of London (Wintle, 1873).

Images of the Landslide

As well as written materials there are also a small number of images available that show the landslide source area and upper debris flow path on the flanks of Mt Arthur. Most newspapers of this time did not include images and no such images have been found for this event. However references in the Mercury newspaper have been found advertising photographs of the landslide at Glenorchy by "S. Clifford" (Mercury, 10 Jul. 1872), including stereoscopic pairs, and "H. Baily" (Mercury, 23 Jul. 1872).

The Tasmanian Archive and Heritage Office holds two similar photographs of the landslide affected area in the upper reaches of Humphreys Rivulet taken soon after the event. One is from a commercially produced album of photographs by Samuel Clifford (c1873), Figure 3, and the other is an individual photograph that is inscribed with H.H. Baily (1872), Figure 4. These two photographs were presented in the earlier MRT publication (Mazengarb*, et al.*, 2007) but it was uncertain where they were taken or exactly what the images represented, that is, the source of the initial landslide or the flow path of the subsequent debris flow.

Figure 3. An 1872 photograph of the landslide affected area in the upper reaches of Humphreys Rivulet (image enhanced), from a commercial album by Samuel Clifford. (Photograph reproduced with the permission of the Tasmanian Archive and Heritage Office.)

Figure 4. A similar 1872 photograph of the landslide affected area in the upper reaches of Humphreys Rivulet (image enhanced), attributed to Henry H. Baily. (Photograph reproduced with the permission of the Tasmanian Archive and Heritage Office.)

The Tasmanian Museum and Art Gallery holds three photographs of the landslide affected area in the upper reaches of Humphreys Rivulet taken soon after the event. Two scenes are depicted (Figure 5 and Figure 6), as stereoscopic pairs (stereographs), and are attributed to Thomas J. Nevin (1872a, 1872b), whose studio stamp appears on the back of one each of the two scenes.

Figure 5. A stereoscopic pair of photographs of the landslide affected area in the upper reaches of Humphreys Rivulet, attributed to Thomas J. Nevin. Note: this photograph has an identical viewpoint to the photograph in Figure 3 but with more foreground area showing. (Stereograph reproduced with the permission of the Tasmanian Museum and Art Gallery.)

Figure 6. A stereoscopic pair of photographs of upper Humphreys Rivulet, attributed to Thomas J. Nevin, showing a broad zone of stripped vegetation caused by the passage of the debris flow; and also showing significant super-elevation on the right (see later section for discussion). (Stereograph reproduced with the permission of the Tasmanian Museum and Art Gallery.)

The photographs in Figure 3, Figure 4 and Figure 5 all show a very similar view and appear to have been taken at around the same time shortly after the event. In fact the photograph in Figure 3 (Clifford, c1873) and the stereograph in Figure 5 (Nevin, 1872a) appear to have been taken from precisely the same viewpoint, whereas the photograph in Figure 4 (Baily, 1872) is taken from a slightly different angle. Close examination shows the details of the surface debris to be identical in these photographs but the shadows differ in each of the three photographs, suggesting that they are separated perhaps by less than an hour, given the steep topography. So it is

possible that these photographs were all taken on the same day, and perhaps likely that two of them (Figure 3 and Figure 5), at least, were actually taken by the same photographer.

The stereograph in Figure 6 (Nevin, 1872b) shows a waterfall in the bed of Humphreys Rivulet with a broad zone of bare slopes stripped of their vegetation by the passage of the debris flow down the Rivulet (see later section). The site of this photograph is well established by the position of this waterfall, which is still recognisable in the present day (Figure 7).

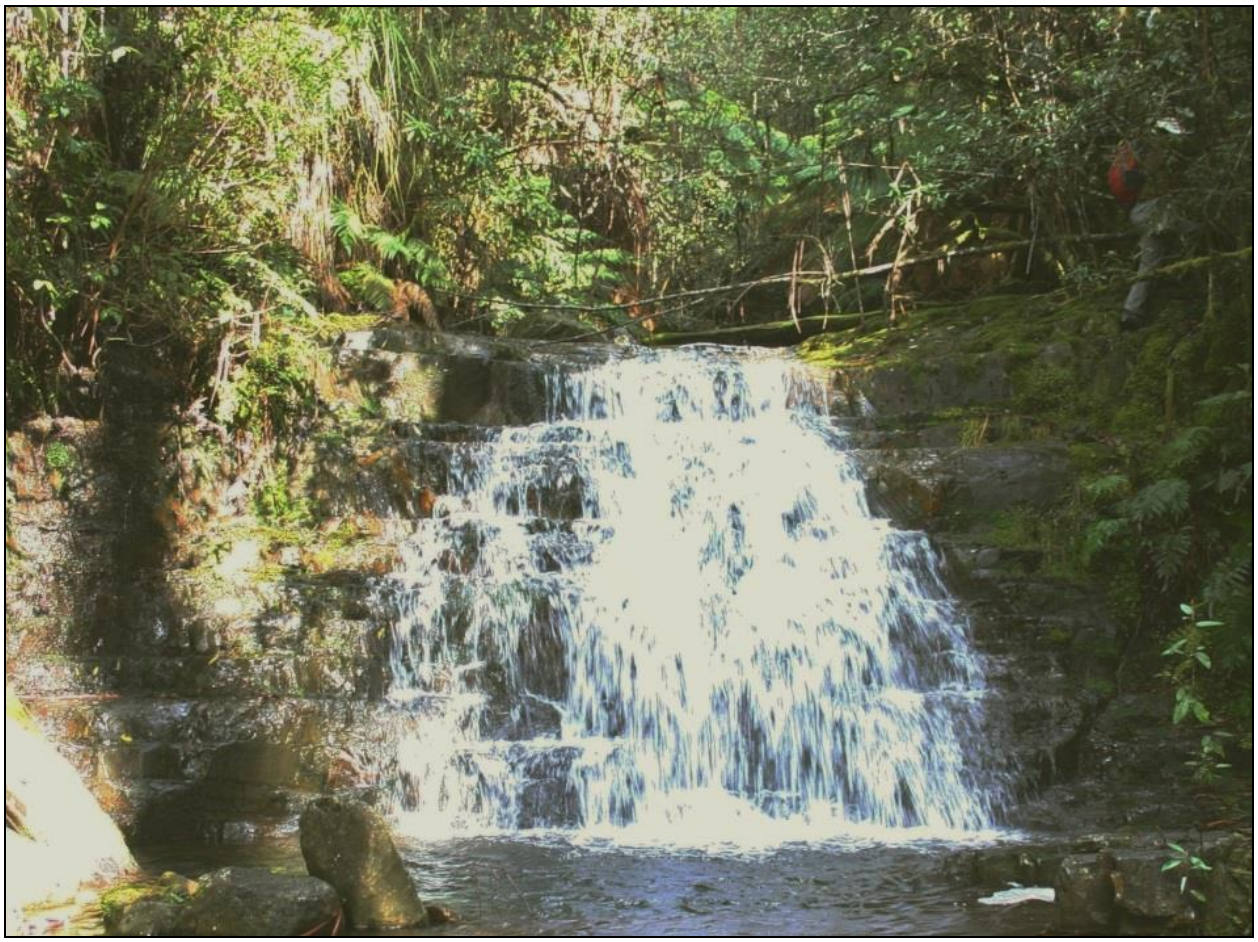

Figure 7. Present day view of the waterfall on Humphreys Rivulet that appears in the 1872 stereograph shown in Figure 6.

The only other image discovered that shows the 1872 landslide is a painting by W.C. Piguenit (c1893) titled "Mt. Wellington from near O'Brien's Bridge" (Figure 8). This watercolour painting shows the clear yellowish scar of the landslide still obvious after about 20 years on the north-western flank of Mt Arthur, at the head of Humphreys Rivulet. A newspaper article in The Mercury (14 Aug. 1976), in recounting the events of 1872, states that "for many years the sight of the great yellow scar on the mountain slopes had marked the scene of the landslide until, gradually it became hidden by encroaching trees and finally, about 1940, disappeared altogether". Stancombe (1968) also states that "nowadays even the yellow gash of the landslide has been softened by time and few have ever heard the story". So it is expected that the landslide scar would have been very obvious in 1893.

ArcScene™ software was used to construct a perspective from a similar viewing point as the Piguenit painting, utilising a digital terrain model (DTM) derived from the 2011 airborne laser scanning (LiDAR) survey over Mt Wellington (Mineral Resources Tasmania, 2011). Figure 8 shows a comparison of this ArcScene™ perspective with the W.C. Piguenit painting and confirms Piguenit's reputation for producing accurate representations of the landscape. The viewing point of the original painting was close to where the present day Derwent Entertainment Centre is located and much of the shallow bay in the foreground of the painting is now reclaimed land.

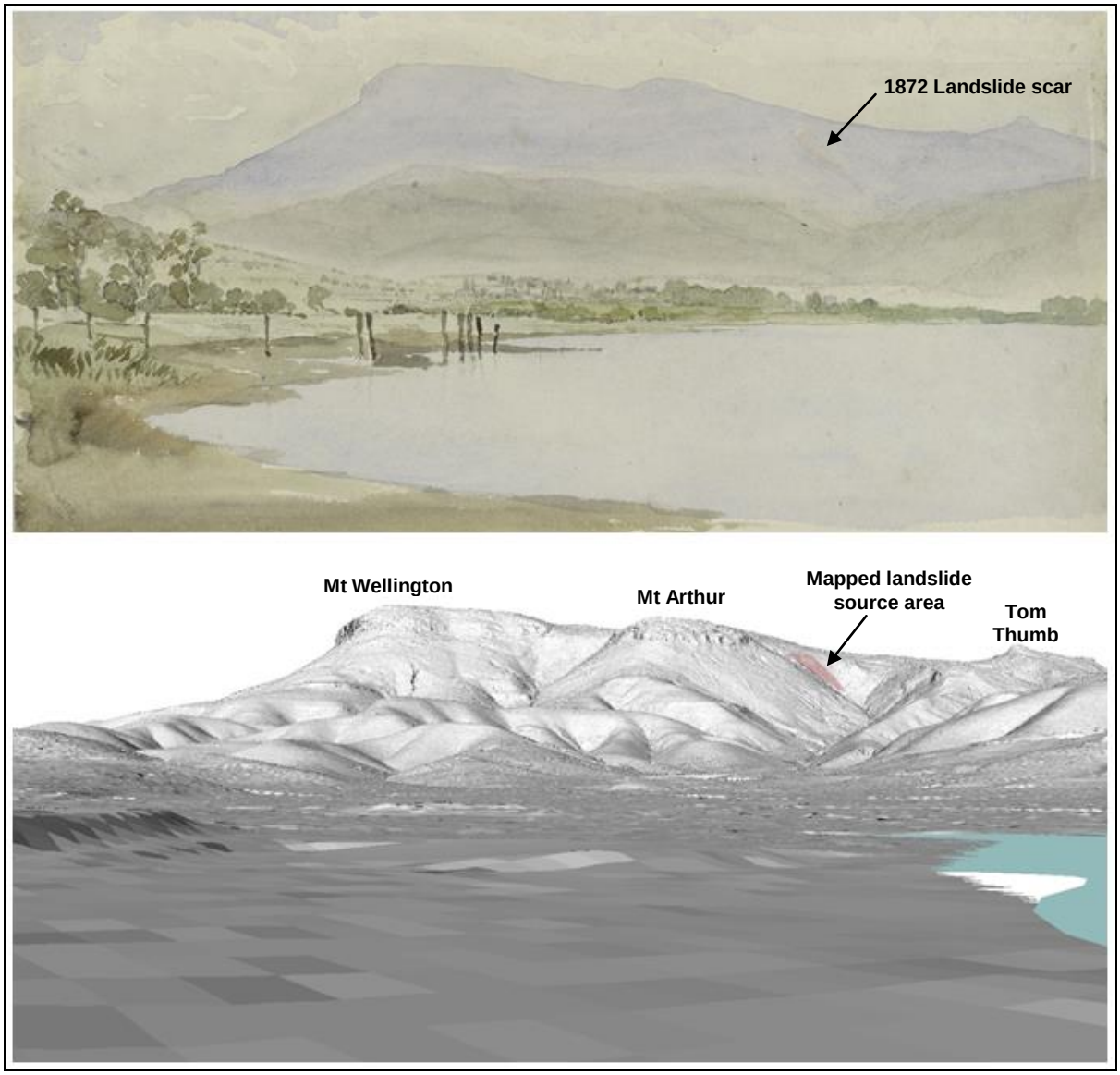

Figure 8. Painting by W.C. Piguenit (c1893), "Mt. Wellington from near O'Brien's Bridge" (detail with enhanced colours), compared with a perspective over the modern topography from a similar viewing point; both of which show the 1872 landslide scar on the north-western flank of Mt Arthur, at the head of Humphreys Rivulet. The lower image has been produced using ArcScene™ software and a DTM derived from the 2011 LiDAR survey over Mt Wellington. Note: the foreground area was reclaimed in the 20th century. (Painting reproduced with the permission of the Tasmanian Museum and Art Gallery.)

Other Later Accounts

A small number of later historical accounts have also been located and were previously published in Mazengarb, *et al.* (2007). These include an entry in a book for tourist's titled Guide to Excursionists (1879), the "Reminiscences of an old Glenorchy resident" (Hull, 1940), and an entry in a published history titled Highway in Van Diemen's Land (Stancombe, 1968). Transcriptions of these texts are provided in Appendix 1.

Reliability of Historical Accounts

In the course of researching the various historical accounts of the 1872 landslide and debris flow it was found that there were many cases of doubtful and contradictory information. The most troublesome accounts were the later accounts and it was found that a lot of the details contained within them, in regard to the actual landslide and debris flow, were not supported by contemporary reports. However, it was found that the contemporary newspaper accounts very commonly misspelt people's names, leading to problems in locating the properties

owned or occupied by these people in 1872 (see later section and Appendix 4). Whereas one of the later accounts, the "Reminiscences of an old Glenorchy resident" by Hull (1940), was found to have the correct spellings for the property owners and occupiers.

The contemporary newspaper reports provide detailed and very useful descriptions, but some tend toward rather poetic language and the dimensions and distances described in some cases are clearly erroneous. The lack of scientific expertise needs to be considered when interpreting these newspaper accounts, particularly in regard to speculation around the cause of the debris flow. It is clear from the reporting of this event, and also early newspaper accounts of other debris flow events in Tasmania, that the concept of a highly fluidised debris flow was difficult for most people to comprehend at the time. As a result, from the earliest newspaper reports there was speculation as to the cause of the debris flow and where the perceived great volume of additional water had come from (e.g. Mercury, 12 Jun. 1872, 15 Mar. 1873). The most commonly invoked explanations were a waterspout that had made landfall (waterspouts being common to people accustomed to sea voyages), the bursting of a subterranean mountain reservoir or channel, or the bursting of a large temporary dam formed at some point by the landslide.

In his first paper Wintle (1872) addresses the widespread speculation in regard to the cause of the landslide and debris flow by dismissing some of the ideas put forward:

> *There had been many absurd theories propounded by the unscientific to account for this cataclysm, among which were the bursting of a waterspout and the disruption of a subterranean mountain reservoir; the waterspout being of the two the more popular. The* vera causa*, however, was to my mind apparent at a glance—in a word, complete saturation of the great depth of incoherent surface-soil, and undermining on the great slope of flaky rock.*

Samuel Wintle, as an experienced geologist, certainly provides the most reliable information in regard to the formation and behaviour of the actual landslide and debris flow. However his descriptions of the effects of the debris flow at Glenorchy, while very descriptive, only refer to general areas and not specific properties or places. As there are no maps included with Wintle's two papers it is not possible to determine the exact course and full extent of the debris flow from his descriptions.

Two aspects of the accounts that are particularly important to understanding the event need to be considered in detail, as there are multiple contradictions and misleading statements:

- The timing of the landslide and subsequent debris flow; and
- The formation of a temporary debris dam and its subsequent collapse

These two aspects are discussed separately later in this report.

The Source Area of the 1872 Glenorchy Debris Flow

An examination of the 1872 photographs (Figure 3, Figure 4 and Figure 5) showing the landslide affected area in the upper reaches of Humphreys Rivulet seems to show a large hollow area, suggestive of the source area for the landslide, but also seems to show slopes of a much lower overall gradient than would be expected around the source area on the flanks of Mt Arthur (refer to Figure 11). The foreground in these photographs certainly shows stripping of the surface within the path of the debris flow, but it was initially unclear if the upslope areas represent a landslide failure surface or more stripped surfaces.

○ Point of correspondence with 1872 photograph

○ Point of correspondence with present day photograph

Figure 9. Correlation of the present day outcrop in the bed of Humphreys Rivulet with that shown in one of the 1872 photographs of the landslide affected area in the upper reaches of the Rivulet.

An ascent was made of Humphreys Rivulet and it was found that the present day *in situ* outcrop in the bed of the Rivulet at one point could be correlated with the outcrop detail that is shown in the foreground of the photograph in Figure 3 and Figure 5. This correlation is shown in Figure 9 and gives a high degree of certainty as to the camera location for this 1872 photograph – being 517375E, 5253125N (MGA) ±10m. It was observed that the bed of the Rivulet upstream from this location is quite steep and it is obvious that the apparent lower gradient in the 1872 photograph is an optical illusion. In the 1800s the photograph would almost certainly have been taken using a tripod and the camera appears to have been pointing significantly upslope. It is also obvious from the orientation of the corresponding points in the two photographs (Figure 9), and the lean of the nearer trees in the 1872 photograph, that the camera used in 1872 had a lean to the left.

The stereoscopic pair of photographs in Figure 5 provides a much more realistic view of the topography at this site, and show that the apparent large hollow area in the middle of the photographs is again an optical illusion – in part due to the shadows. The stereoscopic view reveals an incised gully in the foreground running up to the base of a steep, broadly planar slope that recedes away from the camera at the top right. Multiple erosion rills can be seen running down the face of this steep slope with flows of water evident down some of the rills. On the right side of the images, near the foot of the broad planar slope, there appears to be some accumulation of slumped material, which is largely draped in shadows. Importantly, it is also apparent that the visible top of this broad planar slope is separated quite some distance from the tree-line that is visible to the rear. Thus it is clear that the area denuded of vegetation extends much further upslope, beyond a break in slope, and is not visible from this viewing point.

The location of the upper landslide source area, being further upstream than the area shown in these 1872 photographs (Figures 3, 4 and 5), is apparent from the DTM (2011 LiDAR survey) and also the 1946 aerial photography (the earliest captured over this area). A deep hollow is visible in both with the headscarp of the landslide still obvious in the 1946 photography, as little vegetation had established there by that time – probably because these very steep slopes continued to be unstable. However by 1946 most of the source area of the landslide, apart from the headscarp, is covered in low vegetation and most of the debris flow path has fully revegetated, making it difficult to be certain about the full extent of the original landslide failure. Although the landslide source area is partly discernible in the 1946 aerial photography much of it would not have been visible from Glenorchy, as evidenced by the statement in The Mercury (14 Aug. 1976) that "gradually it became hidden by encroaching trees and finally, about 1940, disappeared altogether".

The upper portion of the landslide source area, including the deep hollow, is fairly well defined in the LiDAR derived DTM (Figure 10), but the limits of the source area on the slopes below this are not obvious. Having identified the camera location for the 1872 photographs, shown as 'Photograph Point-1' in Figure 10, it is possible to conduct a view-shed analysis. Using the LiDAR derived DTM, a view-shed analysis reveals the parts of the landscape that would actually be visible from a particular point (assuming the vegetation were absent). This analysis clearly shows that from the camera location for the 1872 photographs the observer would not be able to see the upper part of the landslide source area where the deep hollow exists (Figure 10). The upslope limit of the view-shed matches a clear break in slope in the DTM that crosses the landslide source area diagonally, as observed in the stereoscopic pair of photographs (Figure 5).

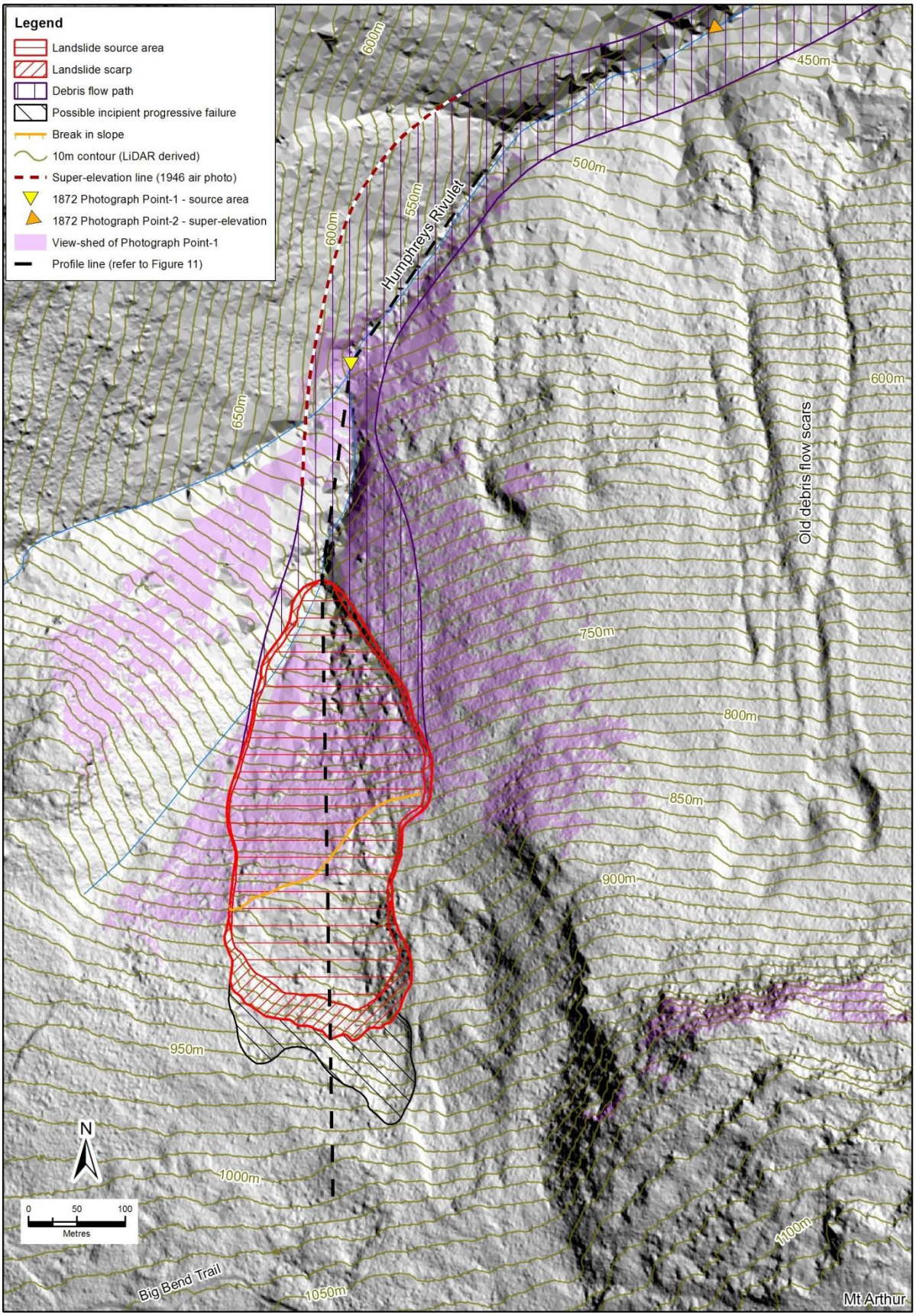

Figure 10. Detailed mapping of the landslide failure of the 4th of June 1872 at the head of Humphreys Rivulet, shown over a LiDAR derived hillshade (with an artificial north-east sun angle). Also shown is the view-shed of the 1872 camera location and the super-elevation line above the first major bend (see later section for discussion). Note the evidence of other debris flows on the slopes to the east.

The stereoscopic pair of 1872 photographs, the 1946 aerial photography and the LiDAR derived DTM in combination allow an accurate map of the original landslide source area to be produced (Figure 10). The stereoscopic pair allow the failed area on the slopes, below the break in slope, to be clearly outlined. The ArcScene™ perspective shown in Figure 8 includes a pinkish area on the flank of Mt Arthur that represents the mapped landslide source area. This perspective matches very well with the landslide scar shown in the Piguenit (c1893) painting and provides confidence that the extent of the landslide's source area has been accurately identified.

Geological Setting and Nature of the Initial Landslide Failure

The entire area surrounding the 1872 landslide source is mapped as Jurassic dolerite, as is most of the upper parts of the Wellington Range, with dispersed areas of Quaternary dolerite slope deposits in the vicinity (Calver, 2007). The mapped slope deposits consist of both dolerite talus and periglacial boulder deposits, and a large part of the landslide source area is mapped as dolerite talus. In reality the entire area is draped with dolerite slope deposits of variable thickness, generally consisting of dolerite rock (up to boulder size) in a clay matrix. The mapped periglacial boulder deposits however lack a clay matrix and are unvegetated. One such periglacial boulder deposit is discernible in Figure 10, adjacent to the landslide source area on its southeast side. Most of the bedrock is obscured by these slope deposits, but inferring from elsewhere on the Wellington Range, the underlying *in situ* dolerite is typically well-jointed, with cooling joints (generally vertical) and stress-release joints (unloading joints parallel to the slope) at variable intensities. The dolerite also typically has a variable depth of weathering and the area of the 1872 landslide source, being at the head of a drainage line, would be expected to have deeper weathering than on the adjacent spurs.

The colonial geologist, Samuel Wintle (1872), described the geology at the landslide source as follows: "Upon gaining the head of [the landslide] I found the greenstone [dolerite] presented a fissile structure" and there was "a high bank of incoherent drift [slope deposits], about 20 feet [6.1m] in depth, crowning all". Wintle (1873) provides a similar description: "Upon examining the head where the mass broke away, I found the greenstone [dolerite] to be highly laminated, and presenting a slope of 43°. Above this, there is a bank of drift [slope deposits] from the higher ground 20 feet [6.1m] in depth and consisting of smaller fragments of greenstone [dolerite] and gravel imbedded in a matrix of yellow clay." These descriptions confirm that the failure surface extended well below the surficial slope deposits and into highly sheet-jointed, and weathered, dolerite. Recent observations at one point, where the geology of the landslide headscarp is still exposed, show that the transition downwards from slope deposits to deeply weathered *in situ* dolerite can be quite subtle, and that the depth of the slope deposits at that point was in the order of 2m depth. This suggests that Wintle's interpretation of slope deposits with a depth of about 6m may have been a misinterpretation of shallow slope deposits capping deeply weathered dolerite (probably with rounded corestones), which in turn overlies weathered and highly sheet-jointed dolerite.

The lower portion of the source area, below the observed diagonal break in slope, has a low scarp around its margins marking the sides of the lower failed area in the 1872 stereoscopic view (Figure 5 and Figure 10). It is apparent that the failure of the slopes across this lower area was relatively shallow, and would have occurred largely within slope deposits. The 1872 stereoscopic view also appears to show bedrock on the exposed steep slope in a number in places that is horizontally jointed. Whereas the deep hollow apparent in the upper part of the landslide source area (Figure 10 and Figure 11) is consistent with the failure surface extending well into the underlying weathered bedrock within that area.

With the true extent of the initial landslide failure being well defined it is now possible to reconstruct the dimensions of the failed mass. The landslide source area in total is about 540m long (measured downslope) and is about 190m across at its head, or about 210m across at its widest point. There being two distinct parts: 1) a deep hollow, where the headscarp and side scarps are at their highest in Figure 10, and 2) the steep lower 70% of the source area below this (crossing the diagonal break in slope). Using the LiDAR derived DTM slope profiles were produced, both within and adjacent to the mapped landslide and it is evident that most of the lower area had a failure depth of around 1m, however it does appear to thicken within about 100m of the toe of the failure to around 2m depth (Figure 10). The upper hollow area is quite deep with a depth of up to about 17m perpendicular to the general slope (Figure 11). The DTM allows an estimate of the volume of the original failed mass by making

the assumption that the original surface approximately followed the trend of the contours adjacent to the landslide area. The volume derived for the upper hollow area is approximately 150,000m³ and that for the lower area of shallow failure is approximately 60,000m³. Thus giving a total failed mass in the order of 200,000m³. There is some uncertainty in this value but it is based on reasonably conservative assumptions about the original surface and it is certainly possible to derive a larger volume.

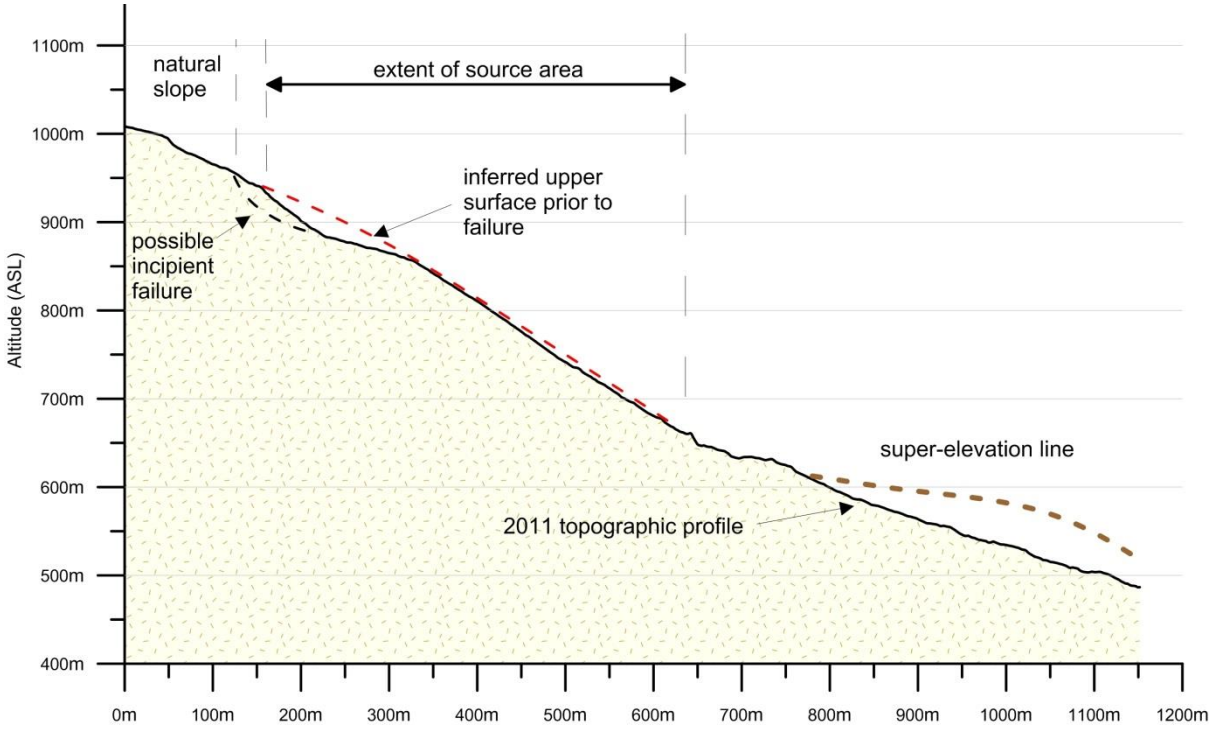

Figure 11. Slope profile through the source area of the 1872 landslide at the head of Humphreys Rivulet – profile line shown in Figure 10. Also shown is the height of the subsequent debris flow super-elevation at the first major bend below the landslide (see next section for discussion).

These observations match quite well with the description of the landslide source area that was provided by Wintle (1872):

> *A large tract of yellow clay, strewn with the ruins of a dense forest, and gigantic masses of rock, stretched upwards to a height of more than a thousand feet* [305m]. *In many places deep channels had been excavated, and down which foaming torrents were rushing. I made the ascent by skirting the slip on the eastern side, a task of much difficulty, owing not only to the great angle, but also to the ground being covered with fallen trees and blocks of stone ……. The clinometers here gave a mean angle of 37°. The mean angle of the site of the "slip" I subsequently found to be 31°. Upon gaining the head of* [the landslide] *……, at the base of which there is a broad terrace having an incline of only 5°, ……*

A useful description of the source area was also provided in The Mercury (12 Jun. 1872), although the dimensions stated are clearly inaccurate:

> *…… reached the top of the slide or the comparatively flat table land forming the new surface of the mountain side caused by the slip of earth. This slopes at an obtuse angle up to the wall or face of earth, which is here disclosed, and which extends in a semicircle for about half a mile and exhibits a depression, from the original formation of the ground, ……*
>
> *Standing as close to the top edge as we could get, and fairly facing the centre of the slide, the following distinguishing features presented themselves. It appeared as though the end of a large rocky spur had fallen away. Assuming the entire cleared space to be divided into four equal parts, the lower three-fourths represented an inclined plane about six hundred yards long, three hundred wide, and sloped at an angle of about 45 degrees. The upper and remaining fourth exhibited a very rugged and irregular surface, was concave in appearance, and extended apparently from the wall to the edge of the steep incline previously mentioned, a distance of about three hundred yards, and across the valley about the same distance, and was sloped at an angle of about twenty degrees.*

The sides gradually decrease in height till their points or ends meet the top of this inclined plane. A later subsidence of rock and soil has destroyed the originally almost perpendicular character of the back wall of this hollow.

The 'floor' of the upper hollow area (Figure 10 and Figure 11) is characterised by Wintle (1872) as a "broad terrace" with a low slope of only 5°, whereas The Mercury (12 Jun. 1872) report describes it as an "irregular surface" with a slope of about 20°. The modern LiDAR derived DEM shows that the irregular 'floor' of this hollow is sloping at approximately 15-17°, but it is likely that this slope has changed since 1872 with material washing down onto this surface. Wintle's stated slope is clearly too low and it is notable that this slope value was not repeated in his later paper (Wintle, 1873).

The form of the landslide source area and its two distinct parts strongly suggests the failure mechanism. Failure probably initiated as a large block failure in the upper part, extending well into the underlying weathered dolerite, and slid on a low sloping failure surface (of about 15°). This large block will have moved toward the steeper slopes of the lower part, where it would then have rapidly accelerated (perhaps as a 'debris avalanche'), and removed material from the lower slopes as it passed over them down to a depth of about 1m (Figure 11). The failed mass would have disaggregated into a very large debris flow as it was funnelled into the channel of Humphreys Rivulet (Figure 10).

Wintle (1873) came to a similar conclusion but invoked the idea of a body of water building up (see later discussion) behind the initial block failure:

…… taking into consideration the incoherent nature of the soil and surface of the bottom rock at this point, and also the very great incline, I am disposed to think that the dislocation happened at this point, through supersaturation and undermining by the great water-flow from the head of the mountain. ……

When the first mass of earth gave way, at or near the head of the slip, it formed an embankment or dam where the angle of the incline is least; the accumulated water at last bursting its bounds, the whole mass was precipitated into the gully below, carrying all before it, ……

The LiDAR derived DTM also reveals evidence of other landslide activity in the vicinity of the 1872 landslide source area. To the east, on the right side of Figure 10, is evidence of a group of smaller past debris flows on the northern flank of Mt Arthur. The hollows of the source areas are evident as well as the debris flow runout paths. Immediately above the headscarp of the 1872 failure is an irregular depressed area (Figure 10), extending up to 100m further upslope, that may be a large incipient failure. This would represent a progressive failure developing since the 1872 landslide (Figure 11) and could have initiated at any time since then, but possibly shortly after the first failure. As mentioned above, the steep slopes of the headscarp appear to have remained unstable for many decades and had little vegetation established on them in 1946. A small part of the western side of the headscarp remains unvegetated to the present day and is still the source of small debris flows. A small debris flow occurred off this slope in the early 1970s and a larger one, of about 130m length, had occurred by the early 1980s; with further reactivation in the mid-1990s. It is possible that the continued instability on the headscarp could be related to slow movement of the broader incipient failure.

The Upper Debris Flow and Evidence of Super-elevation

The historical accounts provide several useful descriptions of the course of the debris flow in the upper reaches of Humphreys Rivulet. These accounts also describe the flow running up higher on the outsides of bends (known as 'super-elevation') and make particular mention of the effects at the first major bend in Humphreys Rivulet below the site of the landslide. Wintle (1872) describes the course of the debris flow in the upper reaches of the Rivulet as follows:

From where the greenstone [dolerite] *first appears* [near the present day Tolosa Park]*, up to the foot of the great "slip", both banks of the rivulet present the appearance of a railway cutting through hills upon a gigantic scale. Trees and soil have been removed most completely to an average height of 80 feet* [24.4m]*. But what strikes the superficial observer as being a somewhat paradoxical feature, is the fact that wherever the water has reached to the height just named on one side of the rivulet, it has not left a trace of having risen to more than fifteen or twenty feet* [4.6-6.1m]*, at the most, on the opposite bank.*

The available 1872 photographs showing the lower part of the landslide source area (Figure 3, Figure 4 and Figure 5) clearly show in the foreground shallow stripping of the surface material within the path of the debris flow. Figure 10 shows the location from which these photographs were taken as '1872 Photograph Point-1', which is accurately located. The mapped debris flow path upslope from this point is interpreted from these 1872 photographs. The stereograph in Figure 6, taken from a point a little further down Humphreys Rivulet, also shows a broad zone of shallow stripping with the passage of the debris flow around the first major bend below the landslide source area. Figure 10 shows the location from which this photograph was taken as '1872 Photograph Point-2' – an approximate location (±50m) based on the waterfall in the foreground (Figure 7), which is clearly composed of sedimentary geology that is known to only have a relatively small area of outcrop along the upper reaches of Humphreys Rivulet. Figure 6 shows an extremely high level of super-elevation on the outside of this first major bend (on the right side of the stereograph), where the initial failure, having transformed into a debris flow, ran up the slope as it hit this first major bend opposite the source area. Also visible is the corresponding stripping to a relatively low level on the inside of the bend.

As mentioned earlier, the debris flow path has fully revegetated by the time of the 1946 aerial photography, however this photography does show a subtle line separating differing forest vegetation on the slopes above the first major bend in Humphreys Rivulet. This line crosses minor tributaries and spurs along Humphreys Rivulet and appears to be unrelated to the topography or the underlying geology. This line appears to be residual evidence of the super-elevation line, the upper limit of the debris flow path, and is consistent with the stripped area shown in the stereograph of Figure 6. This super-elevation line, along with the debris flow path through this bend (interpreted from the stereograph – Figure 6), are shown in Figure 10. This mapping suggests a maximum height for the super-elevation of about 50m, vertically, above the bed of the Rivulet. Further down Humphreys Rivulet no other clear evidence of super-elevation could be derived from the 1946 aerial photography.

The historical descriptions confirm that the super-elevation was highest at the first major bend below the landslide source. In fact the earliest newspaper reports, prior to an ascent of Humphreys Rivulet, describe an upper and lower landslide on either side of Humphreys Rivulet – having mistaken the super-elevated debris flow path, at this first bend, for a lower landslide scar. The Mercury (6 Jun. 1872) describes the two apparent landslides as follows:

> …… *that* [the landslides] *have been of very great extent, admits of no doubt. They occurred amongst the subsidiary hills at the base of Mount Wellington, and about six miles from O'Brien's Bridge* [that is, Glenorchy]. *The earth has not slipped in one mass, but in two distinct divisions on either side of the gully which forms the source of the creek crossing the road at O'Brien's Bridge. …… From observation the first would appear to extend in one direction for nearly a mile, and the area of earth has been variously estimated to contain from 200 or 640 acres of land. The second slip on the further side of the creek is of much smaller proportions, and not much more than half of the magnitude of the other.*

The true nature of the lower (or smaller) feature is clarified in subsequent reports once ascents had been made of Humphreys Rivulet. The Mercury (10 Jun. 1872) describes the debris flow path and super-elevation as follows:

> *From the bed of the creek, for perhaps 80 yards* [73m] *up, each hill-side has been swept of every tree, and the ground is covered with silt and sludge in which stones, rocks, fragments and nearly whole trunks of trees lie tossed together in supreme confusion. …… my companions judged the torrent must have been at least 150 yards* [137m] *wide, and perhaps 70 feet* [21m] *deep. ……*
>
> *What is spoken of here as the "small landslip" appears to be on the clearance made by the surging of the water when its course was arrested by the hill which faces that down which it poured. The so-called small slip is exactly opposite the large one. If the winding course of the valley permitted, it would be seen from the main road that each side, for some distance downwards, is bared almost as high up from the bed of the creek.*

The Mercury (12 Jun. 1872) reports:

> …… *we at length reached the locality of what has hitherto been called the small landslip, but which on a close examination appears to be no land slip at all. The bare hill side, which like the larger land slip presents such a peculiar appearance from the road side, has been caused by the rush of water down the mountain …… and with mighty and resistless force swept the precipitous hill side and carried off the timber, surface soil, and vegetation, leaving it barren to a height of nearly 150 feet* [46m], *and causing it to present the appearance at a distance of a huge fall of earth having taken place. That such however, has not been the case is abundantly demonstrated by a*

close inspection of the ground, as little more than a foot of the surface soil is washed away, and, above the height reached by the waters, the slopes are still fringed with a dense growth of forest and scrub extending in an unbroken line along the level reached by the flood.

This Mercury (12 Jun. 1872) account provides a maximum height for the super-elevation at the first bend that supports the super-elevation line as mapped in Figure 10.

Figure 12 shows a constructed ArcScene™ view from Glenorchy looking up towards the source area of the 1872 landslide. In this view the mapped super-elevation line (in yellow) at the first major bend is clearly visible from Glenorchy, below the mapped landslide source area (in red), which itself is partly obscured from view by a spur in front. It is evident that the view of the debris flow path at the first bend would have been separated from the source area by the same spur, thus creating the impression of two separate landslide scars. It is also evident from Figure 12 that the super-elevation line at the first major bend could not have been much lower than currently mapped; otherwise the debris flow path would not have been particularly visible from Glenorchy and thus mistaken for a second landslide scar.

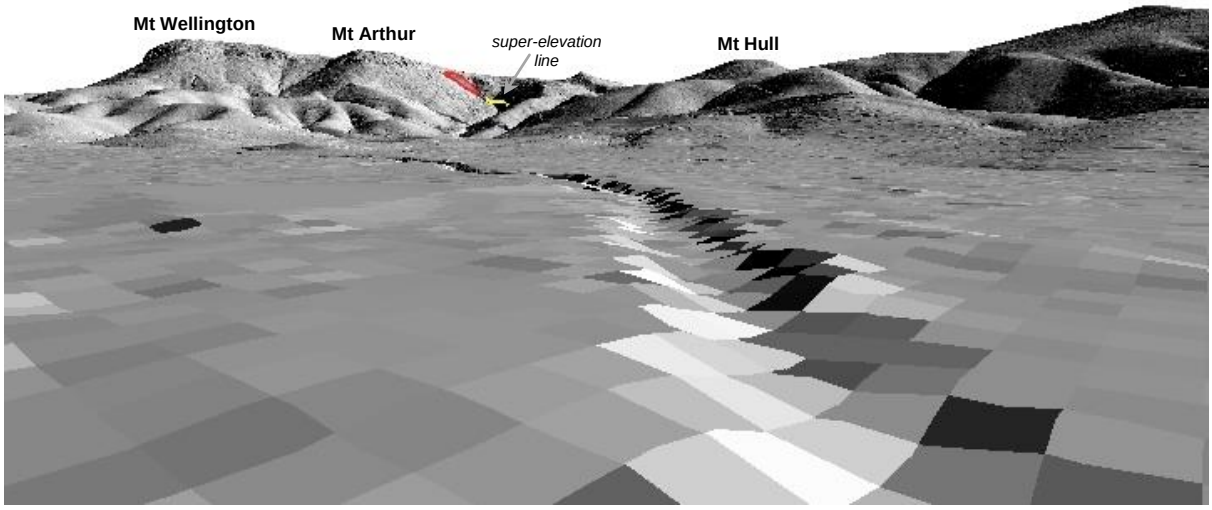

Figure 12. View of the terrain from Glenorchy towards the source of the 1872 landslide with Humphreys Rivulet in the foreground – created using ArcScene™ software and a DTM derived from the 2011 LiDAR survey over Mt Wellington. The red outline is the mapped landslide source area and the yellow line represents the super-elevation line at the first major bend below the landslide.

Wintle (1872) provides further details on the course of the debris flow through the upper reaches of the Rivulet:

…… on both boundaries of the rivulet the water had risen alternately to a surprising height, not only depositing the barkless trunks of huge trees along the edge of the water-line, but also snapping asunder standing trees, at a height in some instances of sixty feet [18m] *from their base; ……. when the great rush of water occurred …… it would, upon striking the slope of the first hill, abutting on the rivulet, be deflected in a great wave on the opposite side, and thus after the motion of a pendulum would leave alternate traces of its devastation.*

For unknown reasons, in describing the super-elevation observed during the ascent of Humphreys Rivulet, Wintle (1873) provides lower estimates of the heights for the debris flow to those in the two Wintle (1872) accounts above:

…… the water had swept every thing before it to a height of 60 feet [18m] *on the one side of the gully, and only to 12 or 15 feet* [3.7-4.6m] *on the opposite side. This feature is to be seen alternating until the foot of the landslip is reached.*

and:

When the first great body of water had been thrown to a height of 60 vertical feet [18m] *on one side of the gully, it deposited at its edge the trunks of enormous trees.*

The second statement appears to refer to the super-elevation at the first major bend, but must be in error because a height of about 18m is no higher than is stated for the remainder of the debris flow's path. This second statement does not accord with all of the other descriptions of the super-elevation at this location, nor the

evidence of the 1872 stereograph (Figure 6), and perhaps also draws into question the heights in the first statement from the 1873 report.

The various historical accounts of the debris flow path in the upper reaches of Humphreys Rivulet suggest that the average depth of the debris flow in this area was in the order of 20-25m, disregarding the Wintle (1873) account. Considering all of the accounts together, and the evidence of the 1872 stereograph and the 1946 aerial photography, suggests that super-elevation was observed on most of the bends in the upper Rivulet, and that the first major bend had a particularly high super-elevation in the order of 50m height (vertically).

Timing of the 1872 Glenorchy Landslide and Debris Flow

The full set of historical accounts state a confusing array of times at which the landslide and subsequent debris flow took place. Most of the later reports are completely at odds with the contemporary reports. However, the contemporary reports, including those of Wintle, make the timing relatively clear and show that the sounds marking the event were obvious to all.

Mercury (6 Jun. 1872):

> *The residents in the vicinity of O'Brien's Bridge were at a late hour on Tuesday* [the 4th of June] *congratulating themselves on the belief that the worst danger had passed, …… when at about half-past ten o'clock a dreadful dull rumbling sound, a heavy smothered crash, and a deafening roar of flowing waters, gave evidence of some unusual convulsion of Nature.*

The following three accounts show that the sound of the event was clearly audible. The Mercury (6 Jun. 1872) states:

> *In order to convey some idea of the noise produced by the land slip, it may be mentioned that it was distinctly heard at Risdon ferry some nine miles distant.*

The Mercury (7 Jun. 1872) states:

> *Mr. Calloway* [actually Kellaway] *describes the descent of the waters as most terrific, the noise caused by the enormous boulders as they came crashing down the creek, being likened to the discharge of a hundred pieces of heavy ordnance.*

and the Guide to Excursionists (1879) states:

> *At ten o'clock at night, dark as Erebus, a concussion was felt as if a magazine of 100 tons of gunpowder had exploded; the country around was shaken; the noise was heard at Risdon many miles off; it shook the house of Tolosa* [at Glenorchy] *which stands on a limestone rocky eminence, ……*

Wintle (1872) states:

> *…… from the moment of the loud rush and roar of the water being heard up to the time when its force was spent on the banks of the Derwent, six miles away, only ten minutes elapsed. In that time all the ruin and desolation had been accomplished.*

Wintle (1873) states:

> *As the cataclysm occurred between 10 and 11 o'clock at night, no eye beheld what part of the mountain-side first gave way*

and:

> *Before I started upon my examination of the site of the slip, I made particular inquiry among the residents of the district respecting the sounds they heard when the event took place. One and all informed me that at first they thought an earthquake had happened—that at five miles distance a rumbling roar was heard at intervals, and it was not till some time had elapsed from the first sound that the destructive body of water made its appearance at the township.*

From the contemporary reports it can be concluded that the whole event, from the initial large-scale collapse of the landslide and the subsequent debris flow down to the River Derwent, occurred between 10 and 11pm on the 4th of June, 1872. The first indication of the event that was heard by the residents of Glenorchy, and around the region, was a loud "rumbling sound, a heavy smothered crash" that was likened to an earthquake. This is likely to be the initial failure of approximately 200,000m³ of material, which would be expected to be quite audible, especially as the rainfall event was nearing its end and the peak intensity had passed several hours beforehand (see

below). The Wintle (1873) account describes "a rumbling roar heard at intervals" that would almost certainly be associated with the travel of the debris flow through the bends of the upper reaches of Humphreys Rivulet.

Importantly, Wintle (1872) states that the whole event, from the first sound, only took about 10 minutes to reach the River Derwent. The measured planimetric length of the debris flow's course down to the River Derwent is 9.1km (from the headscarp of the initial failure), and then adjusting for the steep upper reaches of Humphreys Rivulet gives the actual length of the debris flow course as 9.2km. This then provides an estimate for the average velocity of the debris flow at about 15m/sec, or 55km/hr. This velocity easily exceeds the limit of 5m/sec for the 'extremely rapid' landslide velocity class of Cruden and Varnes (1996). Various international studies show that most of the fastest recorded (or back-calculated) debris flow velocities are in the order of 17-18m/sec, or 60-65km/hr (e.g. Prochaska, *et al.*, 2008); putting the 1872 Glenorchy event in the upper bracket of debris flow velocities worldwide.

Formation of a Debris Dam during the Debris Flow Event

As discussed there was considerable speculation at the time as to the cause of the debris flow and where the perceived great volume of additional water had come from – the concept of a highly fluidised debris flow not being understood, even by the geologist Samuel Wintle. The only realistic theory put forward at the time was that of a large temporary dam being formed in Humphreys Rivulet by the landslide debris, which then subsequently burst. This dam burst theory was widely reported.

In regard to temporary dams forming below the initial landslide source, Wintle only suggests that small, very short-lived dams or blockages formed along the upper reaches of the Rivulet as the debris flow progressed downward – Wintle (1872):

> *Here and there are evidences of dams having been subsequently formed lower down the rivulet, where a more than usually sharp bend exists. Their formation and disruption must have been remarkably rapid, ……*

Wintle (1873) describes the course of the debris flow, after the first major bend, as:

> *…… much of its force being now expended, another dam was formed by the huge trees and rocks; and thus a repetition of disruptions of bodies of water occurred. This is to be seen in several parts of the rivulet by the arrangement of the stones.*

Since it is reliably reported that the debris flow only took 10 minutes to travel its full length down to the River Derwent, at an average velocity of about 55km/hr, it seems very unlikely that there was any significant impediment to its flow. This casts serious doubt on all reports of a large, temporary dam having formed within Humphreys Rivulet, especially when it is considered that the debris flow occurred at 10-11pm in winter when such a temporary dam could not have been observed.

It is possible that the remnant features that Wintle observed, and assumed to be the remains of temporary dams, could have in fact been material deposited after the main body of the debris flow had passed. Pulses of debris subsequent to the main flow have often been observed in modern debris flows, and some of this later deposited material could easily have come from secondary collapses.

As mentioned, Wintle also put forward an entirely different dam burst theory to explain the perceived great volume of water in the flow. He proposed that a dam had formed at the very head of the landslide, behind the initial block failure – Wintle (1873):

> *When the first mass of earth gave way, at or near the head of the slip, it formed an embankment or dam where the angle of the incline is least; the accumulated water at last bursting its bounds, the whole mass was precipitated into the gully below, carrying all before it, ……*

Similarly in Wintle (1872):

> *Nothing is more likely than that the* débris *of the detached mass would form an embankment at the terrace referred to, whereby a large body of water would soon be collected, ……*

Given that the initial failure was not observed, and the passage of time since, it is not possible to establish if Wintle's theory has any basis in fact. It is possible that the initial block failure, on a sloping surface of around 15°, could have been evolving over a long period of time. If this were the case, then there may have already been some

form of cavity at the head of the landslide before the rainfall event of the 4th of June, 1872, and would likely have gone unnoticed. Such a cavity would certainly have greatly aided the ingress of water into the slip plane and help drive the initial block failure.

Most later historical accounts refer to the formation of a large, temporary dam as a matter of fact (e.g. Guide to Excursionists, 1879; Hull, 1940). The Guide to Excursionists (1879) even provides specific details about the height of the dam, 60 feet [18m], and the length of the body of water captured behind it, 300 yards [274m]. However it then goes on to say that this dam was visible from the windows of the Tolosa homestead and that it had formed by 11am on the morning of the 4th of June, 1872. Having established where the Tolosa homestead is located, near the present day junction of Tolosa and Burton Streets (see later section), it would only be possible to see such a dam, especially of that length, if had formed down on the floodplains at Glenorchy. This is entirely contradictory to the other observations and the timing is clearly at odds with all other evidence. It seems likely that what was actually being described from the "windows of Tolosa" was the rising flood waters earlier in the day down on the floodplain at Glenorchy.

The contemporary accounts of the timing of the events, discussed above, leave little room for the formation and bursting of a large temporary dam. The only large temporary dam that may have been possible with this timing is that theorised by Wintle (1872, 1873), i.e. a temporary dam forming behind the initial block failure (of approximately 150,000m³) at the head of the landslide. Although it is not considered by the authors that such a temporary store of water is necessary to the formation of the 1872 debris flow.

It appears that the erroneous timing for the debris flow that is given in the later reports is largely based on an acceptance of the theory that there was a large temporary dam formed after the initial failure, which subsequently burst. An idea which seems to have been based on the observation that the flood waters were subsiding at Glenorchy at the time that the debris flow occurred (Mercury, 6 Jun. 1872; Guide to Excursionists, 1879; Hull, 1940), and also put forward to explain the perceived great volume of additional water.

An analysis of all of the historical accounts and an understanding of the topography strongly suggest that the formation of a temporary dam that subsequently burst is nothing but speculation, with little support from the known facts.

The speculation around the formation of a temporary dam, and the acceptance as fact in later accounts, has led to the incorrect assumption in more recent publications that a temporary dam was indeed a key part of the disaster of the 4th of June 1872. The geologist David Leaman (1999, 2002) briefly describes the 1872 Glenorchy debris flow in two of his books where he states that Humphreys Rivulet was first dammed and then the debris was catastrophically released.

Hobart Water commissioned a report (Fell and Moon, 2007) to review the earlier debris flow susceptibility mapping for Mt Wellington by MRT (Mazengarb, 2004a, 2004b) and also to conduct a debris flow risk assessment. Fell and Moon (2007) modelled the debris flow hazard from Humphreys Rivulet on the basis that a large debris dam did in fact form in 1872 and then breached – they modelled dam heights of 10m, 15m and 22m. However the report does point out that no evidence was found for a large breached debris dam, so a site was selected about 2.3km downstream from the landslide source – a point considered by them to be the likely limit of debris flow travel and where the slope of the steam bed reduces. (Note: the validity of this limit to debris flow travel will be tested by debris flow hazard modelling – to be reported separately). Fell and Moon (2007) also judged that the 1872 Glenorchy debris flow had an initial volume of about 70,000–100,000m³, which is less than half of the measured volume (as shown earlier), but their volume appears to have been derived from an assumption that the initial failure would be largely within colluvial material. Nevertheless, Fell and Moon (2007) also judged that the maximum credible debris flow size from Mt Wellington would be in the order of 300,000m³.

The Associated Rainfall of 1872

In order to properly understand the cause of the landslide and debris flow event of 1872 it is important to define the associated rainfall. It is not only important to understand the magnitude and timing of the rainfall event that triggered the landslide, but also to understand if the antecedent rainfall leading up to the debris flow contributed to preparing the site for failure.

Newspaper reports provide a general description of the rainfall event and broadly describe the timing. The Mercury (5 Jun. 1872) states:

> *After several fine days, up to Monday last* [the 3rd of June]*, when the weather was dull and hazy, a change occurred at midnight, and rain set in with a strong south-westerly gale, increasing during the night to a hurricane.*

and:

> *By five o'clock* [the 4th of June] *the flood had begun to subside, but a great deal more rain fell during the night.*

The Mercury (6 Jun. 1872) states:

> *We may mention that the subsidence of the flood in Hobart Town commenced on Tuesday evening* [the 4th of June]*, although the rain continued, and the wind blew strongly to a late hour.*

and:

> *The residents in the vicinity of O'Brien's Bridge were at a late hour on Tuesday* [the 4th of June] *congratulating themselves on the belief that the worst danger had passed, and hailing with satisfaction the gradual subsidence of the waters in the creek, when at about half-past ten o'clock a dreadful dull rumbling sound …..*

These reports, and others, show that significant rainfall started after midnight on the night of Monday, the 3rd of June, and continued throughout the next day. The subsidence of the floodwaters from about 5pm onwards on Tuesday, the 4th of June, indicates that the peak intensity of the rainfall event had occurred subsequent to this, but rain continued well into the night.

Bureau of Meteorology Records

The Bureau of Meteorology has two meteorological stations for Hobart listed as having been established prior to 1872:

- Station 094030 – Hobart Botanical Gardens, established 1841
- Station 094132 – Hobart (Murray Street), established 1855

However the Bureau of Meteorology does not hold any daily meteorological data for either of these stations for 1872. The Botanical Gardens station has daily data starting from 1885 and the Murray Street station includes only daily rainfall data for 1856-60 and 1876-80.

The Botanical Gardens site was originally established by the British Royal Society as the Royal Observatory, Ross Bank, in 1841 on the Queens Domain near Government House. This observatory was then handed over to the Colonial Government in 1853. Observations at this site ceased in early 1855 but were then re-established at a nearby site (Station 094030) much later (Bureau of Meteorology, 1999).

A private observatory was established by Francis Abbott in his home garden on Murray Street, Hobart (Station 094132), and he began taking observations from 1 January 1855 (Bureau of Meteorology, 1999). With the inclusion of the data from the Royal Observatory, Ross Bank, Abbott maintained a continual set of meteorological data for Hobart from 1841 onwards.

When considering these early meteorological observations it needs to be understood that standard meteorological observation times were not instituted until well after 1872.

The Bureau of Meteorology also has a long-running meteorological station in Hobart that was established in 1882, following Francis Abbott's retirement in 1880:

- Station 094029 – Hobart (Ellerslie Road)

This station is still operating and provides long-term rainfall data for Hobart (Bureau of Meteorology, 1999).

Meteorological Returns of Francis Abbott ("Astronomer of Tasmania")

Francis Abbott (1799-1883) was a watch and clockmaker who, having acquired his trade in England, where he also published works on time-keeping and astronomy, was sent out to Van Diemen's Land as a convict for "obtaining two watches under false pretences". Upon receiving his 'ticket of leave' in 1849 he established himself as a watch and clockmaker in Hobart. Abbott was given training in meteorological and astronomical observation at the Royal Observatory, Ross Bank, in Hobart. He quickly established a successful business and gained a respected reputation as a meteorologist and astronomer (Rimmer, 1969).

Abbott set up his private observatory at his home, which was then 78 Murray Street, in the block between Liverpool and Collins Streets in central Hobart. This address is sourced from the Valuation Rolls that were published annually in the colonial government's Hobart Town Gazette (1825-1880). The modern address for the location is around 86 Murray Street.

Abbott made three daily observations at 7am, 1pm and sunset (Abbott, 1866; Ashcroft, *et al.*, 2014). The summarised daily data was compiled into monthly reports and published in The Mercury (Hobart) newspaper (Abbott, 1872a) and also the Papers and Proceedings of the Royal Society of Tasmania (Abbott, 1872b). The data for the three individual daily observations have not survived. Given that it is reported that significant rainfall started after midnight on the night of the 3rd of June (Mercury, 5 Jun. 1872) and Abbott reports 1.29 inches of rain for the 3rd, and also by comparison with Dr Hall's observations (see below), it is clear that Abbott's daily rainfall totals were taken as of the 7am observation time and assigned to the previous day. The minimum and maximum daily temperatures reported by Abbott were recorded using self-registering thermometers (Abbott, 1861).

Francis Abbott's summarised daily rainfall data for the period of November 1871 to July 1872 are presented in Appendix 2 and shown in Figure 13. Abbott's summarised daily meteorological observations (rainfall, atmospheric pressure and temperature) for early June 1872 are presented in Appendix 3.

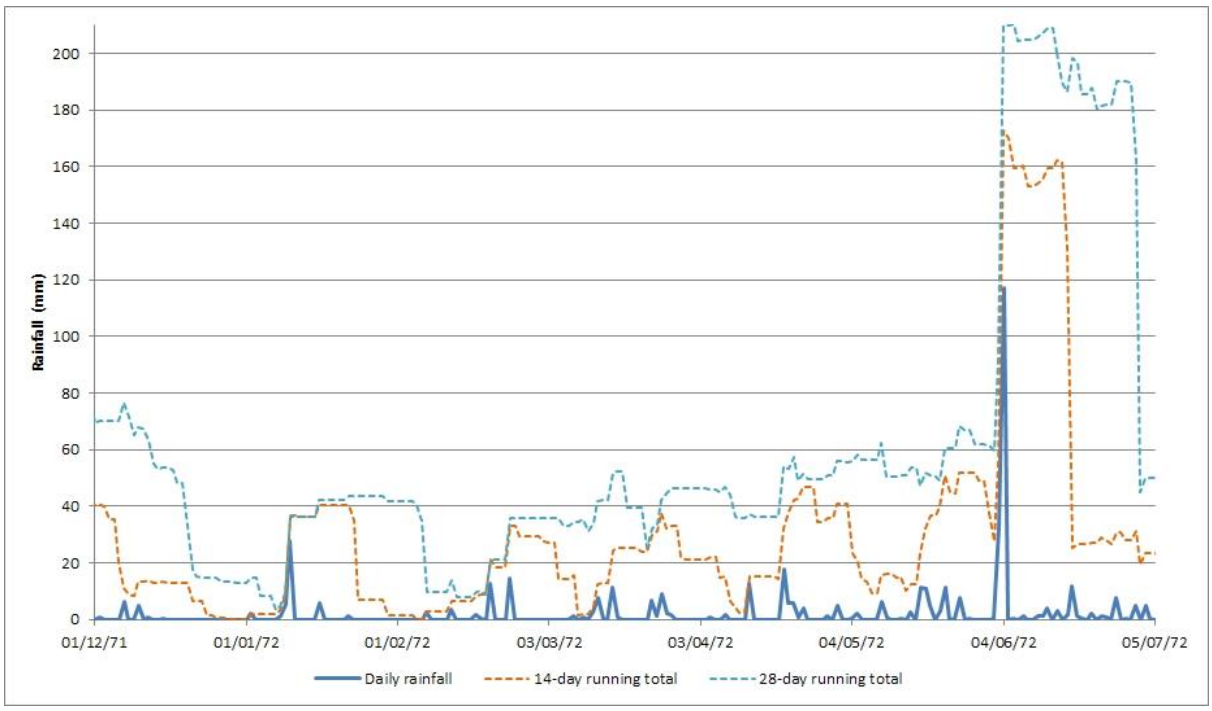

Figure 13. Francis Abbott's daily rainfall data for the 1st of December 1871 to the 5th of July 1872, showing the antecedent rainfall as 14-day and 28-day running totals. Note: the rainfall shown for the 4th of June, 1872, is the adjusted total of 117.3mm (4.62 inches) derived from Dr Hall's records (see below) – the total rainfall event is reported over 3-4 June, 1872.

Meteorological Data of Dr. Edward Swarbreck Hall

Dr Edward Swarbreck Hall (1805-1881) was a qualified medical practitioner who immigrated to Van Diemen's Land in 1832. He filled various medical roles for the colonial government and was a vocal advocate for reform in the health care system and public health, particularly in regard to the treatment of convicts and the poor (Australian Dictionary of Biography, 1966). Dr Hall had a keen interest in the relationship between the weather and public health and reported detailed statistics on the correlation of both in monthly reports to the Papers and Proceedings of the Royal Society of Tasmania. These reports were often published in the proceedings, and also the Mercury (Hobart) newspaper, in association with Abbott's monthly meteorological reports.

Dr Hall made his own meteorological observations at his home, which was then 24 Melville Street, in the block between Elizabeth and Argyle Streets. As for Abbott, this address is sourced from the Valuation Rolls published in the Hobart Town Gazette (1825-1880). The modern address for this location is around 40-42 Melville Street. This address is approximately 360m from where Francis Abbott had his private observatory, thus both were located within central Hobart. Therefore it is expected that the meteorological observations of Abbott and Hall should be quite similar.

Some of Dr Hall's original meteorological observations have survived in the form of handwritten meteorological diaries. These are held at the Tasmanian Archives and Heritage Office and include the year 1872 (Hall, 1872). These diaries show each of Dr Hall's three daily observations, which were recorded at different times to Abbott, at around 10am, sunset and around 10pm. Many of the rainfall measurements (one, two or three per day) are not recorded with a time, but reference to the weather descriptions provided makes it clear at which of the three observation times the rainfall measurement was recorded in each case. Dr Hall's atmospheric pressure and temperature measurements are recorded in pairs, presumably at the same time, twice a day. By comparison with Abbott's minimum and maximum daily temperatures it is clear that Dr Hall's temperatures (and presumably the paired atmospheric pressures) were recorded at the 10am and 10pm observation times.

Dr Edward Swarbreck Hall's three daily meteorological observations for early June 1872 are presented in Appendix 3.

Differences in Historic Rainfall Records

Generally Dr Hall's three daily meteorological observations are consistent with Abbott's summarised daily observations; making allowance for the different observation times – as is expected given the proximity of their meteorological observatories. It should be noted that Abbott's summarised daily rainfall data reported for each day actually has the final observation made at 7am the following day (the modern standard observation time being 9am), whereas Dr Hall's data is simply recorded in his meteorological diaries at each observation time. However there are some minor omissions in Dr Hall's meteorological diaries, particularly in regard to very small falls of rain.

Importantly, for the rainfall event associated with the landslide and debris flow of the 4th of June, 1872, there is a major discrepancy between Abbott's and Hall's rainfall records (refer to Appendix 3). Abbott has a total rainfall for this event (3-4 June) of 4.75 inches (120.7mm) whereas Dr Hall has a total of 5.91 inches (150.1mm) recorded over four observations from 10am on the 4th of June to 10am on the 5th of June. Dr Hall also reported his total rainfall for this event to the June 1872 meeting of the Royal Society of Tasmania, stating that "During the flood last Tuesday, I measured in my rain-gauge 5.91 inches in the 24 hours" (Royal Society of Tasmania, 1873).

Abbott records 1.29 inches (32.8mm) for the 3rd of June (i.e. up to 7am on the 4th of June) and 3.46 inches (87.9mm) for the 4th of June (i.e. up to 7am on the 5th of June). Plotting the cumulative rainfall for the records of both Abbott and Dr Hall shows that Abbott's first rainfall measurement (at 48 hours, Figure 14) would be consistent with Dr Hall's observations, but the second measurement (at 72 hours, Figure 14) is not consistent. Abbott's second rainfall measurement (up to 7am, 5th of June) gives a cumulative rainfall greater than Dr Hall's 4.45pm measurement (about sunset, 4th of June) but less than his 9.45pm measurement (4th of June). Given that Abbott is known to have been making observations at 7am, 1pm and sunset (Abbott, 1866; Ashcroft, *et al.*, 2014), it appears that the discrepancy occurred between sunset on the 4th of June and 7am on the 5th of June (58 to 72 hours, Figure 14). A likely cause for such a large discrepancy in the rainfall would be an over-flowing rain gauge in

the intervening 14 hours – an approximate period within which Dr Hall records 1.75 inches (44.5mm) of rain, on top of the 2.87 inches (72.9mm) of rain that he had recorded in excess of Abbott's 7am, 4th of June, measurement (1.29 inches). If Abbott's rain gauge had over-flowed then this suggests that his rainfall measurement for the 4th of June (i.e. up to 7am on the 5th of June) should have been about 4.62 inches (117.3mm).

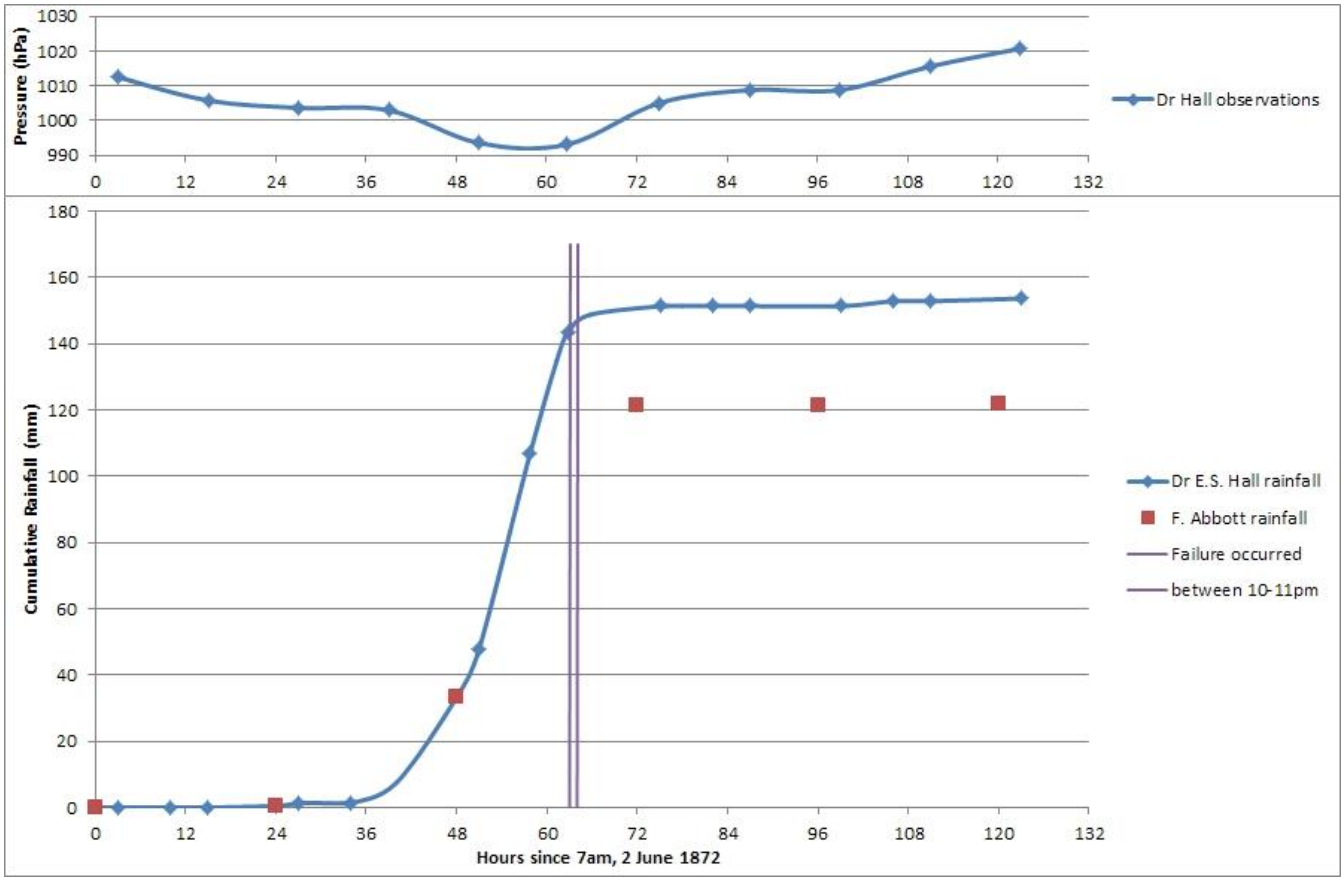

Figure 14. Cumulative rainfall from 7am on the 2nd of June to 10am on the 7th of June, 1872, as independently recorded by Dr Edward Swarbreck Hall and Francis Abbott. Also shown is the atmospheric pressure as recorded by Dr Hall and the period within which the landslide and debris flow are known to have occurred (10-11pm on the 4th of June, 1872).

It is not stated why Dr Hall reported his total rainfall for this event to the Royal Society of Tasmania (1873), which he did not normally do, but possibly because it was recognised that Abbott's recorded total was deficient. In any case it is difficult to explain, other than an over-flowing rain gauge, why Dr Hall would have a significantly higher rainfall recorded for this one rainfall event. Therefore it is assumed here that Dr Hall's measurements more accurately reflect the true total rainfall of this event (150.1mm). An adjustment to Abbott's rainfall data is then necessary for the 4th of June, to 4.62 inches (117.3mm), and this is reflected in Figure 13 and Table 1.

The only other reports found that mention the rainfall total for 3-4 June, 1872, are the two published papers of Wintle. In which Wintle (1872) states:

> *On the 4th June, 1872, the colony of Tasmania was visited by the heaviest rainfall that has taken place since the flood of 1854. Within twenty-four hours (the usual period assigned for the computation of such meteorological disturbances) no less than 4½ inches of rain fell. It was a steady, thick, incessant, and most determined downpour for fully one-half of that time.*

Wintle (1873) states:

> *On the 4th of June last this colony was visited by a very heavy rainfall, which continued without intermission for twenty-four hours, when 4½ inches of rain fell, causing most disastrous floods in many parts of the island.*

Both accounts state that 4.5 inches (114.3mm) of rain, or "no less than" this, fell over 24 hours. This amount is less than Abbott's total rainfall of 4.75 inches (120.7mm) and certainly less than Dr Hall's total of 5.91 inches (150.1mm). However this amount is also much greater than the 24-hour rainfall reported by Abbott for the 4th of June (7am to 7am), being 3.46 inches (87.9mm). It is possible that the stated rainfall of "no less than 4½ inches"

"for twenty-four hours" is merely an estimate of the rainfall that was actually confined to the 24-hour period (midnight to midnight), based on Abbot's reported rainfall (to 7am).

Characterising the Rainfall Event of early June 1872

Dr Hall states that the measured rainfall fell "in the 24 hours" (Royal Society of Tasmania, 1873) and his meteorological diaries, in combination with Abbot's records (refer to Appendix 3), show that the rainfall occurred over a period of no more than 24-33 hours. This period appears to have begun with only very light rain on the evening of the 3rd of June, with Dr Hall's observation of "mizzling again now 10½ pm". The newspaper reports state that the heavy rainfall started after midnight on the night of 3rd of June and that "a great deal more rain fell during the night" of the 4th of June without clarifying when the heavy rain ceased (Mercury, 5 Jun. 1872). Following Dr Hall's 9.45pm observation on the 4th of June he recorded only a further 0.31 inches (7.9mm) of rain, and sunny conditions, the next morning (at about 10am on the 5th of June).

Given Dr Hall's statement to the Royal Society of Tasmania, and these other observations, it seems likely that the great bulk of the rain fell within a 24 hour period. This is also supported by Wintle (1873) who describes "very heavy rainfall, which continued without intermission for twenty-four hours". This period extends from about midnight on the night of 3rd of June, 1872, and ends at a time after about 10pm on the 4th of June, 1872. Thus the landslide and debris flow event, having occurred between 10 and 11pm on the 4th of June, happened around the end of the major rainfall event and well after the peak intensity of the rainfall, as evidenced by the subsiding flood levels from about 5pm onwards in Hobart (Figure 14).

The long-running meteorological station in Hobart (Ellerslie Road, Station 094029) provides rainfall statistics for the years 1882 to 2014 (Table 1), with which the June, 1872, rainfall event can be compared.

The statistics in Table 1 show that the rainfall event of the 4th of June, 1872, (if considered to be within one day) is slightly higher than the highest recorded daily rainfall for June recorded at this station (7th of June, 1954). The highest recorded daily rainfall in any month being 156.2mm on the 15th of September 1957. However this does not consider the full rainfall events that extend over more than one day (9am to 9am). The full dataset reveals that there were very heavy rainfall events on 6-7 June 1954 (190mm), 15-16 September 1957 (175mm) and 22-23 April 1960 (177mm). Therefore the full rainfall event of the 4th of June, 1872 (150.1mm) is far from being the biggest rainfall event experienced by Hobart.

Table 1. Long-term rainfall statistics for Hobart (Ellerslie Road), Station 094029, from the Bureau of Meteorology (1882-2014).

	June (mm)	Annual (mm)
Mean total rainfall	53.9	614.7
Median total rainfall	44.2	595.6
95th percentile total rainfall	123.6	832.6
Highest total rainfall	238.3	1104.2
Highest daily rainfall	147.3	156.2
4 June, 1872	150.1	–
June total, 1872	190.4	–
1872 total	–	822.3

The Intensity-Frequency-Duration (IFD) data available from the Bureau of Meteorology for Hobart show that the total rainfall of 150.1mm over a 24-hour period has an annual exceedance probability (AEP) of slightly less than 1% (assuming the great bulk of the rain did fall over a 24-hour period – midnight to midnight). Considering the rainfall observations of both Abbott and Dr Hall (Appendix 3) over shorter periods (with Abbott's records not capturing the full rainfall event), then the following rainfall intensities can be derived:

- midnight, 3 June, to 7am, 4 June – about 32.0mm in 7 hours
- 7am, 4 June, to 10am, 4 June – 13.9mm in 3 hours
- 10am, 4 June, to 4.45pm, 4 June – 58.9mm in 6.75 hours
- 4.45pm, 4 June, to 9.45pm, 4 June – 36.6mm in 5 hours
- 9.45pm, 4 June, to midnight, 4 June – about 7.9mm in 2.25 hours

Therefore the highest intensity part of the storm was in the period from 10am to 4.45pm, 4 June, which accords with the Mercury (5 Jun. 1872) account that "By five o'clock the flood had begun to subside" in Hobart. Applying the IFD data for Hobart to these periods shows that:

- the first part of the rainfall event up to 10am, 4 June, has an AEP of around 50%
- the 10am to 4.45pm, 4 June, period has an AEP of about 5%
- the 4.45pm to 9.45pm, 4 June, period has an AEP of about 20%

Considering the rainfall in 1872 more broadly (Table 1), the total June, 1872, rainfall is well above the 95th percentile of rainfall for the month of June and the 1872 total is at about the 95th percentile for annual rainfall; but these are well short of the largest rainfalls recorded for June (in 1954) or annually (in 1916). The highest monthly rainfall recorded in any month at the Hobart (Ellerslie Road) station was 255.4mm in March 1946; however this was spread over a number of rainfall events.

If the 24-hour rainfall event of the 4th of June, 1872, is omitted (i.e. removing 5.91 inches, or 150.1mm) then the total rainfall for June would have been 40.3mm and the total annual rainfall for 1872 would have been 672.2mm. Without the large event, the rainfall for the month of June and the year of 1872 would have both been about average. Figure 13 suggests that an antecedent rainfall of about four weeks or more would be required to have any significant influence on causing the 1872 landslide and debris flow. However, this is based on Hobart rainfall records and it is likely that the rainfall on Mt Arthur, and the Wellington Range more generally, would have been somewhat higher. These observations tend to suggest that the antecedent rainfall played little part in causing the 1872 landslide and debris flow and that the single large rainfall event of 4th of June, 1872, with an AEP of a bit less than 1%, was the primary rainfall causal factor.

Another consideration, in addition to the measured rainfall in Hobart, is the potential build-up of snow and any resulting snow melt on the Wellington Range. Abbott (1872a, b) reports that for May, 1872, "Mount Wellington covered with snow on the 20th, with a fresh additional fall on the 21st", and then "Snow never absent from Mount Wellington with frequent fresh deposits" for each of June, July, August and September, 1872. It appears from these observations that while it is likely that there was snow at the site of the debris flow source on the 4th of June, 1872, it is probable that a significant build-up of snow had not developed until after this date.

Debris Flow Deposition

The debris flow event of the 4th of June, 1872, resulted from a very large initial landslide failure (approximately 200,000m³) and it is expected that there would have been a very significant associated deposition of material. In the upper reaches of the debris flow's course, where the slopes are steepest, it is also expected that there would be significant scouring of the bed and banks of Humphreys Rivulet, thus adding more material to the debris flow. As the gradient of the debris flow's course lessened, and particularly downstream from the junction with Knights Creek (Figure 2), deposition would have significantly increased as the velocity of the debris flow decreased and the channel became less confined.

There are difficulties in defining the exact nature of the 1872 debris flow deposits from either the historical accounts or any remnant deposits remaining along the debris flow's course. There are a number of issues:

- The contemporary accounts generally only make vague reference to the actual deposits, and the majority of those relate to the smashed and broken trees deposited on the floodplain.
- The contemporary accounts do not clearly distinguish between the 'regular' flood deposits and what might be considered the true debris flow deposits – as mentioned earlier, the concept of a highly fluidised debris flow was not understood at the time. These accounts perceive the whole event as a flood and the actual debris flow, not being clearly observed at 10-11pm at night, is generally described as a wave or sudden flood. Additionally, other flood events at Glenorchy show that significant debris is deposited during a large flood in any case (see below for further discussion).
- A lot of the 1872 debris flow deposits on the floodplain, in the now populated areas, are virtually impossible to distinguish from earlier or later deposits (flood or debris flow), especially with subsequent human disturbance and removal.
- It is very difficult to determine if any of the deposits along Humphreys Rivulet itself relate to the actual 1872 event. For any such deposits, the level of modification by subsequent flooding and human activity would need to be clarified and this may not be possible in many cases.

Despite these issues the contemporary 1872 accounts and observations of the existing deposits around Glenorchy are useful in defining the general character and distribution of the debris flow deposits.

Areas of Deposition and Scouring Upstream of the Floodplain

As would be expected, the great bulk of the debris flow deposition occurred on the floodplain where the gradient of Humphreys Rivulet is at its lowest. However there appears to have been significant deposition within the channel in the upper and mid-reaches of the Rivulet as well. Wintle (1872) observes:

> *When the visitor has accomplished about four miles* [6.8km] *of real hard travelling over erratic boulders, in following the bed of the stream, he comes to where the limestone …… is again exposed* [650-950m downstream of the initial landslide] ……
>
> *I found the ascent by the rivulet's bed to be excessively laborious, inasmuch as it could only be accomplished by stepping from boulder to boulder, the interstices being filled with a tenacious yellow sludge.*

Some of these deposits of boulders and clay in the channel may possibly be due to late pulses of material coming down the Rivulet, as discussed above. If so, then such deposits may have partly disguised the channel scour that would be expected to result from a large debris flow.

Within the area of dolerite geology, upstream of the present day Tolosa Park (Figure 2), Wintle (1872) does describe some areas of channel scour:

> *In one place, where the channel is constricted for about half-a-mile* [800m] *by an eruption of greenstone* [dolerite], …… *The water had here cut down through the old bed of the channel to a depth of four feet* [1.2m].

The context suggests that this location is somewhere toward the bottom end of the dolerite slopes, perhaps not far above the junction with Knights Creek (Figure 2), as the topography becomes much steeper above this point.

About 1.8km upstream of the junction with Knights Creek, just below the present day Merton Weir, there are small deposits of cobbles and boulders along either side of Humphreys Rivulet that are topped with natural levees. These deposits are possibly from the 1872 debris flow and are at least 2m thick, but it is not known how the height of the existing Rivulet bed relates to that in 1872. This deposit also contains a log embedded within it that is suggestive of a debris flow deposit, or at least a significant flood.

At the junction of Humphreys Rivulet with Knights Creek the valley floor widens for a short distance to about 100m across and it would be expected that significant deposition occurred here during the 1872 debris flow. An account of a later ascent up the Rivulet in the Mercury (30 Jan. 1873) is probably describing the scene at this junction, which is referred to as "Tinker's Corner":

> *Here at our feet the once thickly timbered, the almost impenetrable bush is to-day bestrewed with boulders and heaps of clay, to say nothing of logs broken, smashed, and riven as by thunderbolts, and the general* débris, *all which tell of the maddening fury of the commingled, rocking, leaping, overwhelming, huge mass, whose terrific strength at this bend seems mainly to have been collected, hurled forth, and weakened. High over our heads trees of from 20 to 30 years' growth stand, it is true, but stand snapped off at the height of from 60 to 100 feet* [18-30m]*; …… They stand bare while the trees of prouder growth, defiant of the surging mass, exhibit to their very branches the power of their resistance in their battered and clay-begrimed trunks.*

Below the junction with Knights Creek the Rivulet remains relatively confined for a further 1km or so, but the valley floor widens out to 50-60m in places. Downstream of this point the Rivulet then becomes much less confined and has an associated floodplain (Figure 2).

Deposition on the Floodplain at Glenorchy

The floodplain is generally more developed on the south-eastern side of Humphreys Rivulet, downstream to about Main Road (i.e. O'Briens Bridge) in central Glenorchy (Figure 2 and Map 1), and then opens out onto low-lying ground downstream of the bridge, adjacent to the River Derwent. Most of the building and town development up to 1872 had occurred around O'Briens Bridge and upstream from the bridge – mainly consisting of farms and light industry (see below). The area downstream of the bridge was originally marshy ground and there were very few buildings in that general area in 1872.

The newspaper reports of the flood and debris flow describe a large part of the area around the lower reaches of Humphreys Rivulet as being covered in mud and debris. The Mercury (6 Jun. 1872) reports:

> *Hundreds of acres of ground which a day to two before had gladdened the eye …… were now a desolate waste of mud and silt, with sheets of turbid water lying in patches over their surface, and trees of immense size cumbering the ground at short intervals.*

All of the historical accounts focus on the great number of trees (some very large) that had been deposited around Glenorchy. Most of these trees are described as being heavily battered, smashed and stripped of their bark. Wintle (1872) states that:

> *The first thing that attracted my attention from the bridge* [meaning O'Briens Bridge] *was the immense heaps of timber and gigantic boulders which strewed the bed of the rivulet, and lined its banks on either side of the bridge, ……*

and downstream of the bridge:

> *A vast, entangled, heterogeneous mass of enormous trees, casks of wine, vinegar, &c., fences, agricultural implements, house-building materials, and rock masses covered the soil-swept locality for many acres. A fine orchard stocked with the choicest of fruit trees, covering some acres, had been most completely removed, and in its stead, had been deposited huge, branchless, barkless, rootless trees, ponderous fractured boulders of the adamantine greenstone* [dolerite]*, and gravel.*

Wintle (1872) measured one of the broken sections of tree trunks lying in the bed of the Rivulet near the bridge at 99 feet [30.2m] in length and 15 feet 8 inches [4.8m] in circumference at the larger end, but it was entirely stripped of branches and "both ends were rendered quite fibrous".

(Wintle, 1873) similarly describes the broken trees deposited at Glenorchy:

> *Huge trees, some of them more than 200 feet* [61m] *in height when standing, were piled up in vast heaps, …… Such had been the force of the torrent that not a vestige of bark, branches, or roots could be seen for the most part on these transported trees, while even the blue gum (*Eucalyptus globulus*), which is among the hardest and toughest of Tasmanian woods, not only had its massive protuberances ground down smooth with the trunk, but reduced to fibre where the trunk had been snapped short off.*

Wintle (1872) observed that within the area underlain by limestone, i.e. downstream from about Tolosa Park (Figure 2), the bed of the Rivulet "presents the greatest width, and as a consequence, the least incline ..... here, therefore, as should be expected, the torrent began to deposit its great arborean freight." This supports the supposition that the greater part of the deposition began in the area below the junction with Knights Creek, about level with Tolosa Park, and shows that this was particularly the case for the woody debris. The general description of the deposits given in the Guide to Excursionists (1879) also appears to support Wintle's observation:

> *At one level place where the descent became less rapid, there was an accumulation of trees like those described fully 50 feet* [15m] *high, while the whole course of the Rivulet and its banks for 3 miles* [4.8km] *were strewed with the trunks and limbs of these giant mountain trees.*

Some of the historical accounts show that O'Briens Bridge, at Main Rd (Figure 2), became choked with debris at some point during the debris flow. The Mercury (6 Jun. 1872) states:

> *The bridge has been severely assailed. At the present time a huge denizen of the forest some six feet* [1.8m] *in circumference lies stretched entirely across the creek and jammed against the bridge. One of the centre stays has also given way, but the bridge still seems tolerably secure. When the flood came down, the bridge was completely submerged, the archway became choked with the* débris*, and the water escaped over both sides and covered the road to a depth of several feet.*

A blockage at O'Briens Bridge would have had an impact on the dispersal of the mud and debris as the flow made its way around and over the bridge. It is not recorded when this blockage occurred in the sequence of events, but it is clear that there was significant deposition of large debris downstream of the bridge, so it cannot have occurred at the first arrival of the debris flow.

There are only a few vague references to the deposition of boulders and gravel at Glenorchy in the historical accounts, but importantly Wintle (1872) describes large boulders and gravel having been carried beyond O'Briens Bridge. Wintle (1873) also states:

> *It would be no exaggeration to say that some of the blocks of greenstone* [dolerite] *which have been transported from the mountain-side to a distance of three or four miles* [4.8-6.4km] *weigh many tons.*

The Mercury (22 Oct. 1872) also records later that 1.0-1.3km upstream of O'Briens Bridge:

> *Part of the* [Murrayfield] *estate is still covered with immense boulders and smaller stones brought down by the torrent, ……*

The historical accounts suggest that most of the debris flow deposition at Glenorchy, particularly the trees and rocks, occurred in close proximity to Humphreys Rivulet, and that below O'Briens Bridge on the lower floodplain there seems to have been a somewhat wider dispersal of material. These accounts also show that at some point during the debris flow O'Briens Bridge was choked up with debris and the flow was forced over and around the bridge.

Modification of the Course of Humphreys Rivulet

There are several references in the historical accounts to the bed of the Rivulet, or adjacent areas, on the floodplain being stripped down to the underlying limestone bedrock. On the upstream side of O'Briens Bridge, Wintle (1872) states that:

> …… *the torrent had cut in many places a new channel for itself, and in so doing had exposed the crystalline carboniferous limestone formation of the district,* ……

and:

> *The blue, crystalline, shelly limestone, before mentioned, I found well exposed by the fury of the torrent for fully one mile* [1.6km] *from the bridge;* ……

About 150m downstream of the present day Brent St bridge (Figure 2 – on the Glen Lynden and Ravensdale properties, see Map 1) the debris flow caused the Rivulet to permanently change its course to the west of its original course for a length of about 250m. The Rivulet originally flowed 60-90m toward the east, as evidenced by the remnants of an old flood wall built in 1858 (see below). It should be noted that the present day channel of the Rivulet through this area is actually the result of works carried out following major floods in the mid-1990s, whereby this section of the Rivulet was straightened and now passes midway between the two alternate courses. The channel of the original, pre-1872, course of the Rivulet to the east is now largely filled with cobbles and sediment to approximately 2-3m depth, and was still evident until very recently when a housing development was constructed over this area. A survey diagram covering part of this area (on the Glen Lynden property) from the year following the 1854 flood (Land Titles Office, 1855) shows a broad area of surface soil removed by that flood, which extends across to both alternate channels of Humphreys Rivulet. This suggests that prior to 1872 the Rivulet could have easily occupied either channel here during significant floods.

About 550m upstream of the Brent St bridge (Figure 2) there is a sharp bend in the Rivulet and there is a suggestion from older maps that Humphreys Rivulet had two alternate courses here as well, with a short-cut across this bend to the south (refer to Map 1). It is likely that the 1872 debris flow here also caused an alteration to the course of the Rivulet. It appears the alternate channels here were used to advantage to construct a small dam on the northern channel, supplying water to drive the nearby flour mill owned by W.E. Morrisby (refer to Map 1). It is known that the water race supplying the mill, and presumably the dam also, was damaged by the debris flow (see below). This area has also subsequently been modified with some major channel stabilisation works following the mid-1990s floods, and there is now a small subdivision built over the southern alternate channel.

Another site where Humphreys Rivulet is recorded as having changed its course is about 50-200m downstream of O'Briens Bridge. The Rivulet here originally meandered and it appears that a new, straighter course was cut to the south-eastern side (refer to Map 1). The Mercury (7 Jun. 1872) reports:

> *The top soil has been carried away over a large area, and the ground, in many places strewn with rocky boulders, has a slight resemblance to the ploughed field on Mount Wellington. The creek at this point has made for itself an entirely new channel, running through the properties of Mr. Isaac Wright, and Mr. Cook, instead of in its old course.*

With the exposures these new channels presented Wintle (1872), and similarly Wintle (1873), describes the geology of the broader floodplain as follows:

> *For* [more than] *a square mile* [2.6km²], *where the rivulet disembogues its waters into the Derwent, the area is occupied by rounded boulders of greenstone* [dolerite], *basalt* [probably dolerite also], *limestone, mudstone, and sandstone; and overlain by tertiary drift* [fine Quaternary sediment?] *and vegetable soil to a depth in some places of twenty feet* [6.1m], *as shown by the late erosion. This bed of waterworn stones, which has a mean thickness of between two and three feet* [0.6-0.9m], ……

The depth of 6.1m in some places referred to here is probably describing the deeply incised and confined part of Humphreys Rivulet, not far below Tolosa Park, where old floodplain deposits are exposed in steep channel walls.

These accounts show the potential for a large debris flow to radically alter the course of a stream across the young floodplain deposits at the foot of the Wellington Range. In recent decades there has been some housing development in such areas near the Rivulet that may be at risk if a large debris flow occurs again.

Defining the Extent of the 1872 Glenorchy Debris Flow Runout

The area of the upper and middle reaches of Humphreys Rivulet that were affected by the 1872 Glenorchy debris flow are relatively well constrained by the confined course of the Rivulet. Whereas the area affected by the runout of the debris flow on the floodplain at Glenorchy are much more difficult to define based solely on the written descriptions provided in the various historical accounts.

Mapping the Structures and Natural Features of 1872

As discussed previously, the Wintle (1872, 1873) papers provide very descriptive accounts of the debris flow, but do not provide specific details or maps of the extent of the debris flow at Glenorchy. The newspapers on the other hand provide many specific details in relation to particular properties and structures at Glenorchy affected by the debris flow. Although a clear distinction is often not made in the newspapers between the damage caused by the debris flow and the preceding flood, however this can usually be inferred from the accounts provided.

The newspaper reports usually name the owner or occupier of individual properties or homes affected by the debris flow. In addition to the newspaper reports appearing immediately after the event, a few months later The Mercury newspaper published a series of articles detailing various industries in the wider Hobart area, and these include articles on the industries at Glenorchy (Mercury, 22 Oct. 1872, 26 Oct. 1872, 11 Nov. 1872). These articles provide useful detailed descriptions of the buildings present at four sites of industry (water mills, soap and candle factory, cider factory and tanneries) and mention the structures that were under repair following the debris flow.

Some of the structures described in the 1872 accounts still exist, or exist in part, and some have their original location documented in local histories (e.g. Alexander, 1986), but most have long since been demolished. In addition to the buildings, the stone-built O'Briens Bridge of 1872 still exists beneath the now widened modern roadway and there are parts of a flood protection wall built in 1858 (refer to Map 1) that still remain. The flood protection wall was constructed along the eastern side of Humphreys Rivulet for a distance of at least 1km, possibly as much as 1.5km, and was apparently built in response to the 1854 flood. These extant features have been mapped from aerial photography and site visits and are shown on Map 1.

As described above, parts of the course of Humphreys Rivulet have been altered due to the debris flow of 1872 and also due to regular floods and human modification – both before and after 1872. These alterations to the course of Humphreys Rivulet have also been mapped and are shown on Map 1. The historical property research (see below) utilised documents available from the Land Titles Office, including charts and plans of early land grants and land title information, that often show the position of the early watercourses. This research has revealed that the last 300m of the present day Humphreys Rivulet across the lower floodplain was in fact a drain excavated in the early 1830s to re-direct the Rivulet from its original course – in an effort to drain this formerly marshy area (Land Titles Office, 1835, 1868). Humphreys Rivulet originally entered the River Derwent 200m to the east, at the mouth of the present day Barossa Creek (see Map 1). Other historical documents also show that Humphreys Rivulet originally had two outlets into the River Derwent across the low-lying marshy area. From the site of O'Briens Bridge a minor channel leading off to the west of Humphreys Rivulet (the original Littlejohn Creek) emptied into the River Derwent 450m west of Humphreys Rivulet (Public Works Department, 1837; Land Titles Office, 1868) – refer to Map 1. The western approach to O'Briens Bridge was built over this minor channel and it is now apparently piped underground. The present day Littlejohn Creek has the same outlet into the River Derwent but now captures an entirely different watercourse, the upper reaches of which were redirected into Humphreys Rivulet at some point in the 20th century.

All of the references to specific properties, structures and locations mentioned in the historical accounts have been compiled and are presented in Appendix 4. By locating the affected properties and the specific structures, along with nearby structures that were not affected, and by understanding the original course of the Rivulet it should be possible to constrain the extent of the debris flow runout through the Glenorchy township.

Historical Research to Locate the 1872 Properties and Structures

Historical land ownership records allow the locations to be derived for many of the specific properties and structures extracted from the various historical accounts (Appendix 4). This firstly involved checking the contemporary Valuation Rolls for the Glenorchy area for references to the named people and properties. These rolls, which were published annually in the colonial government's Hobart Town Gazette (1825-1880), are available at the State Library in Hobart. They record information relating to both the owners and occupiers of land within the relevant district, as well as details concerning the size of particular properties.

Experience has shown that the Valuation Rolls are not entirely accurate. The spelling of names can be inconsistent, changes in ownership are not always recorded immediately, and stated acreages are sometimes based on unofficial boundaries, or represent a collection of separate lots. Despite these caveats, the lists are a very useful guide to land ownership and occupancy in the Glenorchy area around 1872.

This research has shown that many of the people named in the newspaper reports were in fact the occupiers of land, rather than the owners. Once the owners of the properties were identified it was then possible to locate the individual properties.

Information gleaned from the Valuation Rolls was used as the basis for a search of records relating to property transactions involving the Glenorchy properties around the debris flow affected area. Such documents are held by the Land Titles Office in Macquarie Street, Hobart. Significantly, they usually give precise descriptions of the boundaries of the parcels of land being granted or sold. This enables such blocks to be located with some degree of accuracy, especially when the information supplied can be linked to other more general historical charts and plans that record the position of early land grants in the Glenorchy district. Documents of the latter type can be found at both the Land Titles Office and the State Library.

The property transaction documents from the Land Titles Office around the relevant period are divided into two categories: the General Law series of deeds, and activity carried out under the Real Property Act of 1862. Most of the records relating to the Glenorchy area in the years up to 1880 are found in the General Law series. An added benefit is that some of these documents contain plans of buildings and other features, such as watercourses, located on the land in question, especially when such features are situated near the perimeter of the property. Similar details can also be found occasionally on the plans drawn up when a new land grant or selection is surveyed, but only when the lot in question had been occupied prior to its formal creation. These survey diagrams are also held at the Land Titles Office, but stored as a separate series, and were quite useful in locating some properties and structures at Glenorchy in 1872.

In addition to the land ownership records, a small number of useful plans showing the locations of buildings and watercourses in the 1800s were found at the Tasmanian Archive and Heritage Office (TAHO) – refer to Appendix 4. Of particular note is a late 1860s plan showing the layout of the Houghton Mills and Tannery complex, which also shows nearby buildings in Glenorchy (TAHO, c1868). Much of this complex is relatively close to the Rivulet (refer to Map 1) but was apparently undamaged by the debris flow, as it is not specifically mentioned in any reports (although general references to "Mr Murray's estate" could possibly include this property in addition to his significantly damaged Murrayfield property).

Utilising all of these documents, individual properties and many of the structures they contained were mapped and entered into a geographical information system (GIS). In the GIS the boundaries and areas of the properties could be accurately measured and fitted, where necessary, with the state cadastral layer and the watercourses (allowing for alterations since 1872). In this way the layout of properties existing in 1872 could be built up, ensuring that the boundaries of neighbouring blocks fitted together. The results of this compilation are presented on Map 1 with each site being classified as to the level of damage sustained, using standard landslide damage qualifiers (Cruden and Varnes, 1996).

Interpreting the Debris Flow Extent from the Historical Data

Map 2 presents the interpreted extent of the debris flow runout through the Glenorchy township on the 4th of June, 1872. This interpretation is based on the levels of damage reported (Appendix 4), the located properties and structures (Map 1), the mapped course of Humphreys Rivulet prior to 1872 (Map 1), and topographic constraints. In defining this extent the LiDAR derived DTM has also been utilised to constrain the limits of the debris flow, with consideration given to those parts of the landscape that have been modified since 1872.

The extent of the debris flow on the floodplain has been here defined as the limit of coarse debris. Which includes both woody and rocky debris, but the majority of the historical reports only refer to the woody debris in association with particular sites, as well as any related damage. It has also been assumed that areas adjacent to Humphreys Rivulet where significant stripping of the surface soil is described, or where the course of the Rivulet has been altered, are also within the extent of the debris flow.

On the Rivulet's floodplain and adjacent areas upstream of the Buntingdale property, above a sharp bend in the Rivulet (Map 1), there are no properties or structures specifically mentioned as being damaged by the debris flow, and it appears no buildings existed here in 1872. The interpretation of the debris flow extent within this area (about 500m in length) is based on the 1946 aerial photography and the LiDAR derived DTM and includes most of the floodplain, which widens here to about 100-150m (Map 2). In 1946 this particular area was largely covered in low, scrubby vegetation while most of the adjacent land had been developed into orchards. There is only one set of buildings within this area in 1946, the Burnside property, but this is known to have been built about 1903 (Appendix 4). It is assumed here that a likely reason for this floodplain area remaining largely undeveloped up to 1946 is that it was probably covered in rocky debris and gravel from the 1872 debris flow, and so would have been relatively unproductive land. This area also appears to be poorly drained, which may also be a result of the 1872 deposits. In the present day this land is now densely covered with housing development.

The historical accounts also refer to mud being distributed over a wider area than the coarse debris. It is expected that there would also have been widespread deposition of mud on the floodplain, but there are very few historical accounts from which the distribution of this mud can be derived. The only reference to muddy deposits specifically on the upper part of the floodplain is in The Mercury (12 Jun. 1872) – refer to Map 1 for property locations:

> *Passing along the Dusty Miller lane* [now Tolosa Street], *and over the property of Murray-field, …… I at length, after going through much soft sludgy matter of the consistency of pea soup for some distance, arrived at the residence of Mr. Stansfield, ……*
> [Note: the Stanfield's house could not be located, but was presumably not on the floodplain as no damage or flooding is mentioned in any reports.]

Downstream of O'Briens Bridge, on the lower floodplain, it would be expected that the muddy deposits would have been spread more broadly but there were few, if any, buildings in this area in 1872. There are a few specific accounts of buildings in central Glenorchy being inundated with mud (Appendix 4). Map 2 shows an estimate of the extent of the mud deposited in the central Glenorchy area in the vicinity of O'Briens Bridge, which is based on these few historical accounts, but there is not enough information to interpret this extent any further. It is also unclear from the historical accounts how much of this mud was deposited by the debris flow event as opposed to the preceding flood, but it would be expected that the majority of the muddy deposit would have been delivered by the debris flow. As mentioned above, O'Briens Bridge was choked with debris at some point and this would have affected the dispersal of the mud and debris carried by the debris flow. This blockage possibly caused the muddy deposits to be dispersed more widely beyond the debris flow path below this point than had occurred further upstream.

Uncertainties in the Historical Data

The reliability of the information contained in the historical land ownership records cannot always be guaranteed. The accuracy of the reconstruction is therefore dependent, in part at least, on the skills of the surveyor who made measurements in the field, as well as those of the draughtsmen who translated those details into survey diagrams. However, by cross-referencing with other historical sources where available, such as newspaper land advertisements and historical photographs, and also by ensuring that the individual properties fit with each other in the GIS, a high degree of confidence has been achieved for most property and structure locations. As

mentioned some of the structures, or their remnants, still exist to the present day, while some others were still present in the 1946 aerial photography, and so are located quite accurately (Appendix 4).

A small number of houses mentioned in the historical accounts as being damaged were not located in this research (Appendix 4). These buildings appear to have been small workers' cottages on larger properties, particularly the Murrayfield property, and possibly the Houghton property, both owned by William Murrray.

Effects of the Debris Flow versus the Flood

It is impossible, based on the historical reports alone, to completely separate the 'regular' flood deposits from the subsequent debris flow deposits of 1872. So, as mentioned, it has been assumed that the limit of coarse debris will closely approximate the limit of the actual debris flow deposits. An added difficulty is that in reality the tail ends of debris flows runouts tend to transition from a true debris flow (i.e. greater than 80% sediment by weight) through a hyper-concentrated flow with 40-80% sediment to high streamflow carrying less than 40% sediment. It appears likely from the historical accounts that this transition occurred on the lower floodplain at Glenorchy and may have occurred within the channel of Humphreys Rivulet, especially given the high rainfall and flooding leading up to the debris flow event.

Other major flood events have occurred on Humphreys Rivulet at Glenorchy and it is interesting to compare the newspaper accounts of these events with the descriptions of the 1872 event. The newspaper accounts of the 1854 and 1923 floods (Colonial Times, 2 Mar. 1854; Mercury, 6 Dec. 1923) suggest that significant coarse debris could be deposited at Glenorchy during any large flood. There is no documentary evidence that these floods were associated with any significant landslide failures, although some small failures may be expected. The descriptions of the damage and debris during these two floods appear somewhat similar to the 1872 event. The Colonial Times (2 Mar. 1854) refers to "the breaking up of land", very large trees being brought down the Rivulet, mill dams being carried away, the choking up of O'Briens Bridge and significant damage to properties and buildings near the bridge. The Mercury (6 Dec. 1923) describes that flood as bringing down "boulders of a huge size and trees and debris of every description", orchards "torn up by the roots", and also refers to the Rivulet being blocked with debris down on the lower floodplain (closer to the River Derwent) and as a result "huge rocks and trees lie scattered all over the area".

It appears that the areal extent of the damage and coarse debris from a major flood at Glenorchy is similar to that for the large debris flow of 1872. As might be expected when it is considered that most of the accounts of coarse debris for the 1872 debris flow were focussed on the woody debris, which floats and so can be carried just as easily by flood or debris flow. However the volume of debris and deposition from the large debris flow of 1872 would appear to be much greater than that reported for the two major floods of 1854 and 1923, and in addition the debris flow did much more damage in altering the course of Humphreys Rivulet.

The Potential for Fatalities

The contemporary newspapers report the drowning death of "Andrew Ranaghan" (initially mis-reported as Mr Moran) at Glenorchy of the 4th of June, 1872, in association with the flood and debris flow event (Mercury, 6 Jun. 1872, 5 Jun. 1872). Newspaper reports upon the finding of his body a month later show that his name was actually Henry Ranahan (Mercury, 6 Jul. 1872a, 6 Jul. 1872b). The reports do not obviously distinguish between the flood and the actual debris flow and this has led some later accounts to assume, or imply, that the fatality was a result of the debris flow (Wintle, 1872; Guide to Excursionists, 1879; Stancombe, 1968). However, as stated in Mazengarb, *et al.* (2007), this fatality occurred earlier in the afternoon of the 4th of June as the result of the flooding that preceded the debris flow event – as is apparent from a careful reading of the contemporary newspaper accounts.

Aside from the Ranahan drowning, the newspaper accounts also show that there were a number of narrowly avoided fatalities during the actual debris flow event. The Mercury (7 Jun. 1872) reports:

> *On the night of the great flood two young men employed by Mr. Murray, and a son of Mr. Calloway* [actually Kellaway]*, had a most miraculous escape. They were watching the waters of the creek when the great wave of water came down and overtook them. They were knocked down several times, and with difficulty regained their feet. Two of the young men found security on some higher ground, and had already reported to Mr. Calloway that his son had been overtaken by the waters. Young Calloway had, however, clambered on to a cattle shed, and from this afterwards climbed into a gum tree, and remained in this perilous position some three hours. …… An embankment built to protect Mr. Murray's property ……, which was considered an impregnable barrier to any flood, was carried away for over thirty yards* [27m] *of its course, and it was when this gave way that the lives of the young men mentioned above were placed in jeopardy.*

A few homes close to Humphreys Rivulet were destroyed by the debris flow and lives could easily have been lost (refer to the earlier section on damaged properties and the associated Appendix 4 for locations). The most dramatic case was that of the Buntingdale property occupied by John Oswell (incorrectly reported as Oswald).

The Mercury (6 Jun. 1872) reported:

> *Of Mr. John Oswald's four-roomed cottage not a vestige is left, and an enormous tree now marks the spot which, on Tuesday evening was Mr. Oswald's bedroom.*

The Guide to Excursionists (1879) states:

…… the cottage of Buntingdale, in the midst of a rich little orchard and garden in a delta of the bank of the Rivulet, and high above all former water marks. A tree eight feet [2.4m] *in diameter and a hundred feet* [30m] *long came end-on like a huge battering ram to the cottage and it disappeared for ever …… the bed of the garden was torn up to the primitive limestone rock on which the alluvial soil stood.*

Wintle (1872) appears to describe the same destroyed home as follows:

> *About half-a-mile from the bridge, in the direction of the mountain,* [Mr. Hull, Council Clerk] *drew attention to the ruins of a house which had been built by his ancestor, situate at a distance of about one hundred yards* [91m] *from the rivulet. It presented a spectacle of confusion worse confounded–a truly heterogeneous heap of broken bricks, shingles, shattered glass, pieces of furniture, onions, and potatoes embedded in a matrix of tenacious sludge. Driven through the south-eastern wall, for several yards into the interior of the building, was a huge battering-ram of a gum tree. This had done the work of demolition at a blow, and if anything else had been left undestroyed, it was accomplished by another tree of equal size being brought down and deposited at right angles upon the former.*

The Mercury (6 Jun. 1872) also reports that a large part of the premises occupied by Thomas Lane "were carried away" (incorrectly reported as Laing). The near loss of several lives in this case is elaborated by Hull (1940):

> *One family in particular (Thomas Lane's) who lived in a typical old English thatched cottage, not far from where the present Water Lane Bridge* [now Brent St] *spans the rivulet. This cottage was completely surrounded by swift running flood waters, and the occupants were standing on top of their furniture while the angry waters swirled through the house. Rescue parties were trying to reach them without avail. ……*
>
> *…… the flood waters below the* [presumed] *dam subsided* [allowing the family to escape]*. It was not long after they had vacated their doomed cottage, the* [presumed] *temporary dam gave way with a mighty crash …… and Lane's cottage was swept bodily away.*

In addition The Mercury (6 Jun. 1872) records:

> *A house occupied by Mr. Cane, on the estate of Mr. Murray, was completely knocked in, and Mr. Cane had only time to make his escape without an opportunity of dressing.*

The following day The Mercury (7 Jun. 1872) also reports that "The hut of a man named Craig was knocked through by heavy trees in three places" – it possible that these two accounts in fact refer to the same property. The location of this property, under either name, could not be determined (refer to Appendix 4) and it was probably a small workers' cottage.

It appears from some accounts that a few other houses were saved from destruction by large piles of woody debris forming a protective barrier around them. The Mercury (7 Jun. 1872) reports:

> *Some of the houses on Mr. Murray's estate have been miraculously preserved by the barricades of wood which accumulated before them. Large logs coming down became in many places fixed and by this means other timber piling itself caused the diversion of the water, and saved, besides Mr. Murray's buildings, several dwelling houses.* [refer to Appendix 4]

These accounts clearly demonstrate that there was a high potential for a number of fatalities resulting from the debris flow of the 4th of June, 1872. The fact that there were no fatalities directly resulting from the 1872 debris flow appears to have been due to a combination of:

- the flood wall built in 1858 having limited the impact in some areas,
- the necessity of the residents of the low-lying parts of Glenorchy to be up during the night and dealing with the ongoing flood; and
- good fortune.

Summary

This analysis of the large Glenorchy debris flow of the 4th of June, 1872, has uncovered a surprisingly large amount of relevant historical information. However, it was found that the historical accounts needed to be critically assessed for their reliability, as there were significant contradictions between the various accounts. The two scientific papers by the colonial geologist, Samuel Wintle, were found to be invaluable in supplying reliable scientific observations; although there are some minor discrepancies between his two reports. Of great value also were the 1872 photographs of part of the debris flow source area and of the super-elevation at the first major bend below the source area. These photographs have led to the initial landslide failure being accurately defined with a measured volume of about 200,000m³ derived for the entire failed mass.

Having defined the source area, the failure mechanism is interpreted to have started as a sliding block failure of approximately 150,000m³ (possibly quite slow moving), which extended well into the underlying weathered dolerite. The moving block then collapsed over a break in slope, removing another 50,000m³ or so during its descent, and rapidly transitioned into a large scale, fast moving debris flow. The debris flow then travelled all the way down Humphreys Rivulet to the River Derwent. This very destructive event would be classified under the Cruden and Varnes (1996) scheme as a "complex, debris slide–extremely rapid debris flow".

The historical accounts show that the large scale collapse and debris flow occurred between 10 and 11pm on the 4th of June, 1872, and only took about 10 minutes to travel a distance of about 9.2km down to the River Derwent – giving an average velocity of about 15m/sec, or 55km/hr. The accounts suggest that the average depth of the debris flow in the upper reaches was in the order of 20-25m with super-elevation occurring on most of the bends in the upper Rivulet – including super-elevation to about 50m height (vertically) at the first major bend. Despite the widespread speculation and acceptance as fact in the historical accounts, there is little evidence of a temporary dam forming and bursting during the debris flow event. The observed travel time of the debris flow makes such a dam very unlikely.

Having two independent sources of rainfall data strongly supports a total rainfall for this event, at Hobart, of about 150mm, and the accounts suggest that the great bulk of this rain fell in about 24 hours. The large scale collapse and debris flow occurred near the very end of this rainfall event, with the highest intensity rainfall occurring 5-12 hours earlier. Long-term rainfall records show that this rainfall event has an annual exceedance probability (AEP) of a bit less than 1%, but it is certainly not the biggest rainfall event experienced in Hobart.

Outside of this single rainfall event, the total rainfalls for the month of June and the year of 1872 are both about average, suggesting that the antecedent rainfall did not contribute significantly to the 1872 landslide and debris flow.

The great bulk of the debris flow deposition occurred on the floodplain, where the gradient of Humphreys Rivulet is at its lowest, and included a great number of heavily battered trees and large dolerite boulders. There was also some deposition within the channel in the upper and mid-reaches of the Rivulet. Significant scouring and modification of the channel of Humphreys Rivulet also occurred during the debris flow event, and O'Briens Bridge (on Main Road) was choked with debris. Most of the debris flow deposition occurred in relatively close proximity to the Rivulet for most of its course. The extent of the debris flow runout through the Glenorchy township has largely been defined with a high degree of confidence by locating the affected properties and structures specifically mentioned in the historical accounts. On the lower floodplain (downstream from about Main Road) there appears to have been a somewhat wider dispersal of deposits, though this is less well constrained due to a lack of structures at the time within this area. The available evidence suggests that the wider dispersal on the lower floodplain was largely of finer material (mud and silt), which may have been due to the choking up of O'Briens Bridge with debris.

The areal extent of damage and coarse debris associated with major historic (regular) floods at Glenorchy appears to be similar to that for the large debris flow of 1872. However the volume of debris and deposition in 1872 is much greater than any reported major flood, and the debris flow also caused much more damage in altering the course of Humphreys Rivulet.

A few homes were destroyed by the debris flow and many other structures were damaged, but no lives were lost as a direct result of the flow. However there was a high potential for fatalities with a number of near misses.

Conclusion

The large amount of historical information documented in this report, along with modern data such as the LiDAR derived DTM, has provided for a detailed understanding of the behaviour of the initial landslide and subsequent debris flow event at Glenorchy on the 4th of June, 1872. The conditions that prevailed at that time and the nature of the triggering rainfall event are also now well documented.

The 1872 Glenorchy debris flow was a very large event of its type and had a very serious impact on the settlement of Glenorchy as it existed at that time, which was relatively sparsely populated compared to the present day. The debris flow caused significant property damage and there was a high potential for fatalities, particularly in regard to those living adjacent to Humphreys Rivulet. In some places the debris flow also radically altered the course of the Rivulet across the adjacent floodplain deposits, thus increasing the area impacted by the debris flow.

The slopes in the vicinity of the source area for the 1872 debris flow show evidence of other past debris flows, albeit smaller. There is also some evidence that a progressive failure is developing at the head of the 1872 landslide source, with continued small-scale landslide activity here up to the present day. This leads to the conclusion that there is potential for future landslides and debris flows on Humphreys Rivulet, which may include flows of a similar scale as that which occurred in 1872.

Having documented the behaviour of the 1872 debris flow event, and the prevailing conditions, key parameters for modelling can now be derived. These parameters will be applied to the modelling of future large debris flow events from the various watercourses that descend from the Wellington Range, which will be the subject of a separate report.

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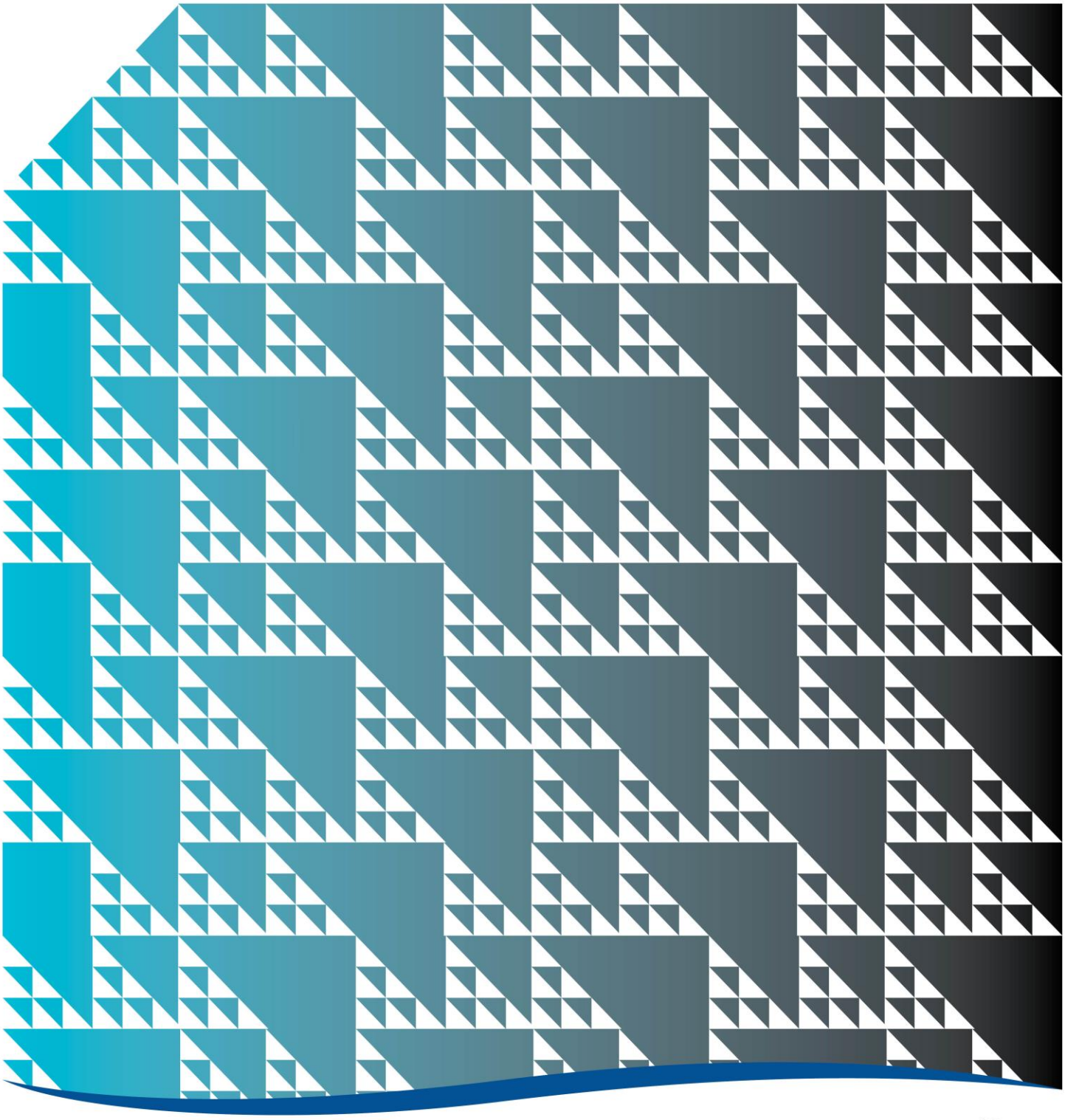
Appendix 1
Historical Accounts of the 1872 Glenorchy Debris Flow (Transcribed)



Mineral Resources Tasmania
Department of State Growth

Tasmanian Government

***The Mercury* (Hobart), Wednesday, 5 June 1872, p.2**

[available online: http://nla.gov.au/nla.news-article8920584].

THE WEATHER AND THE FLOODS.

LOSS OF LIFE.

After several fine days, up to Monday last, when the weather was dull and hazy, a change occurred at midnight, and rain set in with a strong south-westerly gale, increasing during the night to a hurricane. At daylight on Tuesday morning, there was every appearance of floods; the cellars of some of the large establishments began to be inundated, and measures were commenced for removing stores and goods liable to be damaged by the water. As the morning advanced, the wind increased in violence, and fears began to be entertained for the safety of the shipping in harbour; but we are glad to say that the precautions adopted were successful in averting damage. In the meantime, the sea ran exceptionally high and the creeks became swollen, the Hobart Town Rivulet having an unusual fresh, until about 1 p.m., when it over-flowed in Collins-street in the vicinity of the New Market, which presented the appearance of a vast lagoon. By degrees crowds of persons assembled in different localities where they could catch a sight of the creek, in Collins-street, Argyle-street, on Wellington Bridge, and the other bridges upwards, as well as from the back parts of the houses in Liverpool street. About three o'clock a quantity of *débris* was borne on the rushing torrent, indicative of the resistless force of the water in removing obstructions, and showing that the damage customarily resulting from floods, had begun. Some members of the civic body appeared on the scene, as also Mr. Propsting, Superintendent of Police, and a number of Municipal force who were assisted by many of the citizens in preventing an extension of mischief, removing obstructions, and aiding in placing property in safety. We subjoin details as far as we have been enabled to collect them, commencing with those in Hobart Town and suburbs, and including such of the country districts as are within telegraphic reach.

PARK-STREET CREEK.

There was a considerable fresh in the creek abutting on Park-street, and between one and two p.m., a wall and several fences enclosing the properties of Mr. Green and others, were thrown down by the violence of the flood, and the water overflowed in the gardens bordering on the creek, doing damage to the trees. A quantity of timber was floated out of Mr. Green's yard, and fears were entertained for the newly constructed culvert at the Park-street end of Bathurst-street, and had there been traffic a boatman could have plied there.

MOLLE-STREET BRIDGE.

The scene from Molle-street bridge was one of devastation. The rush of waters levelled fences on land near Turner's mill, in one direction, and threw down a fence and wall on Mr. Barnard's property at the back of Macquarie-street, and in each case the water flowed into the paddocks and gardens, and must have done more or less damage. The bridge itself appeared to be staunch, although the water at that point rose to a great height.

WALKERS' BREWERY.

The malt-house on the premises of Messrs. J. Walker and Son was flooded, the water attaining a height of 18 inches, and there was a depth of water of 5 feet at the kiln eyes. About a dozen men were kept actively employed in preventing damage and removing grain. A part of the brewery yard was also inundated. The bridge in Upper Collins-street, and a small bridge opposite the brewery, were at one time thought to be in jeopardy owing to the force of the torrent, but as at that part there is a slight divergence in the creek, and the water has a considerable break, no damage resulted.

WOOD AND SPENCER'S BREWERY.

This establishment, at the back of Liverpool-street, suffered severely by the influx of water and the spoiling of grain. The ground floor of the brewery was completely inundated by the overflow of the creek, and the private bridge from Liverpool-street was carried away. A like disaster occurred at the time of the last flood.

HARRINGTON-STREET.

Mr. Wignall, basket-maker and cooper of Harrington-street, is a considerable sufferer. He had a workshop and store on the west side of the street, and immediately abutting on the creek was his forge, contiguous to which were his principal tools. The action of the water loosened the foundations, and the structure gave away, carrying with it forge, tools, and all. The *débris* of the building, with portions of Mr. Wignall's stock, consisting of casks, pails, baskets, willows, and other articles, were precipitated down the creek with great rapidity. A valuable steam engine in a portion of the same premises was fortunately saved. It is said Mr. Wignall's loss will extend to upwards of £200, and general sympathy was expressed for him. Most of the houses and lands on the same side of the street were also inundated.

MELBOURNE-STREET.

This street was completely flooded, and ingress to the houses was stopped. One aged female inmate had a series of hysterical fits during the afternoon, and she refused to be removed. It was here a rumour arose that a little child had been carried away by the torrent, and a good deal of commotion prevailed in consequence. The news was soon disseminated all over the town, and gained general credence. The names of the persons were given who had seen the child, and could vouch for the fact; but upon our reporter instituting personal enquiries he found the rumour was not confirmed, and we hope it is without foundation.

LIVERPOOL-STREET.

On the south side of Liverpool-street abutting on the creek, most of the residents were alarmed. In that part of the street from Mr. Wood's brewery to Harrington-street, are a number of small tenements close onto the creek, the back parts of which were completely flooded. Further down towards Elizabeth-street the back yards were inundated, and a number of fences behind Mr. Brownell's, Mr. Hollinsdale's, &c., and several outhouses, were carried away. The cellars of Messrs. Salier, at the corner of Liverpool and Elizabeth-streets were flooded to a great extent, and much property was endangered. The cellars of Mr. Arnold and of Mr. Brownell were also flooded, the latter gentlemen remarking that the same thing had not previously happened during ten years' occupation of the premises. During several portions of the afternoon and evening the brigade of the Tasmanian Fire Office rendered effective aid in pumping out the water by means of the engine. The cellars of Messrs. Walch, at the opposite corner, also suffered.

ELIZABETH-STREET.

The outhouses at the back of Messrs. Warner, Aldred, Harbottle, Dobbie's, &c., were either carried away or damaged by the flood. Mr. Warner, was standing on a portion of a fence when it gave way and he was precipitated into the torrent, and would have been drowned had he not been checked by some projecting obstruction, and by the rebound brought again to *terra firma*. A cellar door on Mr. Dobbie's premises was forced open by the rushing in of the water, and some work which was being prepared for the Hon. Mr. Kennerley's new mansion was materially damaged. Two private bridges at the rear of Mr. Harbottle's premises were washed away.

ELIZABETH LANE.

The residents of Elizabeth Lane, *alias* Cat and Fiddle Alley, are among the sufferers, and there were several narrow escapes of children in this locality from being washed away. Mr. Alderman Nicol, and Mr. Superintendent Propsting, assisted by the citizens, amongst whom was Mr. Brownell, did good service in preventing fatal disasters. A number of fences were carried down the stream, and the water overflowed a roadway where had been a lot of youngsters just before, who could with difficulty be prevented from getting into danger. The tenements in the lane were completely flooded, and a good deal of distress must have resulted. Mr. Davis, hardware merchant, had the water in his store, and he and his assistants had to work hard to save a quantity of valuable goods.

WELLINGTON BRIDGE.

This bridge narrowly escaped being burst up in consequence of the accumulation of *débris*, consisting of timber, and other things, which had to be removed by special means. Aldermen Nicol and Rheuben were particularly active on the occasion, and Superintendent Propsting, Constables Green and Hollis, and others, did substantial service in superintending and assisting to clear away obstructions. At the request of the Public Works Committee, the Hon. Colonial Secretary gave orders for two gangs of prisoners from the gaol to work at the bridge, and these, headed by a man named Gleeson, behaved with much daring, indeed risking their lives, to seize the *débris* as it rushed, borne on the torrent, towards the bridge, and hand it ashore. The attention of the Colonial Secretary was specially directed to Gleeson and the other men who acted so praiseworthily in behalf of the citizens. Besides the Aldermen already named, we noticed Aldermen Crisp, Risby, and Belbin taking an active interest in the operations. The timber and other articles rescued from the water were stacked in the road, and showed how much good had been effected in removing such formidable obstructions. The names of the constables referred to, and other members of the force who rendered good service in this and other localities, and of the prisoners mentioned, will be submitted in a formal way to the authorities with a view to the recognition of their services, and, in the case of the prisoners, to some indulgence, which they well merit.

MURRAY-STREET.

The Club Livery Stables, kept by Mr. Taylor, which abutted on the creek, were carried away, the water undermining the foundation. But for the timely aid of Mr. Walter Graham, the horses, five in number, would also have been lost. Mr. Graham got out four of the horses, and then seeing the ground carried away from under the fifth, he, almost at the risk of his life, cut the halter, and rescued the animal. He also let out the dogs that were there. We have been unable to find out to whom the horses referred to elsewhere as having been carried away, belonged. It was generally reported that a bay horse lost was one of Mr. Taylor's, but Mr. Graham asserts that all Mr. Taylor's horses were got away safely. The back portion of the premises of Mr. Turner, the butcher, adjoining Mr. Taylor's stables, was carried away. A shed at the rear of Messrs. Huybers and Hammond's premises a little higher up Murray-street was washed away, and at the same time several trusses of hay, all of

which were seen at the Wapping end of the creek, progressing towards the sea. In the same street, on the opposite side of the way, some piles at Bealey & Son's store, on which rested an outer store, were likewise washed away. In the morning about ten o'clock, while the storm was raging with great fury, the ceiling of Mr. Wintle's shop in Murray-street gave way, and fell with a loud crash, doing much damage. It seems a slight intimation of the impending disaster was given a few seconds before, by a small patch falling first, which attracted Mr. Wintle's attention. On looking up he saw a very large mass giving way, and while in the act of placing two shutters against the front of a glass case, to protect it, the mass fell, striking him on the head and knocking him down, but fortunately he escaped with no more serious consequences than a few bruises.

COLLINS-STREET.

The wall at the rear of Mr. Lewis's, Collins-street, was carried away into the creek and the house was inundated, the water being several feet in depth, carpets and other furniture being completed saturated. By timely assistance however, the principal valuables were removed, and it is not thought the damage done is very considerable. The cellars of Mr. D. Lewis's large store began to fill at an early part of the day, and several hours were occupied in lifting the stores aloft.

THE CAMPBELL-STREET BRIDGE.

At this bridge, and at the lower end of Collins-street, a large amount of destruction was done. The waters in the creek rose steadily till about 3 o'clock, when great fears were entertained that the bridge would give way to the immense pressure of the water which was then coming down the creek. Masses of *débris*, the portions of bridges, sheds, &c., which had been carried down by the current, came against the arch of the bridge, the heavy pieces of timber striking with the force of battering rams. About a quarter past 3 o'clock, the wall abutting on Collins-street, opposite the New Market, gave way—a piece of some 25 yards falling with a dull crash into that street. The foaming torrent, thus released from the confining walls, found its way down Campbell-street towards Macquarie-street, and thence into the Fishermen's Dock. At this time the numerous spectators congregated on and about the Campbell-street bridge were horrified at seeing three men carried away by the rush of the water which had escaped by the falling of the confining wall. One of these men climbed up a lamp post opposite the New Market, and remained in this perilous position for some minutes till the fury of the sudden outburst of water had abated. Another man was rolled over and over in the seething torrent like a cork, and was carried many yards before regaining his feet. The third escaped with some difficulty by swimming and wading up Collins-street. Two horses came down at this time, one of which was not quite dead, and efforts were made rescue it from the waters, but without avail. The falling of the wall confining the flood waters in Collins-street caused the sudden submergence of the lower rooms of the whole of the houses in the lower part of Campbell-street and from the bridge to the dock, across Macquarie-street, it was one unbroken sheet of troubled water. The water-pipe main which crossed the road at this bridge was carried away early in the afternoon, and the water flowed from the pipe for some hours, till it was turned off.

LOWER COLLINS-STREET.

The dwellings in the lower part of Collins-street, suffered severely from the devastating flood of water. From the Campbell-street bridge to the Domain the whole of the house basements were covered to a depth varying from three to six feet. The wooden bridge leading from the Young Queen Hotel to Cross-street was severely assailed, but being well elevated withstood the fury of the flood. The inhabitants of these dwellings were compelled either to clear out altogether or to take to the upper stories. Several distressing scenes were here witnessed in the removal of the many families who were rendered suddenly homeless. One woman who had been recently confined had to be carried out of her house in the pitiless downpour, the waters having risen to the bed in which she was lying. She was with her infant, taken to the Sir George Arthur Hotel where she was kindly attended by the landlady Mrs. Screen. Several other families found shelter at this hotel, and the kindness of the hostess was extended to many of the unfortunate who had been suddenly driven from their homes. At the Thatched House Hotel several families also found a refuge. A family of young children in a house in Cross-street were, at one time, supposed to be in great peril, and were compelled to take to the upper story, but the flood subsiding they suffered nothing but the temporary fright and inconvenience. The tannery of Mr. Holmes in this locality was covered several feet deep in water, the pits being filled and a vast amount of destruction done.

THE NEW MARKET.

The tenants of premises in the New Market seeing the danger which threatened them, took early precautions against the flood, and by constructing barriers of planks well puddled up with clay kept the water out of their premises for some time. When the wall in Collins-street succumbed, however, their precautions were rendered unavailing, the waters rushing over the barriers and flooding the market to a depth of one or two feet. Messrs. Ikin, Knight, and Pogue suffered heavy loss. Mr. Pogue had a large quantity of jams ready for shipment by the Pet, the whole lot of which was destroyed. Mr. Cresswell, dealer in furniture and miscellaneous goods, has also been a great sufferer.

MACQUARIE-STREET BRIDGE.

The whole of the lower portion of Macquarie-street, from Pregnell's butcher, to the bridge, was submerged to a depth of three or four feet, the water which escaped from the creek by the falling of the confining wall in Collins-street, rushing in a boiling torrent down the lower end of Campbell-street, and escaping through the lanes in that locality into the Fishermen's

Dock. The old Treasury building was completely surrounded to a depth of two or three feet, and very considerable damage was done in this locality.

THE UPPER PART OF THE CITY.

Proceeding upwards along the Hobart Town Rivulet, it presented a seething volume of water dashing onward with irresistible fury, and ever and anon overflowing its banks where there were low grounds, carrying with the current, fences, palings, garden products, and sweeping away the surface soil. At the Dynnyrne Saw Mills the lower portion of the premises, and the entire timber yard, were inundated to a depth of several feet, the fences and a considerable portion of the timber being washed away. Prompt assistance was given here by the neighbours, and a gang of prisoners, who rendered valuable services in removing the timber and workmen's tools to the higher ground, where the swollen waters could not reach. Mr. Elliott's tannery was surrounded by the raging stream, and the wash-sheds at the rear, with skins and contents, soon disappeared before the rushing waters. At the Cascades Factory a large wall in front of the buildings, which on previous occasions had suffered from the action of the stream was entirely washed away, but with this exception the damage done was but very trifling. At Messrs. Degraves' Brewery the lower portions of the premises were inundated but comparatively little damage was done. In the upper portion of the town, for a time, between two and four o'clock, the streets were almost inundated, the streams of water instead of being confined to the channels at each side of the streets covering a large portion of the footpaths and roadway, and stopping up the mouths of the sewers with mud and gravel. In Davey-street a small rivulet ran down both sides of the street, and the gravel and screening was entirely washed from the footpaths and roadway. A large tree at Heathfield, the late residence of the Hon. J. A. Dunn, Esq., M.L.C., was blown down, being broken right across at a distance of five or six feet from the ground. This occurred a little before three o'clock in the afternoon. The tree fell at right angles to the street, reaching to the middle of the roadway. Fortunately, there was no one in the immediate vicinity and no casualty occurred. Later in the day another tree further down the street growing at the premises occupied by Dr. Richards was blown down, but it fell within the limits of the garden.

BATTERY POINT.

As Battery Point is situated on rising ground the houses in this locality suffered very little from the floods, but in one or two of the lower streets the cellars and ground floors were inundated. Swift-flowing currents ran river-ward from Battery Point down Montpellier Retreat, and Kelly, South, and Runnymede-streets, towards the New Wharf. On the other side of the hill swollen currents swept along Cromwell, Sloane, Trumpeter and Mona-streets, as also down Secheron Road and Hampden Road, in the direction of the Castray Esplanade.

SANDY BAY RIVULET.

The upper portion of this mountain torrent presented one mass of foam, as its waters dashed downwards from the Reservoir, the embankments of which burst some months ago. Even on that occasion the residents on the banks of this rivulet affirm that the volume of water, which swept the gardens of Sandy Bay, carrying the fences and horticultural products to the Derwent, was less than that which yesterday rushed headlong down the rivulet's course, overspreading the gardens below the bridge at the toll gate on the Sandy Bay Road. A little higher up the rivulet, in Digney's Lane, a substantial looking bridge was erected some years ago, spanning the rivulet and with an arch as was supposed sufficiently large to admit of the passage of the largest rush of water that was ever likely to flood the rivulet. This bridge has been carried away, and as it would appear, through the basement having been undermined by the action of the swollen current. One or two smaller bridges for foot passengers have also been swept away. A small hut which stood in the angle on the left bank of the rivulet, and which for several years past had been occupied by an old woman named Mrs. Curtis but who is now we understand, an inmate of the Cascades Pauper Asylum, was entirely swept away.

BROWN'S RIVER.

The ford here was impassable from the early hour in the day, and the river was swollen to such an extent that it reached far beyond its usual boundaries.

THE WHARVES.

Torrents of water which the sewers were incapable of carrying off, flowed from the higher parts of the town towards the New and the Franklin Wharf, inundating the thoroughfares, and rendering them impassable, so far as regards pedestrians, for two or three hours during the afternoon. The streets bounding the Constitution Dock were also flooded to a depth of several inches.

GLENORCHY.

Very serious disaster has to be recorded in this locality, and the devastation, we regret to say has been attended with loss of life, a man named Moran in the employment of Messrs. Wright and Co. having been carried away by the flood in the endeavour to save the property of his employers by removing some logs which threatened it. The properties of Messrs. Wright, Reed, and the Rev. Mr. Symons, have also suffered much injury, the whole of the extensive hop grounds of Mr. Stephen Wright being completely inundated. The residence and grounds of the Rev. Mr. Symons was almost entirely

submerged, the water being up to the eaves of his cottage and he and his family being compelled to seek refuge at the residence of Mr. H. Hopkins, New Town.

NEW NORFOLK.

In this locality the floods were of almost unprecedented violence. At the Sorell Creek the water was flowing clean over the bridge, and masses of trees and other *débris* flowed over it. Nearly the whole of the road between Bridgewater and New Norfolk was under water, and the hop grounds of Messrs. Terry and Riddoch were completely submerged. It was deemed unsafe to despatch the coach from New Norfolk, and the mails, which were sent on horseback had to perform a long circuit by way of the Dromedary.

MISCELLANEOUS.

By five o'clock the flood had begun to subside, but a great deal more rain fell during the night. As the obstructions had been so thoroughly removed, it was not anticipated that much further damage would ensue. Compared with the floods in 1854, there was a much heavier rush of waters, and had not some of the obstructions that formerly existed been removed, and alterations made to the creek by way of widening it at certain parts, the damage would have been enormous. As it is, it must occur to every one how dangerous it is for the Corporation to permit so many buildings, out houses, etc., to be erected on the creek. It is what we have been trying to hammer into the head of the Municipal authorities for years past, that the creek should be divested of all obstructions, and be adapted for the purpose for which it is naturally intended.

The Launceston coach arrived last night at about 8 o'clock. The roads generally were reported to be flooded, and a good deal of fencing had been washed away. At Jericho the water was said to be up to the horses' girths. The up-coach was signalled as having passed Oatlands at the usual time. At Ross the water was reported to be five feet over the road.

There were all sorts of rumours afloat as to casualties, among others was one that four children were missing, but we were unable to discover any truth in it.

FLOODS IN THE COUNTRY.

[BY ELECTRIC TELEGRAPH.]

[FROM OUR OWN CORRESPONDENTS.]

NEW NORFOLK.

TUESDAY, 8 P.M.

The Lachlan River is heavily flooded. Numbers of sheep and quantities of hop poles have been carried away. Several of the hop gardens are much damaged. The bridge approaching New Norfolk from Hobart Town is considered in great danger, Sorell Creek is impassable. It is still raining.

HAMILTON.

8 P.M.

It has not ceased raining since 12 p.m. of the 3rd. The rivers Ouse, Clyde, and Derwent, are rising with great rapidity.

BRIGHTON.

8 P.M.

The Jordan is much flooded, and is still rising. The flood threatens to be higher than that of a few years since. It is still raining heavily.

GREEN PONDS.

It has been raining hard all day, but no damage has been reported as arising from floods beyond the carrying away of a few fences. It is raining hard now.

MELTON MOWBRAY.

It has been raining in torrents since last night, and the rivers and streams are flooded in all directions. Melton bridge is under water, rendering it dangerous for travellers to cross.

The Woodlands establishment is literally submerged. Three men on the estate narrowly escaped drowning, having been carried away whilst crossing in a chaise cart.

OATLANDS.

It has been raining incessantly since ten o'clock last night. Lake Dulverton is fast filling up. The main road near Mr. Weeding's is flooded for about 60 yards.

ROSS.

At 6 p.m., the flood was higher than when Mr. M'Cracken was drowned. The water was rushing six feet deep across and along the main road, but is now decreasing. Page's stables and several houses are flooded. The mail coaches cannot cross to-night.

CAMPBELL TOWN.

The Elizabeth River is in flood and still rising. It has been raining for two days. The inhabitants of some of the houses near the river have been obliged to clear out.

LONGFORD.

There is no flood here. The river has scarcely begun to rise yet.

***The Mercury* (Hobart), Thursday, 6 June 1872, p.2**
[available online: http://nla.gov.au/nla.news-article8920982].

THE FLOODS.

FURTHER PARTICULARS.

We have to supplement the details of the ravages of the flood, published in yesterday's issue, by further particulars. It is to be feared we have yet to receive more disastrous intelligence from different parts of the country. The rains and consequent floods have evidently been general, and there can be little doubt that immense damage, in the aggregate, has been a result. We may mention that the subsidence of the flood in Hobart Town commenced on Tuesday evening, although the rain continued, and the wind blew strongly to a late hour. A wall at the rear of Mr. Brownell's, Liverpool-street, and another wall, behind Mr. Winter's, Elizabeth-street, fell in the evening. Yesterday there was a gradual and an acceptable change. At 8.30 a.m. the wind was reported as S.W. fresh; at noon, S.W., moderate; and at 4p.m., calm. The barometer, which read 29.30 on Tuesday afternoon, has risen at 4p.m. yesterday to 29.90. The day was a delightful one, and people gladly availed themselves of the opportunity for outdoor exercise.

GLENORCHY—IMMENSE LAND SLIPS.

In addition to the few particulars which we gave in our yesterday's issue, we have now to record a far more disastrous visitation in this locality. The residents in the vicinity of O'Brien's Bridge were at a late hour on Tuesday congratulating themselves on the belief that the worst danger had passed, and hailing with satisfaction the gradual subsidence of the waters in the creek, when at about half-past ten o'clock a dreadful dull rumbling sound, a heavy smothered crash, and a deafening roar of flowing waters, gave evidence of some unusual convulsion of Nature. Those who had not retired to rest started to their feet in alarm, whilst many who had sought repose after the fatigues and anxieties of the day's work in protecting their premises from destruction, hurriedly attired themselves and issued from their dwellings anxious to ascertain the cause of the shock. The night was intensely dark, and the inhabitants of the village were soon all astir congregated in groups, and dull forebodings passed rapidly from one to another as to the unknown, invisible danger which threatened them. Preparations were at once made for the saving of life and property, those having tenements on the low lands leaving them and taking with them such property as they could secure. About an hour after the sound was heard that caused so much consternation, the waters were heard approaching with a dull rumbling sound. An immense wall of it was seen in the darkness to be coming on, bearing onward with irresistible force everything with which it came in contact. Eyes which had now become accustomed to the darkness, saw borne on the foaming torrent, huge masses, consisting of trees uptorn by the roots, and bearing with them branches of others, tangled undergrowth, dead timber, masses of rocks, portions of broken buildings, and other *débris* all mingled, tumbling one over another in a most grand but terrible confusion. Houses substantially built were carried away like wooden matchboxes, and the furious flood burst from the inadequate creek channel, and forced for itself new passages over the cultivated ground. Land which had hitherto had entire immunity from inundation was suddenly covered to a depth of many feet; and trees, dead timber, and other drift, finding obstructions, piled itself in gigantic heaps, resembling hastily constructed barricades. The light of morning was never more anxiously awaited then by the watchers through that fearful night, and when dawn broke it revealed surroundings which told in the most forcible way of the desolation which has been wrought in the few previous hours. Hundreds of acres of ground which a day to two before had gladdened the eye of the traveller as he passed through the picturesque village, and admired the trim and neat appearance of the gardens and the luxuriance of the hop grounds and orchards, were now a desolate waste of mud and silt, with sheets of turbid water lying in patches over their surface, and trees of immense size cumbering the ground at short intervals. A glance to the left disclosed the cause of the previous night's alarm. Those familiar with the scenery at the foot of black-browed Wellington at once

discovered an appearance entirely dissimilar to that which had hitherto met their eyes as they had daily wandered round the horizon. A great land slip had occurred. One immense mass of fallen earth of a dusky brown intermixed with a yellow clayey material met their view, and another similar, but a much smaller one, was to be seen where, the previous evening, only verdure clad hills were visible. It is impossible to adequately describe the altered appearance of the locality and the dire destruction which has visited the property holders. On the estate of Mr. Murray thousands of tons of wood are to be seen spread over the ground. His property of Murrayfield has suffered to an extent which at present it would be difficult to estimate. His manufactory has been thrown down, and the vinegar and candle works and appliances by which he carried on his business, entirely destroyed. The bridge has been severely assailed. At the present time a huge denizen of the forest some six feet in circumference lies stretched entirely across the creek and jammed against the bridge. One of the centre stays has also given way, but the bridge still seems tolerably secure. When the flood came down, the bridge was completely submerged, the archway became choked with the *débris*, and the water escaped over both sides and covered the road to a depth of several feet. Of the sudden and furious discharge of the destroying element, the land slips, were, it is conjectured, the primary cause. Of the extent of these, various and widely different estimates have been made, but that they have been of very great extent, admits of no doubt. They occurred amongst the subsidiary hills at the base of Mount Wellington, and about six miles from O'Brien's Bridge. The earth has not slipped in one mass, but in two distinct divisions on either side of the gully which forms the source of the creek crossing the road at O'Brien's Bridge. Those familiar with the conformation of the country in the locality of the hills mentioned, will understand that behind those hills, and lately enclosed by them was a natural basin, and it is supposed that during the heavy rains a vast area of water was here collected, which forced away the immense wall of earth and carried down with it the masses of trees, rocks, dead logs, and *débris*, which created such destruction as it deluged the low lands in the ungovernable fury of its onward course. This view of the catastrophe is borne out by the fact that over the dark soil of the land slip which presents itself to the spectator, and even at a distance of six miles the water may be still seen in several places where it has cut its way into the fallen bank of earth and still continues to flow in reduced volume over it. It would of course with the very insufficient data which we at present have at command, be impossible to judge with any degree of accuracy of the extent of these land slips. From observation the first would appear to extend in one direction for nearly a mile, and the area of earth has been variously estimated to contain from 200 or 640 acres of land. The second slip on the further side of the creek is of much smaller proportions, and not much more than half of the magnitude of the other. In order to convey some idea of the noise produced by the land slip, it may be mentioned that it was distinctly heard at Risdon ferry some nine miles distant.

In the hurry of collecting particulars of yesterday's floods in this locality, a mistake occurred by which the name of a man drowned at O'Brien's Bridge was given as Moran, and he was stated to have been in the employ of Messrs. Wright. The unfortunate man who lost his life was named Andrew Ranaghan, and he was employed by Mr. Murray as foreman. In the endeavour to save his master's property, he was, on Tuesday afternoon, with some others, engaged in attempting to make more secure a wooden embankment which kept the water in the creek from flooding the premises. With this object he took a chain, and clambering over the barrier was in the act of fixing it on the side abutting on the creek, when the barrier suddenly gave way, and falling on the poor fellow he was borne down under the turbid waters, never rising to the surface. He was an excellent swimmer, but, of course, could not bring his powers into use. The poor man leaves a wife and eight children. We have been unable to gather the whole of the particulars of losses in this locality, but append a list of the principle ones. Mr. Murray has been by far the greatest sufferer, the whole of his manufacturing works being destroyed, his lands submerged, and thousands of tons of fallen timber and other *débris* scattered over his ground. A large portion of Mr. Thos. Laing's premises were carried away. Mr. R. Shoobridge had a portion of his house destroyed, and his grounds partially inundated. Mr. Edwin Morrisby, miller, has had his private bridge and mill race washed away. His brother, Mr. Tasman Morrisby has a portion of his garden destroyed. Mr. Isaac Wright has suffered extensively; the walls of his tannery are gone and the tan pits filled with *débris*. Mr. Stephen Wright, on the opposite side of the creek, had five acres of hops destroyed. A house occupied by Mr. Cane, on the estate of Mr. Murray, was completely knocked in, and Mr. Cane had only time to make his escape without an opportunity of dressing. The Rev. Mr. Symons was not so severe sufferer as was reported to us yesterday, the water only rising a little over the doorstep. Of Mr. John Oswald's four-roomed cottage not a vestige is left, and an enormous tree now marks the spot which, on Tuesday evening was Mr. Oswald's bedroom. Of the wholesale devastation which is visible on every side it would be extremely difficult to convey an idea, and the dwellers at Glenorchy and in the vicinity of O'Brien's Bridge will long have cause to remember sadly the floods of June 1872, and the landslips at Mount Wellington.

We regret to state that the splendid garden of Mr. H. Cook was flooded by the waters of the creek, which washed away a quickset hedge and then overspread the garden, which is about 3½ acres in extent. Yesterday the whole area of the land presented the aspect of a foaming sea. All the valuable trees are destroyed. Mr. Cook was a large sufferer by the flood of 1854, but the damage now sustained is unprecedented and greatly discouraging.

***The Mercury* (Hobart), Friday, 7 June 1872, p.2**
[available online: http://nla.gov.au/nla.news-article8925565].

THE FLOODS.

GLENORCHY—THE LAND SLIPS.

The marshy state of the ground and the numerous mountain torrents render it impossible to get sufficiently near the scene of the recent land slips in this locality, and hence no accurate estimate can be formed of their extent. A stream of water still continues to pour over the dislodged earth, but its volume has materially diminished. The damage to Mr. Murray's manufacturing buildings has been found to be not so severe as at first reported. The buildings used for the manufacture of candles and vinegar have not been destroyed but are still standing, although the former are surrounded by a densely packed mass of dead timber. A portion, consisting of one corner of the building used as a soap manufactory and store-house was carried away, but this, it is anticipated, may be easily repaired. Mr. Calloway, Mr. Murray's manager, has a large body of men vigorously engaged in removing the timber and other obstructions, and expects to be able to proceed with the manufacture of candles on Monday morning next. On the night of the great flood two young men employed by Mr. Murray, and a son of Mr. Calloway, had a most miraculous escape. They were watching the waters of the creek when the great wave of water came down and overtook them. They were knocked down several times, and with difficulty regained their feet. Two of the young men found security on some higher ground, and had already reported to Mr. Calloway that his son had been overtaken by the waters. Young Calloway had, however, clambered on to a cattle shed, and from this afterwards climbed into a gum tree, and remained in this perilous position some three hours. During this time his parents were in a most anxious state, but were at length re-assured by their son announcing his safety. No efforts could, however, by made to relieve him till the waters abated. Mr. Calloway describes the descent of the waters as most terrific, the noise caused by the enormous boulders as they came crashing down the creek, being likened to the discharge of a hundred pieces of heavy ordnance. Trees from 50 to 100 feet long and six or seven feet diameter at the butt, are strewn all over the ground. An embankment built to protect Mr. Murray's property, the piles having been shod with iron and secured with iron rods, and which was considered an impregnable barrier to any flood, was carried away for over thirty yards of its course, and it was when this gave way that the lives of the young men mentioned above were placed in jeopardy. Some of the houses on Mr. Murray's estate have been miraculously preserved by the barricades of wood which accumulated before them. Large logs coming down became in many places fixed and by this means other timber piling itself caused the diversion of the water, and saved, besides Mr. Murray's buildings, several dwelling houses. This was observable in two or three instances, the piles of timber forming closely packed walls around three sides of many of the cottages. Mr. Murray's garden, which before the flood was in a most flourishing state, and contained many choice and prolific fruit trees, has had the top soil washed away, boulders and drift timber remaining. The hut of a man named Craig was knocked through by heavy trees in three places. At Mr. Stephen Wright's, as we mentioned yesterday, immense injury has been done, and further examination discloses greater disasters. The top soil has been carried away over a large area, and the ground, in many places strewn with rocky boulders, has a slight resemblance to the ploughed field on Mount Wellington. The creek at this point has made for itself an entirely new channel, running through the properties of Mr. Isaac Wright, and Mr. Cook, instead of in its old course. A number of men were yesterday engaged in putting Mr. Isaac Wright's tanneries in order, and others in clearing the road and bed of the creek at O'Brien's Bridge. A party of men were out searching for the body of the unfortunate man Andrew Ranaghan, but without success. Barrett's store was one of the places flooded on Tuesday night, about a foot of water going into the shop Tuesday night, about a foot of water going into the shop and filling the cellars. The road at this point is still covered some inches deep with sludge.

***The Mercury* (Hobart), Monday, 10 June 1872, p.3**
[available online: http://nla.gov.au/nla.news-article8926283].

THE LAND SLIPS.

A correspondent writing from Glenorchy on Friday, says:—

Yesterday four of us started to follow up the gully down which the fatal O'Brien's Bridge deluge poured. Those who knew the gloomy, densely wooded ravine prior to the descent of the water, will be astonished when they see it again. From the bed of the creek, for perhaps 80 yards up, each hill-side has been swept of every tree, and the ground is covered with silt and sludge in which stones, rocks, fragments and nearly whole trunks of trees lie tossed together in supreme confusion. For over a mile from the foot of the great slide the course of the water had a slope of at least 30 degrees. The timber met with along here, presents a singular uniformity of appearance. Every branch and root has been shorn close to the stem, the bark stripped off, and a large proportion of the surface wood feathered up into fine splinters. One green trunk, about 30 feet long, and perhaps 4 feet through at the base, attracted our particular attention. It is split for about half its length, and three considerable logs remain wedged in it. A little above where this log lies, my companions judged the torrent must have been at least 150 yards wide, and perhaps 70 feet deep. The edges of the stream are lined with shattered timber. Large trees, standing many yards above the water mark have been struck high up, their branches rent and bark torn off, apparently by the

logs which the water hurled along. One spot, on the left as we ascended, seems to have been passed over by a water spout. Trees have been torn up and smashed, the naked trunks of others left, blotched with muddy splashes, and large mud-covered stones scattered among them, yet there is no sign of water having overflowed the ground.

What is spoken of here as the "small landslip" appears to be on the clearance made by the surging of the water when its course was arrested by the hill which faces that down which it poured. The so-called small slip is exactly opposite the large one. If the winding course of the valley permitted, it would be seen from the main road that each side, for some distance downwards, is bared almost as high up from the bed of the creek.

The aspect from the foot of the great slide is inexpressibly grand and awful. Its distance from O'Brien's Bridge lends it an appearance of smoothness, which leaves the observer quite unprepared for what will meet his gaze when he enters upon the scene itself.

By the time we reached this spot, our party was reduced to two. Mr. —— and myself climbed to within what he thinks was 150 yards of the head of the great slide, when a fog began to shroud the top, and obliged us to descend. The course we had traced by eye from below bade fair to lead us right out, and it was disappointing to be obliged to return without reaching the top. The journey up and down is one not likely to be forgotten.

The Mercury (Hobart), Tuesday, 11 June 1872, p.2

[available online: http://nla.gov.au/nla.news-article8921794].

THE LAND SLIPS.—A visit to the locality of the recent Glenorchy disaster, made yesterday, showed the course taken by the devastating torrent, which swept down upon the unsuspecting inhabitants of the district on Tuesday night last. The aspect of the gigantic convulsion which has occurred, viewed from the road at O'Brien's Bridge, conveys but a faint idea of the wonderful magnitude and destructive effect produced a few miles distant, the apparently smooth, level surface, which presents itself to the eye of those travelling along the road being, on a nearer approach, changed to rugged, rocky, and uneven banks, while the mountain sides are utterly denuded of vegetation, and rent and channelled by the many torrents which have occurred down their dusky sides. The site is of the grandest, although most terrible description. A pressure on our space compels us to hold over a detailed description, which will appear in to-morrow's issue.

The Mercury (Hobart), Wednesday, 12 June 1872, pp.2-3

[available online: http://nla.gov.au/nla.news-article8916356].

A VISIT TO THE LAND SLIPS.

[By our own Reporter.]

In this description of the recent disaster at Glenorchy, I shall endeavour to give as accurate an account as a minute and thorough examination of the locality will enable me to do. On Monday morning I left town at an early hour by the fast-travelling omnibus, Ben Bolt, tooled by the obliging Mr. Charles Cooley. The morning was fine and clear, the sun shining brightly, had dispelled the few clouds which, in the early morning, had floated about the horizon, and the cool pure bracing air which blew in gentle breezes from the mountain tops, was of a most invigorating and delightful character. We passed along the New Town road at a rattling pace, the notes of the conductor's horn sounding cheerily in the sharp frosty air, and even the horses seeming to draw spirit from the invigorating atmosphere as they danced along, their hoofs making music on the hard polished surface of the well-kept road. Alighting at a spot known as the Dusty Miller lane, I at once commenced to equip myself suitably for the journey I had before me. I had been warned by a gentleman who had already paid a visit to the "slips," to attire myself in my worst clothes and my stoutest boots, and anyone who had met me when I was thus equipped would, I think admit that I had bettered the instructions. Passing along the Dusty Miller lane, and over the property of Murray-field, the locality embraced in previous descriptions, I at length, after going through much soft sludgy matter of the consistency of pea soup for some distance, arrived at the residence of Mr. Stansfield, about a mile and a half from the main road, and here met Mr. Betts, a gentleman familiar with the country, and who had already twice visited the *locale* of the land slips. He courteously placed his services at my disposal as guide, and further modified my travelling costume to fit with the experience gained by him of the necessities of the route we were about to travel. We then started on our journey, proceeding up the bed of the channel made by the recent flood. About a quarter of a mile from Mr. Stansfield's, after passing huge stacks of timber piled over the level ground, extended for some distance from the creek, we arrived at a spot known as the Junction, and to give me some idea of the transformation effected in the creek down which the flood waters had travelled, my companion drew my attention to the other stream which formed, by its confluence with the watercourse we were following, this junction. Here, running due east, was a small mountain rivulet, into which a tiny rill of sparkling water found with difficulty its way over the weather-worn and discoloured rocks and through the tangled undergrowth to the main

creek beneath. Contrasting this with the other branching watercourse down which the mighty torrent had passed, and which took a north-east course towards the mountain, the change effected was shown by the difference exhibited in the comparison. Before the flood, the waters of the stream we were now following ran through a densely timbered, narrow gorge, thick with tangled ferns and almost impenetrable scrub. But all this was now changed. The timber had been completely cleared away, and with the fury of the torrent thrown with wonderful power back against the sides of the creek, and wedged into the earth of the bank. The channel now exhibited the appearance of a newly formed railway cutting, its bed being almost level, and about 22 chains wide. The singularly systematic manner in which the piled wood had formed its barriers as if to confine the waters, is truly remarkable, and the appearance of the creek bed here is similar to what would be seen on public works where extensive machinery had recently been employed in excavating and clearing a track for a road or railway. Passing along further we came, about three-quarters of a mile on our course, to a rocky basaltic formation familiarly known as the Black Rocks, and here a very striking illustration of the herculean force of the torrent is exhibited. At this point an enormous mass of the rocks extending for about thirty feet along the course of the creek and 16 feet backwards into the bank, had been hewn down, as though quarried out by the labour of many men, and by means of blasting or other mechanical appliances. This mass of stone had fallen into the creek and some of it lay in huge misshapen blocks some distance down its course, while others stood where they had fallen, poised with mathematical nicety on smaller stones, acting as ponderous obelisks and monuments of the catastrophe which had so suddenly disturbed them from their long resting place. Pushing further along, our course became increasingly difficult, but the devastation and weird grandeur of the scene was also enhanced. The loose boulders lying in the bed of the channel were rounded and polished by the action of the water, and their smoothness in some instances almost suggested that the ingenuity of the lapidary had been brought to bear upon them. Continuing our course up the gorge, the height to which the water had reached, as marked by the absence of vegetation on the precipitous banks of the ranges on either side, became gradually greater, the comparative narrowness of the channel and the fact of the immense wall of water having a more confined area, causing it to reach a height, at this point, of at least 50 feet perpendicularly. But high over the flood level, the trees on the hill sides exhibited far up their stems traces of injury and ruin. Their trunks, to a height of some 50 feet above high water mark, were seen to be denuded of branches, their bark stripped off, and they were scarred and indented by having come into violent contact with some passing object. These abrasions on the trees above water-mark have evidently been caused by the heeling over of some of the Titanic denizens of the forest in their headlong course down the turbid torrent. A singular circumstance in connection with the progress of the waters, and which goes to confirm the opinion as to the sudden release of an almost incalculable body of the destructive element, is the fact that, in forcing its way through the chain of hills from the mountain to the head of the creek leading to O'Brien's Bridge, the onset of the flood was so rapid as to temporarily prevent it finding in its downward course its level. Thus in many instances the mark of the water is on one side many feet above that on the opposite, and where one spur is entirely swept of its timber, the other side has escaped uninjured, thus showing how various and fantastic were the forms into which this huge mass of water shaped itself as it bore down the natural barriers which opposed themselves to its terrible progress. As we penetrated further up the winding valley the channel again widened out, its precipitous banks on one side consisting of a rich chocolate alluvial soil, and on the other of a rocky basaltic formation, overgrown with scrub, and covered with moss and lichens, with huge fallen logs and dead timber, distributed high up and strewn along its banks. The whole channel was here encumbered with enormous boulders, trunks of dead timber and green trees. These trees were literally stripped root and branch, and their long stems bore the appearance of having been scraped with knives, in a manner similar to that adopted in preparing spars for ship-building purposes. Interspersed with these rocky fragments and masses of timber, were huge sludge beds where the surface soil washed from the hill sides had accumulated; and we were compelled to exhibit much caution in avoiding these quicksands, as although they seemed to present a hard surface, my companion assured me that if I trusted to them, I should be "taken in" in a double sense. The area of cleared ground increased on our nearer approach to the primary cause of the disaster, and the space at this point (about 3 miles and a half from Mr. Stansfield's,) could not have been less than 350 yards across the valley, and the depth of the torrent at least 80 feet perpendicularly. We had now attained a considerable altitude, and we paused to take our bearings, and look back down the tortuous valley which we had ascended. The delightfully cool mountain air blew in perfumed breezes, and resting on a jutting rock on the hill side we took a deep draught of "God's glorious oxygen" as we admired the landscape scenery in the vicinity of O'Brien's Bridge, seen through the vista which opened out before us. Mount Direction stood in the distance, an imposing background, with its sun-flushed summit and its sombre slopes wreathed in vapoury mists of dark blue, while along the river's course hung festoons of fleecy clouds lightly lifting themselves in obedience to the increasing power of the sun's rays, and disclosing the various green patches of meadow and upland which had remained undevastated by the waters, and which, by reason of the sinuosities of the noble stream which laved their shores, appeared like

> "Summer isles of Eden
> Lying in dark purple spheres of sea."

Pursuing our journey we at length reached the locality of what has hitherto been called the small landslip, but which on a close examination appears to be no land slip at all. The bare hill side, which like the larger land slip presents such a peculiar appearance from the road side, has been caused by the rush of water down the mountain having, by reason of a projecting spur, been temporarily dammed back, and the impatient torrent thus held in check has stormed up the slopes of the ravine, and with mighty and resistless force swept the precipitous hill side and carried off the timber, surface soil, and vegetation, leaving it barren to a height of nearly 150 feet, and causing it to present the appearance at a distance of a huge fall of earth

having taken place. That such however, has not been the case is abundantly demonstrated by a close inspection of the ground, as little more than a foot of the surface soil is washed away, and, above the height reached by the waters, the slopes are still fringed with a dense growth of forest and scrub extending in an unbroken line along the level reached by the flood. We had reached the foot of the "great land slip," and the valley now appeared entirely cleared to a width of nearly a quarter of a mile, the scene presented being one of the wildest which could possibly be witnessed. Stupendous boulders, gigantic tree trunks, splintered into matchwood, lay prone upon the slope of the ranges and buried in the numerous gullies and channels which had been carved out of the solid rocks by the fury of the torrent. Stones of immense size were to be seen embedded on the wood as though impelled from a Krupp gun or other mighty piece of ordnance. All was

"Ruin upon ruin, rout upon rout,
Confusion worse confounded."

Mr. Betts informed me that before the deluge which has passed over this locality, took place, it would have been almost impossible to have explored the valley we were now traversing, so heavily was it timbered, so dense the undergrowth, and so dark and sombre its depths—a place in fact, where the sun's rays never penetrated. It was now a chaotic ruin of rocky boulders, and dead and green timber piled in most admired disorder, and extending for a quarter of a mile in one direction. We now deliberated as to whether we should ascend to the top of the great slip, and being anxious to view this wonderful convulsion of nature from all possible points of 'vantage, and my courteous "guide, counsellor and friend," being equally enthusiastic with a similar object, we started up the face of the slide choosing those places where the water had washed the earth from the rocks as presenting a better and less treacherous foothold than that offered by the slippery shingle which composed the other portions of the slide. By jumping from rock to rock, using the holes cut in the rocks as stepping stones, and occasionally crawling on hands and knees, we at length, when about 1,500 feet above the sea level, reached the top of the slide or the comparatively flat table land forming the new surface of the mountain side caused by the slip of earth. This slopes at an obtuse angle up to the wall or face of earth, which is here disclosed, and which extends in a semicircle for about half a mile and exhibits a depression, from the original formation of the ground, varying from 10 to 25 feet. There is, however, nothing in the conformation of the country to adequately account for the collection of the immense mass of water that deluged the lower lying lands, and it appears almost certain from the appearances here presented, that some other supplementary natural disturbances must have been at work to produce the ruin here observable—such as the bursting of a waterspout over the locality, or the release of the waters of some subterranean channel, which, while pouring forth its pent-up flood undermined the superincumbent earth, and brought down the rocks and timber, which now lie strewn over the surface and embedded on the fallen earth. That no water came from beyond, or, to make my meaning more intelligible, from the rear of the larger land slip, is abundantly clear from the fact that the whole margin of the hill-side above the slip has been undisturbed, the broken line caused by the fall showing a stratum of timber and decayed vegetable matter—a condition of the surface which had doubtless remained unaltered for many years past. As we gazed up to the face, or escapement caused by the fall, to the heights beyond, lighted by the rays of the sun, the sight was of the most grand and impressive description. The stillness of the air and bright refraction of light from the snow-capped summits of Mount Wellington afforded the most striking contrast to the murky scene of dire desolation in the midst of which we stood. To the left was a forest of blackened trees half burned away by bush fires, their skeleton branches now burdened with snow. The whole scene most vividly illustrating the lines of Tennyson:—

"A foreground black with stones and slags,
Beyond a line of heights, and higher
All barred with long white clouds and scornful crags,
And higher snow and fire!"

After viewing the slips from this point, my companion and I decided to endeavour to reach the head of the great slip in order to, if possible, ascertain if any overflow of water had occurred from the heights beyond. With some difficulty we accomplished this. The nature of the country immediately above and beyond the head of the slip, and for at least half a mile back, does not encourage the supposition that any lagoon, large or small, could have a place at the top of the mass that has slipped away. It is composed of a field of rocks, with dense undergrowth and gnarled stunted trees growing between them. There is no trace of any lagoon bank or bed, visible, and had one existed some portion at least of its upper side would have remained. The nearest resemblance to a swamp is fully half a mile distant, in a south easterly direction, and here we crossed many acres of native artichokes, and other vegetation usually found on perpetually damp ground, and where the melting snow had doubtless supplied the water we slushed through. Between the swamp and the head of the slips lies a "ploughed field" similar to that crossed by excursionists to Mount Wellington, but much less in area and composed of smaller, though rougher rocks.

Standing as close to the top edge as we could get, and fairly facing the centre of the slide, the following distinguishing features presented themselves. It appeared as though the end of a large rocky spur had fallen away. Assuming the entire cleared space to be divided into four equal parts, the lower three-fourths represented an inclined plane about six hundred yards long, three hundred wide, and sloped at an angle of about 45 degrees. The upper and remaining fourth exhibited a very rugged and irregular surface, was concave in appearance, and extended apparently from the wall to the edge of the steep incline previously mentioned, a distance of about three hundred yards, and across the valley about the same distance, and

was sloped at an angle of about twenty degrees. The sides gradually decrease in height till their points or ends meet the top of this inclined plane. A later subsidence of rock and soil has destroyed the originally almost perpendicular character of the back wall of this hollow. The devastation caused to the trees and timber in this locality, and the entire absence of any evidence to account for the collection of the enormous wall of water which rushed down the ravines, and even in its half-checked fury inundated the grounds in the vicinity of O'Brien's Bridge, seems to favour the impression that some natural phenomenon such as a waterspout, or the sudden bursting through of an underground reservoir, caused this disaster, nor does it now seem that the sudden accumulation of such a vast body of fluid can in any other way be accounted for. The theory of a land slip taking place, thereby forming a dam across the valley, and thus storing up the drainage of the hills till it acquired sufficient volume to break through it, is, I think, no longer tenable now that it is seen that the *débris* fell into the head of the valley rather than across it. Besides this it is evident that the greater portion of the mass carried down by the flood consisted of rocks and trees. There seems only one course open when endeavouring to sum up the results of a visit to the locality of this now celebrated landslip, and that is to adopt the formula of coroner's juries in doubtful cases and say that a great land slip has occurred, concurrently with a devastating deluge of waters, but how the land slip was occasioned and how the flood waters accumulated there is not sufficient evidence to show.

Myself and companion started for the return journey about two o'clock, reaching Mr. Stansfield's at half-past four, the time occupied since leaving that place in the morning till our return, having been nearly six hours. Here I was most hospitably received, and my guide still further earned my gratitude by providing me with a change of apparel. After a brief interval devoted to relating our experiences

> "Wherein we spoke of most disastrous chances
> Of moving accidents by flood and field,"

I left for town in a car driven by a man who assured me that he was going "straight away." We had not, however, proceeded more than half way towards the city, when my Jehu discovered that he wanted a lamp in order to escape falling into the clutches of a vigilant constabulary without those lights which he ought to have with him. The discovery of the want and its being supplied were events separated by the lapse of at least an hour. The only lamp available, had it appeared, gone in a spring cart to a part of the country a few miles distant. This lamp appeared to be a partnership affair between these two conveyances and the carman could not start till its return. It was of course expected every minute, but, as usual in such cases, did not come up to time or expectations. Waiting at a dull roadside inn only a few miles from town after a journey of the description mentioned is not calculated to put one in the best of spirits, and I am afraid I have scarcely yet quite made up my mind to forgive the carman or look with favour on the benighted policy which prevails in the locality mentioned, and which registers its carriage lights so strictly under the provisions of the Limited Liability Act.

The Mercury (Hobart), Saturday, 15 June 1872, p.3

[available online: http://nla.gov.au/nla.news-article8923224].

A compilation of earlier reports from the *The Mercury* (5-7 June, 1872) followed by a republication, under the heading "THE LAND SLIPS", of the bulk of the previous article from 12 June 1872.

The Mercury (Hobart), Saturday, 6 July 1872, p.2

[available online: http://nla.gov.au/nla.news-article8918230].

FINDING OF THE BODY OF RANAHAN.—The body of the unfortunate man Henry Ranahan, who was drowned at O'Brien's Bridge on the 4th June, was discovered early yesterday morning by Mr. John Wilkinson, on the beach bordering his grounds at Elwick, and some distance from where the poor man lost his life. The body was not decomposed or injured by fish in any way, although the skull was battered in, which, no doubt, resulted from the embankment falling on the man at the time he met his death. It is surmised that the body has remained some time covered with silt, and that the high winds and tides of the past few days have uncovered it, and washed it into its present position. The body was conveyed by the police to the house of the widow, where an inquest will be held to-day at ten o'clock, before Henry Bilton, Esq., coroner.

The Mercury (Hobart), Tuesday, 23 July 1872, p.2

[available online: http://nla.gov.au/nla.news-article8915610].

THE LATE LANDSLIP.—Photographs of the late landslip at Mount Wellington have been issued by Mr. H. Baily, scenic artist, of Liverpool-street. There are two views, representing what are known by the appellations of the "great slip" and the

"lower slip," and although they are not so clear as might have been desired by those who have not seen the actual effect, yet the representations depict the scene with considerable vividness. There is some difficulty, however, in discerning the precise situation of the slip on the views, but the aid of a little colouring would remove this, and materially assist persons at a distance, who are unacquainted with the locality, in arriving at some estimate of the enormous body of earth which was removed.

***The Mercury* (Hobart), Tuesday, 22 October 1872, p.3**
[available online: http://nla.gov.au/nla.news-article8922102].

TASMANIAN INDUSTRIES.

[No. 5.]

"MURRAYFIELD."

Murrayfield is the name of an estate owned by Mr. William Murray, and it consists of about one hundred acres of land near O'Brien's Bridge. Upon this there is a farm where a number of interesting experiments have been made, a soap manufactory, a vinegar manufactory, a candle manufactory, and a colonial wine manufactory. We have lately been afforded an opportunity of inspecting the whole of the establishments, and in our description we will begin, where our inspection commenced.

THE VINEGAR MANUFACTORY.

Here vinegar is made of sugar, molasses, small fruit, such as cherries, plums, gooseberries, and apples, sugar beet, and white cabbage. We were first taken to the vinegar shed, in which there are about sixty puncheons that will hold about 250 gallons each, one that will contain 900 gallons, and two others that will hold 500 gallons each. There were about 15,000 gallons of vinegar in this shed at the time of our visit. In another part of the building there is a fruit crusher, which grinds the apples to pulp, and crushes the smaller fruit before it goes into the boiler. The cabbage are put in whole and the sugar beet is crushed. The boiler or copper will contain 400 gallons, and about one foot from the top there is a strainer, above which the fruit is placed in order that the pipes which conduct the liquid away may not get choked. When the liquid leaves the copper it is conducted by means of shoots to a tank and then into a wooden cooler, after which it is allowed to run into the fermenting vats. One of these is a large square wooden tank. The other two are large casks. After fermentation the vinegar is conducted across the yard to a little brick building heated by a flue. Here it is allowed to stand in casks to acetify, and as the temperature is kept at about 80 degrees, it does not take long to render the liquor sour. There are three tanks in the yard, and into these the vinegar is next conducted; after which it goes into casks in another part of the premises, where a number of sheds that were destroyed by the last flood are in course of repair. In addition to the 15,000 gallons in the vinegar shed, there are about 15,000 gallons more in the other sheds and in the store room, so that the quantity in stock is about 30,000 gallons. The vinegar which has by this time been matured, then goes to the shed which we first described, and here it is kept in stock ready for sale. There is a regular network of two and a half inch pipes under the yard, and through these the vinegar is conducted from one place to another by means of a double action pump, which is also used to pump the water required from a well on the premises. This well is 22 feet deep, and is bricked from top to bottom. All the fruit used in the manufacture of vinegar is produced in the orchard at Murrayfield, and the sugar beet is grown on the farm. The cabbages used to come from Port Esperance.

THE SOAP WORKS.

At the soap manufactory at Murrayfield eighteen tons of soap per fortnight can be turned out with the appliances available. The building in which this branch of the business is carried on is a wooden one, two stories high. On the upper floor are the two pans now in use, one capable of holding 10 tons, and the other 8 tons. These pans are set in brick, and are heated by means of fires beneath. Into these pans the tallow is shovelled from the casks. The caustic soda used in the manufacture of soap is placed in a tank on the ground floor, and there diluted with water, the alkaline solution being pumped up into the pans as required, and pumped out again when it is become exhausted or reduced to the condition when it is known amongst soap makers as "spent lees." When the lees was made with soda ash instead of caustic soda it was boiled in a tank. When the tallow, lees, resin, soda, and other ingredients used have been sufficiently boiled, everything is made ready for putting the liquid soap into the frames. Fifteen of these frames, when fitted together, form a box, into which the soap is poured from buckets. These buckets are suspended from the rafters and are filled with large ladles. When the soap has become cool and set, the frames are taken off, one at a time, and the slab of soap exposed is cut off by means of a wire. The slabs are then placed upon the cutting table, five at a time, and each slab is cut into 24 bars of soap by means of wires, which are passed through divisions made in the table. The bars are all branded with the name of the maker, and marked either No. 1, or No. 2, according to their quality. After this they are stacked, ready for packing. The boxes used for the soap are all made of Tasmanian wood, on the premises, in a shed kept for the purpose, and they are made to hold either a hundredweight or half that quantity. When the packing is completed the name of the proprietor of the manufactory is

stencilled on the boxes, and the soap is ready for sale. In connection with the soap works there is a copper, over which the tallow casks are steamed in order that all the tallow may be got out of them. Both Tasmanian and imported tallow is used at Murrayfield, but the greater part is from Victoria. A large quantity is kept in store, and there is also a lot of caustic soda in iron drums, and resin in barrels in the store room, ready for use. The soap made, appears to be of excellent quality, and fully equal to any of the same description that is imported. A large business is done, and at the time of our visit both the large pans were full.

THE CANDLE WORKS.

There are two candle houses with separate appliances, and in the winter time from one and a half to three tons of candles are made every week. Upon first entering the candle house we were taken to the fat loft, where all the fat used in the manufacture of the candles is placed, upon its arrival on the premises. Here all the fat is cut up by hand, and then let down through a shoot into a large iron copper, where it is rendered. After being rendered it is placed in a wooden vat with water. This vat is called a "settler," and all the impurity in the tallow sinks to the bottom of the water. The tallow is then melted once more preparatory to its being poured into the moulds, or frames, as the candle-makers call them. These moulds consist of a number of metal pipes the size of a candle, fitted together, with a trough at the top for the reception of the tallow. The bottom of each of the pipes is shaped as we see the top of the mould candles sold in the shops. The wicks, which are made of cotton, are imported from England in balls, and are cut into the proper lengths by women and children employed at Murrayfield for the purpose. The wicks are stretched through the moulds, over wires, and when all is ready, the melted tallow is dipped from the boiler into a large can, from which the operator fills the frames, two at a time. Each frame contains 18 candles, or three pounds weight, and there are 300 frames in the two houses. The cooling of the tallow in the frames depends a good deal upon the weather, and sometimes water is thrown over them to hasten the setting. When the tallow has set, the frames are lifted up, and the wires over which the wicks were stretched, are drown out. With an instrument made for the purpose all the tallow is scraped from the trough, and after this the ends of the wicks are clipped off, and the candles pulled from the moulds. They are then packed in cases, bought for the purpose, and containing quantities ranging from 60 to 200 lbs. After the tallow has been rendered, the refuse that is left in the copper, is all placed in a strong screw press, where all the tallow that remains is extracted. The stuff left in the press is called "graves," and it is taken out in solid blocks five or six inches thick, and sold for feeding pigs, poultry, and dogs. There are two of these grave presses on the premises, and the second candle house, which is not always in use, contains the same appliances as the one we have described. The candles appear to be of good quality, and it is a noticeable fact that in connection with the manufactory there is very little of that unpleasant smell that generally renders a residence in the vicinity of a candle manufactory a thing not to be desired. Outside the candle house there is a weighing shed, where everything that comes into the place is weighed. Another industry carried on at Murrayfield is

COLONIAL WINE MAKING.

Wine is made here on a pretty extensive scale from grapes, gooseberries, and cherries, and at the time of our visit there were about thirty hogsheads in the cellar in wood, and a large quantity in bottle. All the wine is made of the juice of the fruit grown upon the estate, and there is no fortifying with spirits. The fruit, which is first crushed, is placed in a large tank with water and sugar, and after it has been allowed to steep for a sufficient length of time, the liquor is drawn off and fermented, after which it is put in casks and stored in the cellar. A good deal of the wine is bottled. We tasted some of that made from grapes, cherries, and gooseberries, and that which had been in the wood for five or six years was very good. There is also in store some wine made from mixed fruits. It is all disposed of in the colony, and there is a ready sale for it.

THE FARM.

Besides growing the ordinary crops, and following the ordinary agricultural pursuits, Mr. W. Murray has for years past made a number of interesting experiments, in connection with the growing of sugar beet, flax, and canary seed. In 1867, when the starting of a beetroot sugar manufactory in Tasmania was first mooted, Mr. Murray commenced to grow sugar beet for the seed, and in order to ascertain whether the soil and climate were adapted for it. That both the soil and the climate were adapted to the growth of sugar beet is pretty well proved by the fact that on the farm at Murrayfield twenty tons to the acre have been obtained. The seed of the variety known as the "White Silesian" has been grown largely, and 600 lbs. of seed were obtained in one year. The cultivation of flax was commenced as far back as 1864, and it has been grown ever since, for the seed. In 1866, an attempt was made, on a small scale, to manufacture the fibre, but it was found to be impracticable without machinery, as hand labour was far too expensive. At one time, between one and two acres were under flax, and it is still grown for the seed. Both the soil and the climate appear to be very suitable, and the yield has been 10 or 12 bushels per acre. Six or eight acres of the Murrayfield farm have been sown with canary seed each year for many years past, and large quantities of seed are produced and sold. In fact, the imported seed has almost, if not quite, been driven out of the market. Some has been exported, but it is now all sold in Tasmania. The canary seed seems to flourish well. Before the late flood, chicory had been grown very successfully for some years, but the part of the estate upon which this was grown was left covered with stones and *débris*. The quantity of land under chicory was about two acres. There are five acres of lucerne growing now, and the sheep appear to thrive splendidly upon it. The growing of hops on a small scale was commenced some years ago, and the area of land devoted to this has been increased this season so that the hop grounds will cover about three

acres and three quarters. Close to where the soap and candle manufactories are situated there is a large shed where seventeen head of cattle are fattened in stalls for the market. They are fed on mangolds and corn, the mangolds being cut up in one of Ransom and Sons patent root-slicers. There are over a dozen pig styes near the cattle shed, and each has two or three tenants. One monster pig was killed the other day, and its weight was found to be 621 lbs. There are over 50 pigs being fattened at the present time. The quantity of land under fruit is between eleven and twelve acres, more French crabs and pearmains being grown there than any other variety. Murrayfield is a regular hive of industry, and its proprietor deserves every credit for the successful manner in which he has established so many manufactories.

It will be a long time before the traces of the last flood are all removed. Part of the estate is still covered with immense boulders and smaller stones brought down by the torrent, and in one place extending over an area of about 50 yards square the logs that floated down are lying packed close together. To prevent further damage, Mr. Murray is having a fine embankment constructed where his land abuts on the creek. This embankment extends 40ft. into the creek and is 200ft. long. It is made of large stones, with a slope on the water side of one foot in five.

***The Mercury* (Hobart), Saturday, 26 October 1872, p.3**
[available online: http://nla.gov.au/nla.news-article8919236].

TASMANIAN INDUSTRIES.

(No. 6.)

"HOUGHTON."

This is the name of another estate at Glenorchy, owned by Mr. William Murray, whose establishment at Murrayfield we described in a previous article. At Houghton there is a large flour mill, and an extensive tannery.

THE FLOUR MILL.

The mill is a large wooden structure three stories high, and we began our inspection at the top, where there is a large store-room capable of holding about 50 tons of grain. This is where the wheat is placed when first it comes to the mill, and it is raised up with the common tackle. On this floor there is a bin situated over the smutter, which is in the room below. On the second floor there is a store-room in which twenty five tons of wheat can be easily stored. In this part of the building is the smutter in which the wheat is cleaned, the dressing machine, and the stones. There are two pairs of stones three feet eight inches in diameter. These, with the smutter and dresser, are all driven by the wheel, or engine, of which we shall have more to say directly. There are hoppers over each pair of stones, and after the wheat has been ground into meal, it is carried to the dressing machine, which consists of a cylindrical sieve of wire gauze, in the centre of which there are a number of revolving brushes. The meal passes into the sieve which is fixed in a sloping position. At the highest point the wire gauze is as fine almost as muslin, and here the finest flour comes through. Further down the cylinder, and towards the lowest part, the wire gets coarser, until at the extreme end it is large enough to allow the bran to pass through. There are four qualities of meal that come from this sieve, flour, "sharps," or course flour, pollard, and bran, and each of these passes into a different shoot. These shoots end in long calico "sleeves" which descend to the floor below, and from which the bags are filled. After this the flour is stored ready for sale, and the average stock on hand at the Houghton mills is about fifty tons. Of course there are all the other mill appliances on the premises, weighing machines, and tools for dressing the stones. In a room adjoining that in which the stones were at work, is a bark mill, for grinding the bark used in the tannery. This as well as a large chaff cutter in another part of the premises, is driven by the water wheel and engine. The wheel is provided with what is called spur gear, and the power is from the centre of the wheel, the stones being poised upon pinions in the usual way. The wheel can be regulated in speed by the moving of a lever inside the mill. On the ground floor is the receiving room, which will contain about 25 tons of grain, and there are also a number of little store-rooms. In the engine house which is close to the wheel, there is a crown engine of 12 horse-power, and as the strength of the wheel is estimated at 12 horse-power, 24 horse-power can be obtained by connecting the two. The boiler is a large one with egg-shaped ends. The wheel is an overshot, of 17 feet in diameter and the water is conveyed to it from the creek, along eight hundred feet of wooden troughing. It was found that owing to the porous nature of the ground a good deal of the water was lost, as it ran down tho old race, and the troughing was constructed with a view to economising the supply of water, which is rather short in the summer months. The troughing is 3ft. 6 inches wide and a foot deep, and is made of two-inch timber.

THE TANNERY.

The tannery at Houghton is a very extensive one, and large quantities of leather are made and sent away. The process of tanning consists of soaking the skins and hides in pits containing fresh water, lime, and infusions of bark of different strengths. There are sixty of these pits at Mr. W. Murray's tannery. The kinds of leather made are sole leather from bullock hides, harness leather from horse and bullock hides, kip leather from calf skins, leather for lining boots and other purposes from sheepskins, and kangaroo leather. These nearly all go through different processes, and as the sole leather is that chiefly made,

we will first describe the various processes to which the hides destined for this use are subjected. When the hide arrives on the premises it is, first of all, put into pits containing fresh water, after which it goes into the lime pits. From there it goes into the hands of the beamsman, who, with a sort of two-handled knife or scraper, removes the hair. The hair having been taken off, the hide goes again into fresh water, and then into the first of the tan pits, which are called "spenders." The pits into which it next goes are called "handlers," and here the hides are handled, after which they go to the last of the pits which are called "layers." Here the hides are not only steeped in a strong infusion of bark, but there are layers of bark placed between them. When the hides are removed from the "layers" they are hung up until nearly dry, and then taken to the floor above to the "rolling bed," which consists of a smooth wooden floor, upon which the hides are laid. A heavy brass roller, weighing about 600lbs., is then passed over them, and after this process they are allowed to dry thoroughly, and are then ready for sale to the bootmakers and others who require sole leather. The difference in the process through which the leather for kips, calfskins, harness leather, and kangaroo skins go, is very slight. These skins all go into pits called "butes," containing some other preparation besides the infusion of bark, and they do not go into the "layers" like the sole leather, and are not rolled. All the leather that is to be curried goes into the "butes." The kip and calfskins, kangaroo skins and harness leather, do not remain nearly so long in the pits as the sole leather. The sheepskins, or "basils" as they are called by the tanners, come to the tannery with the wool on. The dry skins are placed in a close room, to "sweat" before they are washed, and the green ones are at once soaked in fresh water, then put in the lime pits, and then washed. The wool is then cut off and the skins are tanned, the process being much shorter than that which the other leather goes through. The room in which all the pits except some of the soaks and some of the lime pits are, measures 100 feet long by 50 wide. The leather for kip and harness is the best, and the hides used for the purposes are those upon which there are no brands. Horse hides are sometimes used for harness leather, but comparatively few of them are tanned on the premises. The water used in the tannery is all obtained from the fine race which supplies the flour mill, and by a very good arrangement of shoots the water can be easily conducted to all the different pits. The liquor from these pits when it is done with has to be pumped out. Nearly all the refuse from the tannery is made use of. The horns which come attached to the hides are exported, and the bones between the horns and the hair scraped off the hides are sold for manure. On the floor above the pits there is the currier's shop, where all the leather except the sole leather is curried, some being blackened, and some left the same colour it is when it comes from the tan pits. Here the leather is finished, and made fit for market. Near the curriers shop there is a store room, in which there are samples of most of the descriptions of leather made on the premises. We were also shown three or four tanned dog skins, and some mats made of sheepskins tanned without the wool having been taken off. In the other part of this floor, which is altogether about 100 feet by 504, the wool taken from the sheepskins is dried, some of it upon wire tables running the whole length of the room. At the end of this room is the rolling bed which we mentioned before, and there are also a number of bars upon which the hides are hung to dry. The wool after being dried and sorted is placed in a powerful screw wool press, and then done up in bales for exportation. There are two other drying floors in addition to the one we have mentioned, and when necessary, some of the wool is dried upon the roof of the outbuildings. With the press at present in use about six or seven bales of wool per day could be turned out. The bark used in this tannery is all black wattle bark, and it is ground in a powerful mill situated in the flour mill. Under the bark mill is the store, which will hold ten tons of bark.

THE KENSINGTON FLOUR MILL.

The Kensington flour mill, carried on by Mr. W. E. Morrisby at Glenorchy, is a very old establishment, and has been in existence for nearly thirty years, although the present occupier has only had the business for about twelve months. There are three stores, and when the wheat arrives on the premises it is hauled up to the top floor, and placed in a bin, which is situated over the smutter below. From the smutter the grain goes into the bins over the stones, and these bins will contain from 100 to 150 bushels each. The smutter is on the second floor, and 20 bushels of wheat can be passed through it and cleaned. When the wheat leaves the smutter, on its way to the bin over the stones, it passes over a wire screen, by which most foreign substances which the smutter may have left are removed. Before it goes to the stones, it passes through another sieve, and this catches any large pieces of earth or nails that are often left in the grain. There are two pair of stones 3ft. 6in. in diameter, and they are what are called French burrs. Those stones are periodically dressed with instruments called "mill bills," and this is one of the most important matters connected with flour milling. In dressing the face of the stones a wooden bar called a mill staff is passed over them in order to ascertain whether they are true, and the staff is tested with an iron bar imported from England. From the stones the flour runs into two bins, from whence, after it has cooled, it is placed in sacks and stored until it has aged. This does a great deal towards improving the quality of the flour. It is then hoisted again and passed through the dressing machine, where the flour, sharps, pollard, and bran are separated, and pass to the floor below in four different calico shoots or sleeves. The dresser is a wire cylinder in which there is a shaft furnished with brushes. These brushes make about 1,400 revolutions per minute. The stones are driven by an overshot water wheel 35ft. in diameter, set against the side of the mill. The wheel drives the stones with what is called counter gear, the power being got from the extremity of the wheel and not from the centre. The stones are set on pinion wheels in the usual way. About 84 feet of troughing conveys the water from the dam to the wheel, and this troughing is all zinc lined. The dam is a fine large one, and the race that conducts the water to it from the creek is about 200 yards long. This race was almost choked up by the late flood, and had to be cleaned out. The Kensington Mill is one of the most compact establishments we have seen, and the dam enables the work to be carried on there when there is not water enough to drive the mills lower down the creek.

***The Mercury* (Hobart), Monday, 11 November 1872, p.3**
[available online: http://nla.gov.au/nla.news-article8923797].

TASMANIAN INDUSTRIES.

(No. 7.)

THE KENSINGTON TANNERY.

We have been afforded an opportunity of inspecting the Kensington tannery at O'Brien's Bridge, owned by Mr. Isaac Wright. This is the most extensive tannery on the Southern side of the Island, and is one of the oldest in the colony, for it has been in existence for about forty years, and Mr. Wright, the present proprietor, has been in occupation for about twenty-five years. The premises, which abut on the main road, consist of a range of large wooden and brick buildings, and the first thing that strikes the visitor upon entering the gate is an immense heap of black wattle bark—about 100 or 150 tons—stacked ready for the mill. By the time he has surveyed the bark stack and wondered how long a time will elapse before the black wattle is exterminated, he becomes unpleasantly conscious of the presence of two large, gaunt, and fierce-looking dogs, the guardians of the place, who look as if they contemplated an early meal upon his carcase. These brutes stand nearly three feet high, and to a stranger it is a relief when the monotony of their company is broken by the appearance of the manager, who, with the proprietor, showed our reporter over the premises. We have before given one or two descriptions of the process of tanning, and we do not propose to weary our readers with a repetition of what we have told them before, but will merely describe the premises and the business carried on there. There are half-a-dozen "soaks" or fresh water pits into which the skins are first placed. When the skins are removed from these, they are "broken over" or softened by manipulation with the hands, and after this they go to the lime pits of which there are twelve. Here they remain for about three weeks, when they go to the hands of a beamsman who places them over a rounded block of wood and takes off the hair and what particles of flesh may have been left adhering to the hide, with a peculiarly-shaped two-handled knife. When the hides leave the hands of the beamsman, they are ready for the tanning process, and are placed in the first of the tanpits of which there are about one hundred, some being under a large shed and others in the open air. The liquors in these pits are of different strengths, and the hides go from one to the other until they have lain for some time in the strongest of all the liquors contained in the pits called layers. There is some little difference in the processes to which the different descriptions of hides are subjected, and none but those intended for sole leather are placed in the layers, while there are some other pits called "bates" in which some of the hides are placed before they go into the tan. The hides when they are taken from the tan pits are partly dried on bars placed there for the purpose, and then the sole leather is taken to a loft overhead called the rolling room. Here there is a smooth wooden floor, upon which the large hides are placed, and then a brass roller, which weighs between 1,400 and 1,500lbs. is pulled over them. After this process the sole leather is dried, and it is then ready for sale. There are sometimes from 1,000 to 1,500 bullock hides in this loft at one time. A good deal of the other leather is dried in this place as well and it sometimes contains over one hundred dozen kangaroo skins at a time. At the time of our visit there were heaps of leather all round the room ready for sale. In the part of the loft used as a drying-room, there were a number of hides hanging up that were to be made into harness leather, and which had already gone through the processes of blacking and "stuffing" with tallow and oil. In the same loft there is a large and smooth wooden bench upon which the stuffing is done. In the currier's shop, which is close at hand, all the harness leather, kip, calf, kangaroo, and basils or sheepskins, are prepared for market by being dressed in various ways. We must not omit to mention the scouring shop into which the hides go after they come wet from the tan pit, and before the currier sees them. Here they are placed over another block or beam and are subjected to very nearly the same treatment they had received in the early stages of their conversion from raw hides to leather, at the hands of the beamsman. The "rub shop" is a place that most strangers would enter carefully, and leave with decided feelings of relief. It is in this sanctuary that the curriers sharpen their tools and prepare the—to a stranger—somewhat unpleasant mixtures used in the currying trade. There is rather an unpleasant stickiness and greasiness about this place, that a novice cannot appreciate. The bark mill, which is a very powerful one, stands in a shed by itself, and is worked by horse-power. The water for all the pits is brought from the creek, which runs close to the premises, and there is always a good supply. The last flood did great damage at the Kensington tannery, as it did elsewhere in the vicinity, and Mr. Wright was a considerable loser. All the pits were filled with water and sludge, and the expensive liquors wasted, while many of the buildings were injured. Everything, however, seems to be in apple-pie order at the present time. Mr. Wright is an extensive buyer of sheepskins, and he contracts for the purchase of large quantities from the butchers in Hobart Town and the district. Of course the sheepskins are chiefly valued for the wool that is upon them, although the pelts of the green skins are tanned. The pelts of the dry skins are generally consigned to the manure heap, as they are of no use as leather, and there is no market here for them for other purposes. When the sheepskins first come upon the premises, they are placed in a pit containing fresh water, to soak, and here they remain from 14 to 16 hours. They are then removed from the soak and taken to a shed where they are "painted," with lime on the fleshy side, and then stacked and covered over and left to "sweat." After this process the skins are taken back to the same soak, where they are washed clean. They next make their appearance in the "pulling shop" where all the wool is pulled off by hand. The different qualities of wool are of course kept separate, and the pelts are sent off to the lime pits, from which they go into the tan yard and are converted into leather. All the dry sheepskins are first of all placed in a warm room, until they become soft. On the premises is a small two-storied brick

building, on the upper floor of which the wool is dried in the winter time, when there is no possibility of drying it outside. This place is heated with a coke stove. The wool store is a large brick building with four floors for drying the wool upon, and a large store on the ground. The sides of this store are made so as to admit the air and exclude the rain, and the floors upon which the wool is dried are made of battens, so that a current of air is admitted beneath. A good deal of the wool is dried on the roofs of some of the outbuildings when the weather will permit of this being done. On the ground floor of the wool store there were, at the time of our visit, immense piles of wool of different qualities, standing ready to be conveyed to Mr. Isaac Wright's premises on the New Wharf, where all the wool packing and pressing is done. Just outside the wool store is a very large and powerful screw press, in which the bales of leather are reduced to the required size. Nearly all the refuse from the tannery goes to the manure heap, for here there is no market for stuff that would bring a good price in Great Britain. The sheep's trotters are boiled, for the sake of the "neats foot" oil, which is used for dressing the hides in the curriers' shop, and the horns and hoofs of the cattle are kept for exportation to England, where they fetch a good price, but the pelts that are unfit for tanning, the fleshings and hair from the beamsman, and the leather shavings from the scouring shop are all cast away as useless and unmarketable, and can only be sold for manure. In England all the hair can be sold, and the useless pelts, and the scraps of the raw skins from the beamsman are all used in the manufacture of glue. The shavings and scraps of tanned leather which are here cast away as useless are used at home for stuffing common furniture, and for forming the insides of children's balls. Possibly, as other manufactories start up here, all this refuse stuff will have its value, but now it is all waste. The leather manufactured at the Kensington tannery is sent all over the colonies, New Zealand being the chief market for the kangaroo skins. Mr. Isaac Wright employs 17 or 18 men at the tannery, the busiest time being the middle of winter. In connection with the tannery, there is a splendid ten acre paddock, from which from 25 to 30 tons of hay is obtained every year. This is nearly all consumed by the horses used at the tannery.

***The Mercury* (Hobart), Thursday, 30 January 1873, p.3**

[available online: http://nla.gov.au/nla.news-article8926544].

THE LANDSLIP.

TO THE EDITOR OF THE MERCURY.

Sir,—If one could gather up within himself the endowments and acquirements of a poet, geologist, and of an artist, a magnificent field of operation he might occupy with advantage by ascending to the landslips of your Mount Wellington, of which a graphic description was supplied to *The Mercury* by your special reporter a few days after that destructive death-dealing catastrophe moved the heart of the city. But endowments and acquirements not creating surprise, nor giving occasion for the breaking of the lower section of the table—not of Serbâl, but from "Ras" Sufsâfeh—Sinai—could scarcely fail to give scope on such a field for at least wonder, for awe, even for thought and emotions irrepressible.

We shall turn in by the church at O'Brien's Bridge with the determination of reaching, if God permit, the dark ground at the back of the starting place of the landslip. Six to seven miles' continuous rise will compass the undertaking. Winding along, as the easiest and quickest way, near the left bank of the newly cut gorge in which murmurs the stream that noisily plays through O'Brien's Bridge, we shall keep to this bush cart road, passing by Messrs. Calloway's and Shoobridge's farms, going on, and up four miles, always winding to the right till the remaining road determines our choice and leads us upward to the left, winding till we come to a stand. Returning down the treacherous track to "Tinker's Corner," we turn to make our way down into the gorge to follow its twists, its curves, up alongside its waters. Now at each step one stands amazed. Over there at a depth of from 200 to 300 feet you listen to the meandering stream. Here at our feet the once thickly timbered, the almost impenetrable bush is to-day bestrewed with boulders and heaps of clay, to say nothing of logs broken, smashed, and riven as by thunderbolts, and the general *débris*, all which tell of the maddening fury of the commingled, rocking, leaping, overwhelming, huge mass, whose terrific strength at this bend seems mainly to have been collected, hurled forth, and weakened. High over our heads trees of from 20 to 30 years' growth stand, it is true, but stand snapped off at the height of from 60 to 100 feet; they stand bare—as we fear, stood bare last week in the Straits of Dover the masts of the Northfleet bringing our navvies. They stand bare while the trees of prouder growth, defiant of the surging mass, exhibit to their very branches the power of their resistance in their battered and clay-begrimed trunks.

We shall now attempt to get down the new-raised, yielding banks of the gravel, clay, and boulders. A high-pitched and the loudest cooey might arrest the ear of your friend on the opposite side. Now, standing by the stream, and looking up and around, at once we have suggested to us the deep railway cuttings at home by the swarming navvies. There, up the stream, the rolling elements, the mighty mass finding obstruction—the obstruction of a hill of rock standing out to the right, appears to have been lashed into fury, boiling and amassing, and piling up its forces only to burst its self-raised barrier to dash across and spend its rage as described; but immediately with its reserve reeling and leaping over to the opposite side, wrenching, breaking down, and tearing up, like the fallen angels of Milton warring, and dashing forward; but yet again rebounding with scattered, with still diminished volume, and bursting a highway, though more in character with what pleases, than that which creates the emotions arising from the stupendous. At this height the eye is delighted in looking down by a view presented of

the Derwent north of Risdon Ferry, with its peninsulas, farms, houses, and receding hills. Leaving here sufficient for the second meal, we trudge on up along the course of the lessening stream. Look at that huge tree, and at the other farther up, almost entirely bridging the gorge. How came those monsters, of Cromwell's time there? Let the landslip speak. We mount the thickly boulder-studded side and cross on one over to the left. Are you giddy? Ahead to the right steals forth the sparkling water from beneath the tangled undergrowth. And there at almost a right angle, leftward, opens before us the yellow, precipitous—I will say the "Giant's Causeway." This hitherto hidden view is stupendously grand; it is magnificent; it is bewildering. A steep mile will bring us to that brown curved edge, the extreme point of the catastrophe. Now climbing—for now it is climbing—the yellow height falls back, till it reaches from side to side a width, say, of 300 to 400 yards. The purling streams make music as they slide, and dance, and roll, and leap, and spit, and foam, here and there and everywhere upon the rocks, from the right, the middle, and from the farthest corner upward to the left. We are now shut in from all views, except from the view of that eaglehawk just settling on a trembling limb of the tree whose trunk we may by and by reach. All around us lie heaps upon heaps of clay and boulders of every size, with imbedded trunks and trees treacherous as Alpine avalanches. Woe to the careless, light-shod mountaineer, and to the panic-stricken desperate kangaroo, or sporting goat. Keep close up to the left near the bush, fair brave one, and you may defy the peals of laughter. And now, "after much of danger past and many a 'cooey' rude," we rush for the brown shaggy edge, having scared that soaring eagle, and after sinking in and getting out, only to slip in and slide down and struggle yet again, "we stand like the brave with our face to the foe," having gained the highest, the semicircular point of the landslip.

Beautiful, grand, magnificent is the prospect before us; a prospect embracing outlying mountains and hills, with cultivated patches and tiny homesteads, and the Brighton district and the last fall of the capricious, tantalizing Jordan, and the sky-reflecting Derwent looking calm as the rising moon, with the landslip's course appearing at this distance over the intervening hill, but a little zigzag, bronze-colour, cut up bush road.

Respectfully yours,
ONE OF TWO.

Hobart Town,
January 28th, 1873.

***The Mercury* (Hobart), Saturday, 15 March 1873, p.3**
[available online: http://nla.gov.au/nla.news-article8914455].

THE LANDSLIP AT O'BRIEN'S BRIDGE.

TO THE EDITOR OF THE MERCURY.

SIR,—Can any of your readers give any information as to what was the cause of the landslip? Was it occasioned by a water spout, by subterranean waters, or merely by the rainfall?

An approximation to the bulk of the water may be made by calculating its width, depth, and velocity, and time of passing.

It is evident that gravity and force occasioned the disruption of earth, stones, and timber, and projected them as described by S. H. Wintle. The bulk and weight of water being ascertained, was it possible for the local falling rain to effect what was accomplished?

My opinion is that it was not. That either a water-spout, delivering its water for some minutes, or the outburst of waters supplied from a higher level must have taken place, otherwise some convulsion of nature. If an outburst of water, the channel may be effectually concealed by the débris.

Yours, &c.,
C.

Extracts of Monthly Proceedings and Meteorology - Royal Society of Tasmania.

Royal Society of Tasmania 1873. *In: Papers and Proceedings of the Royal Society of Tasmania*, 1872.

[page 21]

JUNE, 1872.

The monthly evening meeting of the Society was held on Tuesday, the 11th June. M. Allport, Esq., in the chair.

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[page 21]

The Secretary read the following note, which he had received from Dr. E. S. Hall ;—

"Melville-street,

"11th June, 1872.

"MY DEAR DR. AGNEW,—I have had my time so much engaged, that I have not been able to complete my usual Health Report. The deaths were 51, being +11 1-15th above the June average for the previous 15 years. Curiously enough the female deaths were one more than the male. Only 7 under 20 years old; 15, 60 and upwards. No particular disease prevalent. Great variations of temperature, the principal abnormal condition. The mean daily range of temperature being +4.94 above the average.

"During the flood last Tuesday, I measured in my rain-gauge 5.91 inches in the 24 hours. In *all* June, 1842, had before the highest rainfall 4.41 inches. In 1854 flood there fell 8 inches in 38½ hours.

"Very truly yours,

"E. SWARBRECK HALL.

"Dr. Agnew, Hon. Secretary

"Royal Society."

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NOVEMBER, 1872.

The monthly evening meeting of the Society was held on Tuesday, the 12th November, M. Allport, Esq., V.P, in the chair.

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[page 47-48]

Mr. STEPHENS also remarked that it was desirable there should be on the records of the Society some account of the recent landslip near O'Brien's Bridge, and mentioned some of the conclusions arrived at during a recent examination of the interesting phenomena connected therewith. The subject would afford good material for a future paper.

Discussion followed in which various opinions were expressed upon the original cause of the landslip.

[page vii, Appendix]

MAY, 1872.
PRIVATE OBSERVATORY, HOBART TOWN.

Day of month.	Bar. 37 feet abv. sea level corrected & reduced.		Self-Registering Thermometers.				Wind.		Rain in Inches.
	Highest.	Lowest.	Highest in shade.	Lowest in shade.	Highest in sun.	Lowest on grass.	Direction from three daily re-gisters	Force in lbs. per square foot.	
	In.	In.	°	°	°	°			
1	29.638	29.591	64	46	66.5	43.5	SE NW SW	.26	0.20
2	29.822	29.803	64	37	87.0	33.0	NW SW	1.30	
3	29.976	29.892	66	32	91.0	30.0	SW NE SW	.52	
4	30.154	30.072	63	34	90.0	29.5	NW E	.78	0.02
5	30.181	30.134	62	38	83.5	33.0	NW	.78	0.09
6	30.328	30.260	63	40	87.5	35.0	NW SW W	.52	
7	30.421	30.326	68	34	92.0	30.5	SE NW	.26	
8	30.322	30.147	62	35	85.5	30.0	NW	1.56	
9	30.000	29.922	59	45	63.0	41.0	NW	.26	
10	29.992	29.729	57	47	79.0	43.5	NW SW	.26	0.24
11	29.642	29.533	68	47	91.0	42.5	NW N	.78	0.03
12	29.443	29.320	68	46	87.5	40.0	NW	.52	
13	21.721	29.593	65	45	93.5	42.0	NE NW E	.78	
14	29.893	29.834	59	46	79.0	42.0	NW NE SE	.52	0.02
15	29.603	29.431	57	44	68.0	42.0	NW	.78	
16	29.554	29.525	64	40	87.0	36.5	NW N NW	1.04	0.10
17	29.722	29.688	63	48	88.5	43.0	NW E SE	.52	
18	29.730	29.723	61	50	62.0	44.0	SE	5.72	0.45
19	29.402	29.302	54	48	60.0	43.0	SW S	7.80	0.42
20	29.606	29.312	51	39	53.0	34.3	NW NE SW	3.38	0.19
21	30.045	30.019	63	43	89.0	33.5	NW	1.30	
22	30.095	30.079	66	48	66.0	33.0	NW	3.64	0.12
23	30.040	29.727	65	48	89.0	46.5	NW	3.12	0.44
24	30.069	30.012	67	37	81.0	31.5	NW	1.30	
25	30.085	30.033	55	45	54.0	42.0	NW N	1.30	0.01
26	29.837	29.735	70	49	91.0	44.5	N NW	1.30	0.30
27	30.290	30.002	66	45	88.0	42.5	SE SW	1.30	
28	30.380	30.341	60	33	80.5	29.0	NW	.78	0.01
29	30.377	30.301	59	34	76.0	29.5	NW	1.04	
30	30.198	30.142	58	36	75.5	31.0	NW	.78	
31	30.093	30.002	57	36	80.0	32.0	NW	1.04	
Mean Monthly 29.905			51.19		79.50	37.21	Total Force	45.24	2.64

The mean in all cases is taken from the sums of the three daily registers, and not from the maximum and minimum.

The direction of the wind is registered from currents moving at a height of 192 feet and the force according to Lind's Wind Gauge. The supposition, however, of a uniform velocity during the month is a very arbitrary one, and the results can be considered only approximately correct.

The relations of the quantities of rain which fell under different winds are registered each evening at sundown.

The 25 years' standard tables are used for obtaining the difference from the average.

Barometer mean, 29.905in., being 0.058in. above the average.
Temperature mean, 51.19°, being 0.91° above the average.
Solar intensity mean, 79.50° being 2.37° below the ditto.
Dew point mean, 42.8°, being 0.68° below the ditto.
Humidity of air mean, .78, being .02 per cent. above the ditto.

Elastic force of vapour mean, .294, being .008 per cent. below the ditto.
Total amount of rain, 2.64in., being 0.83in. above the ditto.
Increase of rain fall on spontaneous evaporation, 1.25in.
Mean amount of ozone, 7.05, being 0.25 of chromatic scale above ditto.
Electricity active on the 4th, 6th, 7th, 8th, 13th, 14th, 21st, 24th, 26th, 27th, and 31st.
Mount Wellington covered with snow on the 20th, with a fresh additional fall on the 21st.
Auroras on the 27th and 28th.

Leafing, Flowering, and Fruiting of a few Standard Plants in the Royal Society's Gardens during the month.

21st—Coronilla glauca commencing to flower.
25th—Photinea serrulata ditto.
27th—Diosma alba ditto.
30th—Spiræa prunifloia ditto.
3lst—Ailanthus leaves all shed.

FRANCIS ABBOTT.

[page xi, Appendix]

JUNE, 1872.
PRIVATE OBSERVATORY, HOBART TOWN.

Day of month.	Bar. 37 feet abv. sea level corrected & reduced.		Self-Registering Thermometers.				Wind.		Rain in Inches.
	Highest.	Lowest.	Highest in shade.	Lowest in shade.	Highest in sun.	Lowest on grass.	Direction from three daily registers	Force in lbs. per square foot.	
	In.	In.	°	°	°	°			
1	30.072	29.925	53	36	82.5	33.5	NW	.78	
2	30.061	29.882	60	40	82.0	36.0	NW	.78	0.02
3	29.959	29.750	59	40	59.5	34.0	NW	.26	1.29
4	29.459	29.336	56	37	55.0	47.0	SW	15.63	3.46
5	20.934	29.837	64	44	87.0	40.0	SW NE	1.30	
6	30.048	29.977	62	42	72.5	30.0	W S SE	.26	0.02
7	30.182	30.158	60	32	79.0	28.0	NW	.52	
8	30.161	30.037	60	44	70.0	33.5	NW SW	.78	0.06
9	30.305	30.194	57	40	75.0	36.0	SW W SE	1.04	
10	30.372	30.251	60	33	85.5	27.0	SW E SW	.52	
11	30.074	29.932	65	35	90.0	32.0	NW SW	1.30	0.06
12	29.876	29.803	54	43	64.0	39.0	S SW NW	0.	0.05
13	29.850	29.762	50	41	58.0	38.0	NW SE	.52	0.16
14	29.965	29.950	60	40	87.5	38.5	NW	.52	
15	29.874	29.756	59	37	62.0	29.0	NW NE	.52	0.12
16	29.708	29.656	54	43	67.5	37.0	NW SW SE	.52	
17	29.910	29.828	58	35	78.0	28.0	NW	.78	0.07
18	29.614	29.554	51	39	57.5	32.5	NW	.26	0.46
19	29.504	29.409	54	42	60.0	41.0	NW	.52	0.05
20	29.341	29.327	64	40	87.0	34.5	NW	1.04	0.01
21	29.403	29.310	68	44	86.5	36.5	NW	.52	
22	29.246	29.178	60	43	67.0	36.0	NW	.52	0.09
23	29.255	29.045	58	44	79.5	41.0	NW	1.04	
24	29.365	29.139	55	41	57.5	32.0	NW	1.04	0.06
25	29.488	29.454	63	44	84.0	41.0	NW	.78	0.03
26	29.801	29.609	59	43	65.0	38.5	SW W	1.04	
27	29.877	29.606	56	39	76.0	29.0	NW	.52	0.31
28	29.663	29.456	68	46	87.5	42.0	SW SE	.78	
29	29.706	29.596	62	38	68.0	33.0	NW	.52	0.01
30	29.338	29.309	63	42	85.5	36.0	NW	1.30	
Mean Monthly 29.712			48.36		73.70	35.32	Total Force	35.91	6.33

The mean in all cases is taken from the sums of the three daily registers, and not from the maximum and minimum.

The direction of the wind is registered from currents moving at a height of 192 feet and the force according to Lind's Wind Gauge. The supposition, however, of a uniform velocity during the month is a very arbitrary one, and the results can be considered only approximately correct.

The relations of the quantities of rain which fell under different winds are registered each evening at sundown.

The 25 years' standard tables are used for obtaining the difference from the average.

Barometer mean, 29.712in., being 0.179in. below the average.
Temperature mean, 48.36°, being 1.27° above the average.
Solar intensity mean, 73.70° being 1.79° below the ditto.
Dew point mean, 41.7°, being 0.01° below the ditto.
Humidity of air mean, .81, being .02 per cent. above the ditto.
Elastic force of vapour mean, .274, being .005 per cent. below the ditto.

Total amount of rain, 6.33in., being 4.53in. above the ditto.
Increase of rain fall on spontaneous evaporation, 2.98in. ditto.
Mean amount of ozone, 6.89, being 0.28 of chromatic scale above ditto.
A very feeble amount of atmospheric electricity all through the month; out of 90 records there were 53 nils.
Auroras on the 10th and 27th.
Snow never absent from Mount Wellington with frequent fresh deposits.
Lightning on the 30th.

Leafing, Flowering, and Fruiting of a few Standard Plants in the Royal Society's Gardens during the month.

18th—Osage Orange leaves commencing to fall.
20th—Common Privet leaves shedding.
28th—Calycanthus præcox in full flower.
30th—Black Mulberry leaves all shed.

FRANCIS ABBOTT.

First journal article by Samuel H. Wintle (1830-1909), geologist

S.H. Wintle, 1872. *The Australian Mechanic and Journal of Science and Art*, 1872(Oct): 116-117 and (Dec): 145-146.

NOTES ON THE LANDSLIP AT MOUNT WELLINGTON, TASMANIA

BY S. H. WINTLE.

On the 4th June, 1872, the colony of Tasmania was visited by the heaviest rainfall that has taken place since the flood of 1854. Within twenty-four hours (the usual period assigned for the computation of such meteorological disturbances) no less than 4½ inches of rain fell. It was a steady, thick, incessant, and most determined downpour for fully one-half of that time. On the following morning, while the citizens of Hobart Town were energetically exerting themselves to save life and property, news arrived that a landslip on a most gigantic scale had occurred on the previous night in the vicinity of O'Brien's Bridge (which is distant from the capital five miles), causing loss of human life, and immense destruction of property.

Upon the rain ceasing, I started for the scene of the catastrophe, having been honoured by urgent solicitations from several of the residents of that locality to make a geological examination of the site. Upon arriving within a mile of O'Brien's Bridge, a large yellow tract of the northern face of Mount Wellington, reaching nearly to the summit of that part of the mountain, was visible from the main road, and which at a distance of six or seven miles presented a striking contrast to the surrounding locality, in being completely denuded of that dense and gigantic canopy of vegetation which characterises what may be called its frame-work.

Although the accounts that had reached the city prepared the mind of the visitor for witnessing a scene of extensive ruin and desolation, I must confess that the mental picture that I had drawn of the scene fell very far short indeed of the reality, for chaos had come again in truth, as far as this part of the district was concerned.

The first thing that attracted my attention from the bridge was the immense heaps of timber and gigantic boulders that strewed the bed of the rivulet, and lined its banks on either side of the bridge, while to one who had become familiar with the modifying operations of water as a geological agent, one glance was enough to understand the terrible force that had been at work here.

It had been arranged through my friend Mr. Hull, Council Clerk for the district, who kindly placed his services as *cicerone* at my disposal, that I should attempt to reach the bottom of the slip on horseback, in company with several gentlemen of the neighbourhood, who well knew the locality. But at the appointed hour of starting the weather became unfavourable, and the project was abandoned for that day; I therefore had to be content with following my guide to the different points of painful interest in the immediate locality.

On the river side of O'Brien's Bridge, where the land lies the lowest a terribly weird and wild scene presented itself. A vast, entangled, heterogeneous mass of enormous trees, casks of wine, vinegar, &c., fences, agricultural implements, house-building materials, and rock masses covered the soil-swept locality for many acres. A fine orchard stocked with the choicest of fruit trees, covering some acres, had been most completely removed, and in its stead, had been deposited huge, branchless, barkless, rootless trees, ponderous fractured boulders of the adamantine greenstone, and gravel.

Startling evidence of the immense hydraulic force that had been in operation was exhibited in the transported boles of the great trees, by their being completely stripped of their bark, their branches, and their roots. A few hours since, they were growing in their towering grandeur on the great mountain's side, as though ambitious of emulating in altitude the rock

which bore them. Now, they lay bare, battered, and broken, and hurled in heaps of dire confusion, miles distant from where they had grown.

It is well known that the blue gum tree (*Eucalyptus globolus*) is amongst the toughest of Tasmanian woods, a fact due to its labyrinthine grain, and yet a vast number of these trees (many of which must have attained a height far above 200 feet) had been snapped as short in the middle—to use an expressive vulgarism—as a carrot.

A portion of one of these trees, which I measured as it lay in the bed of the rivulet, near the bridge, was 99 feet in length, and 15 feet 8 inches in circumference at its largest end; and yet there was no sign of branches or roots. To such a pounding had it been subjected in its passage from where it grew, that both ends were rendered quite fibrous, so much so that one indulging in a little poetic imagination might regard these portions of trees as the stumps of brooms with which the Titanic gods had in olden times swept creation.

About half-a-mile from the bridge, in the direction of the mountain, my guide and companion drew attention to the ruins of a house which had been built by his ancestor, situate at a distance of about one hundred yards from the rivulet. It presented a spectacle of confusion worse confounded—a truly heterogeneous heap of broken bricks, shingles, shattered glass, pieces of furniture, onions, and potatoes embedded in a matrix of tenacious sludge. Driven through the south-eastern wall for several yards into the interior of the building, was a huge battering ram of a gum tree. This had done the work of demolition at a blow, and if anything by chance had been left undestroyed, it was accomplished by another tree of equal size being brought down and deposited at right angles upon the former.

On this side of O'Brien's Bridge I found that the torrent had cut in many places a new channel for itself, and in so doing had exposed the crystalline carboniferous limestone formation of the district, which is replete with the brachiopodous fossil shells, typical of the period when these beds were laid down. Here, as in other parts of the island the *spirifera*, *productus* and *terebratula*, are seen in great abundance in association with the corals *stenopora*, *fenestella*, and others. For many a square mile, where the rivulet disembogues its waters into the Derwent, the area is occupied by rounded boulders of greenstone, basalt, limestone, mudstone, and sandstone; and overlain by tertiary drift and vegetable soil to a depth in some places of twenty feet, as shown by the late erosion. This bed of waterworn stones, which has a mean thickness of between two and three feet, has been regarded by some intelligent observers as being evidences of the existence of a large ancient river; but the fact seemed to be overlooked that such a river must have had an existence before Mount Wellington was formed. The truth is, this rivulet has been constantly altering its channel during such periodical floods, cutting into the bank on one side, and depositing material on the opposite side; and thus re-arranging the rounded stones, has travelled backwards and forwards from one hill boundary to the other through time immemorial.

Finding it impossible to extend my investigation further up the bed of the rivulet on this occasion, I returned to town, and the weather clearing up, I resumed my examinations a few days afterwards.

Starting from the point where I had "brought up" last, I followed the bed of the channel up to its source, where the landslip occurred. The blue, crystalline, shelly limestone, before mentioned, I found well exposed by the fury of the torrent for fully one mile from the bridge; here it became covered with greenstone, forming steep hills on either side of the gully, and which feature has given to the rivulet its very serpentine course. This igneous formation obtains for about two-and-half miles, at which point the limestone again appears in the bed of the channel, in conjunction with other sedimentary strata to be treated of hereafter.

Where the bed of the rivulet is occupied by the limestone *in situ*, it presents the greatest width, and as a consequence, the least incline. The clinometer gave a mean dip of 7° W.S.W. Here, therefore, as should be expected, the torrent began to deposit its great arborean freight. In one place, where the channel is constricted for about half-a-mile by an eruption of greenstone, I observed a far more startling proof of the force which the deluge had exerted, than that, great as it is, afforded by the pounding of the leviathan trees. This consisted of sharp, angular fragments, or chips of the greenstone, which lined the sides of the rivulet to a depth of several inches. The water had here cut down through the old bed of the channel to a depth of four feet, depositing the gun-flint-like fragments of the hard rock on either side of the margins occupied by the undisturbed bed. Every boulder that I observed presented a fractured surface.

From where this greenstone first appears, up to the foot of the great "slip," both banks of the rivulet present the appearance of a railway cutting through hills upon a gigantic scale. Trees and soil have been removed most completely to an average height of 80 feet. But what strikes the superficial observer as being a somewhat paradoxical feature, is the fact that wherever the water has reached to the height just named on one side of the rivulet, it has not left a trace of having risen to more than fifteen or twenty feet, at the most, on the opposite bank, a phenomenon which I will subsequently account for.

So tortuous is the channel of the rivulet from where the igneous rock first makes its appearance till the foot of the landslip is reached, that could both banks be made to meet, the hills, or projections, on one side would exactly fit into the curvatures on the other, like the sutures in a skull.

When the visitor has accomplished about four miles of real hard travelling over erratic boulders, in following up the bed of the stream, he comes to where the limestone, which he left in the lower regions, is again exposed in some good vertical

sections by the removal of the overlying greenstone, but now it is seen in association with other sedimentary rocks. From O'Brien's Bridge up to the foot of the "slip" there is a mean ascent of 10°, consequently, now, he has obtained an elevation of over 1000 feet. It is here seen that the shelly limestone is covered by beds of sandstone and mudstone, which strata have been removed in the lower regions. A most interesting feature is now presented by these beds having undergone metamorphism by contact with the greenstone, no uncommon feature where the trappean series of rocks abound, a fact that has been well noted and commented upon by my eminent friend and colleague, the Rev. W. B. Clarke, of New South Wales. Here I found thick-bedded sandstone to be the uppermost stratified rock of the district, and that it had been altered by fusion from the overflow of the molten greenstone into a semi-vitreous mass, which extended in depth from twelve to eighteen inches from the point of contact. As is frequently the case, not only had the grains of quartz been fused together, but the lines of bedding completely obliterated, while in some instances the original veining of the stone was preserved. Wherever this metamorphism was observable the rock presented a rhomboidal structure. This alteration is not solely confined to the sandstone. It is exhibited to an equal extent in the mudstone, limestone, and claystone. The faces of the sections of these rocks consists of a series of ledges which give to them a stair-like structure, this feature producing very beautiful waterfalls. It is plain that these strata presented the same surface, perhaps millions of years ago, that they do now, when the greenstone which forms Mount Wellington was injected in a molten state far down beneath the surface of an old-world ocean, for the metamorphism which they display could only have been produced by the molten mineral matter filling up the inequalities of their surface.

Another interesting fact afforded by these sedimentary strata is, that they prove beyond question that when the subterranean forces were in operation that produced Mount Wellington and the contiguous heights, very little displacement of such strata took place from the originally horizontal plane, for their mean dip is only 7° towards the mountain, showing that the last effect of the mutative force was to depress the strata towards rather than tilt it from the axis of the eruptive force.

These strata afford an excellent vertical section of the geological structure of this part of Tasmania. The following table gives their order of occurrence, and respective thickness on a descending scale:—

1. Thick-bedded variegated sandstone, metamorphosed at the surface, dip 70 deg. S.S.W., thickness 20 ft.
2. Arenaceous conglomerate, containing waterworn fragments of granite, quartzose rock, clay slate and micaceous schist altered at surface, thickness 10 ft.
3. Blue sandstone containing fragments of quartz, and a black cherty rock altered at surface, thickness 8 ft.
4. Coarse sandstone, altered at surface, thickness 11 ft.
6. Blue fossiliferous limestone, replete with brachiopodous shells and corals altered at surface, thickness 12 ft.
7. Dark claystone, altered at surface into a jasperideous rock, thickness 100 ft.
8. Greenstone covering the continuation of the above beds.

The whole of the above strata are conformable to the first-named and superimposed sandstone.

In approaching the foot of the landslip, we again lose sight of these sedimentary deposits for good, owing to their being completely covered up by the igneous rock.

I found the ascent by the rivulet's bed to be excessively laborious, inasmuch as it could only be accomplished by stepping from boulder to boulder, the interstices being filled with a tenacious yellow sludge. Upon arriving at the base of the "slip," a sight presented itself which is not likely to be ever forgotten. A large portion of the side of a mountain thickly clothed with huge trees and undergrowth, peopled by thousands of mammals, birds, and reptiles, had been hurled with a terrible force into the gully below, and thence swept by a resistless torrent into the sea. A large tract of yellow clay, strewn with the ruins of a dense forest, and gigantic masses of rock, stretched upwards to a height of more than a thousand feet. In many places deep channels had been excavated, and down which foaming torrents were rushing. I made the ascent by skirting the slip on the eastern side, a task of much difficulty, owing not only to the great angle, but also to the ground being covered with fallen trees and blocks of stone, the latter the result of landslips which had taken place in bygone times. The clinometer here gave a mean angle of 37°. The mean angle of the site of the "slip" I subsequently found to be 31°. Upon gaining the head of it I found the greenstone presented a fissile structure, with a slope for some distance of 42°, at the base of which there is a broad terrace having an incline of only 5°, a high bank of incoherent drift, about 20 feet in depth, crowning all.

There had been many absurd theories propounded by the unscientific to account for this cataclysm, among which were the bursting of a waterspout and the disruption of a subterranean mountain reservoir; the waterspout being of the two the more popular. The *vera causa*, however, was to my mind apparent at a glance—in a word, complete saturation of the great depth of incoherent surface-soil, and undermining on the great slope of flaky rock. Nothing is more likely than that the *débris* of the detached mass would form an embankment at the terrace referred to, whereby a large body of water would soon be collected, which, bursting its bounds, would be precipitated to the foot of the mountain with a terrific rush, sweeping everything before it that offered opposition.

I have already remarked that on both boundaries of the rivulet the water had risen alternately to a surprising height, not only depositing the barkless trunks of huge trees along the edge of the water-line, but also snapping asunder standing trees, at

a height in some instances of sixty feet from their base; and I must also remind the reader that I mentioned the cause of the serpentine character of the bed of the stream being produced by the slopes of the numerous trappean hills. Now, when the great rush of water occurred by the bursting of the embankment it would, upon striking the slope of the first hill, abutting on the rivulet, be deflected in a great wave on the opposite side, and thus after the motion of a pendulum would leave alternate traces of its devastation. Here and there are evidences of dams having been subsequently formed lower down the rivulet, where a more than usually sharp bend exists. Their formation and disruption must have been remarkably rapid, when it is stated that from the moment of the loud rush and roar of the water being heard up to the time when its force was spent on the banks of the Derwent, six miles away, only ten minutes elapsed. In that time all the ruin and desolation had been accomplished.

In looking at the battered and pounded condition of the forest giants with their cold, slippery, naked trunks, I could but think of the enormous quantity of paper-making material which must have been swept into the sea. One large blue gum tree, which had obtained a height of over 200 feet, had fallen across the gully and snapped in three places, although 5 feet 7 inches in its greatest diameter, where the first fracture occurred. Not far from this was another tree that had been split nearly its whole length, and into the fissure the trunk of a second tree had been driven.

I found wherever I went in the vicinity of this landslip, that where the surrounding slopes presented an angle of 30°, landslips had been of frequent occurrence in former times, and the *débris* subsequently overgrown with dense forests. In fact, there is not a part of Mount Wellington having such an incline, but what striking evidence of such mutations is to be seen. The well-known "ploughed" or "potato fields", erroneously thought by many persons to be strong proofs of past volcanic agency, are simply the result of landslips. The intense yellow clay that forms the subsoil of the mountain's side, I may observe, is the result of the decomposition of the greenstone. This igneous rock is composed of felspar and hornblende for the most part, and contains a very large percentage of iron. The felspar being a mineral, essentially consisting of silica, alumina, and potash, and being more readily decomposed than the hornblende, such decomposition has furnished the clay, while the iron, by combining with oxygen, imparts the reddish yellow colour.

In reflecting upon the quantity of organic material that has been swept into the estuary of the Derwent, the geologist is naturally led to speculate upon the future, and picture in his mind what an interesting bed of fossil bones, plants, and land-snails, may be discovered in future ages by some descendant of the present race (should it be preserved), while perchance in the act of sinking a well in a remote inland district on the spot where the river Derwent now flows. The altitude of the top of this landslip cannot be much less than 3000 feet above sea level.

Second journal article by Samuel H. Wintle (1830-1909), geologist

S.H. Wintle, 1873. *Quarterly Journal of the Geological Society*, 29(1-2): 33-39.

5. *On an* EXTENSIVE LANDSLIP *at* GLENORCHY, TASMANIA.
By S. H. WINTLE, Esq.

(Communicated by Prof. Ramsay, F.R.S., V.P.G.S.)

On the 4th of June last this colony was visited by a very heavy rainfall, which continued without intermission for twenty-four hours, when 4½ inches of rain fell, causing most disastrous floods in many parts of the island. While the citizens of Hobart Town were actively employed in trying to save life and property from the raging torrent that rushed through the heart of the city, news arrived of a most extensive landslip having occurred during the night at Glenorchy, five miles distant from Hobart Town, which had entirely altered the physical features of a considerable portion of that district, besides causing loss of life and wide-spread desolation.

Upon the cessation of the storm, I at once started for the scene of the catastrophe; and, upon arriving at O'Brien's, Bridge, I found that rumour had not in this instance travelled on the wings of exaggeration. From this point, distant five miles from Mount Wellington, it could be seen that a large portion of the northern face of that mountain had given way, and, descending to a depth of nearly 2000 feet into the bed of the rivulet which takes its rise at that point, had carried destruction and desolation on either hand. This mountain-torrent, after pursuing a very tortuous course, and having a mean descent of 9° for about six miles from its source, empties itself into the river Derwent, about one mile from the township of Glenorchy.

The scene which presented itself at this locality was one that could never be forgotten. Huge trees, some of them more than 200 feet in height when standing, were piled up in vast heaps, presenting an entangled mass of timber, boulders, casks, fences, agricultural implements, and various other objects. Such had been the force of the torrent that not a vestige of bark, branches, or roots could be seen for the most part on these transported trees, while even the blue gum (*Eucalyptus globulus),* which is among the hardest and toughest of Tasmanian woods, not only had its massive protuberances ground down smooth with the trunk, but reduced to fibre where the trunk had been snapped short off.

Finding it completely impracticable to approach the landslip on this occasion, owing to the condition of the country, I was compelled to return; but I renewed the attempt a few days afterwards. Starting from O'Brien's Bridge, I took up the bed of the rivulet. This I found to be occupied by carboniferous limestone, a formation which is well developed in this part of the island. This limestone, which, as a rule, teems with Brachiopodous remains (the most abundant of which are *Spirifera producta* and *Terebratulæ)* and an equal abundance of Bryozoa, has been exposed by the erosion of the torrent for more than two miles. In those places where the *débris* deposited by the flood have left natural sections of this formation fully exposed, I find the blue, crystalline, shelly limestone alternating with beds of mudstone and thin interstratifying shales. I mention this fact for the reason that hitherto Tasmanian geologists have regarded the mudstone deposits as upper members of the Carboniferous limestone series. This mudstone, I may observe, contains, as far as known, the same species and genera of fossil Testacea and corals as the true limestone; but it differs from the latter in the important particular of yielding only the *casts* of those organisms—being, in short, entirely devoid of carbonate of lime.

At the distance of one mile, or thereabouts, from O'Brien's Bridge, I found still more striking evidence of the power of the torrent than that already referred to. This consisted in both banks of the rivulet being lined for a considerable distance with small angular fragments of close-grained dioritic greenstone, sharp at their edges as gun-flints, and all presenting fresh fractures. These fragments were the result of large masses of that rock (which composes the mountain-summit) having been hurled with terrific violence against each other by the fury of the torrent. It would be no exaggeration to say that some of the blocks of greenstone which have been transported from the mountain-side to a distance of three or four miles weigh many tons.

Having proceeded about two miles along the course of the rivulet, over limestone, greenstone then makes its appearance, rising into lofty hills on both sides of the watercourse, and covering up the limestone and its associated strata for fully one mile and a half. To the eruption and overflow of this igneous rock is to be ascribed the before-mentioned tortuous character of the rivulet's course, to which, as I shall eventually endeavour to show, must be traced the ruin and desolation that followed.

Close to the base of the great landslip, the limestone is again exposed in the bed of the rivulet, where superincumbent deposits have been recently removed by the flood. The beds have a dip of 10°, W.S.W., towards the mountain, and a strike nearly due north. A very excellent section of them is here exposed in stair-like ledges, the upper surface displaying much metamorphism by contact with the greenstone. The following Table gives their descending order and respective thickness:—

	Thick-ness, feet.
1. Brown, thick-bedded sandstone. Upper surface altered for more than 1 foot in depth into a semivitreous mass, and presenting more or less rhomboidal joints	20
2. .Arenaceous conglomerate, containing worn fragments of decomposed granite, clay-slate, quartz rock, and mica-schist. Upper surface also metamorphosed	10
3. Dark blue mudstone, studded with angular fragments of quartz, altered, and presenting joints	8
4. Coarse sandstone, containing rounded fragments of a quartzose rock, altered near surface into a compact crystalline mass with rhomboidal joints	11
5. Blue carboniferous fossiliferous limestone, replete with *Spiriferæ*, *Producti*, Terebratulidæ, and *Fenestella*, altered near surface; rhomboidal joints	12
6. Blue mudstone conglomerate, with casts of the foregoing shells and corals. Altered near surface	100
7. Greenstone, fine, close-grained, and compact, lying conformable to the above strata.	

The inference to be drawn from the foregoing facts is, that the different strata here treated of presented, at the time when the greenstone composing Mount Wellington was ejected, the same broken and stair-like surface that they do now, and the overflow filling up the inequalities of the older sedimentary rocks produced their metamorphosed character at the point of contact.

At the distance of about two thirds of a mile from this natural section the foot of the great slip is gained, the intervening space being occupied by polished greenstone having an angle of 10°, the smoothness being due to the grinding process carried on by the transport of immense masses of rook from the head of the mountain during periodical floods.

The sight that bursts upon the beholder from this point is terribly wild indeed. Stretching above him to a height of more than 1000 feet is an enormous tract having a mean inclination of 32°, and strewed with prostrate battered trees of gigantic dimensions, and ponderous blocks of greenstone, many tons in weight, half-buried in yellow clay and sludge. A clean sweep has been made in the centre of the denuded tract, baring the underlying greenstone and forming a new channel many feet in depth.

It was with very great difficulty that I reached the top of the slip by skirting its margin, which is densely timbered with huge gum-trees and thick underwood. The face of this steep is thickly covered with great masses of fallen greenstone, while its mean angle as furnished by the clinometer, is 42°. This fallen rock is evident1y the result of a former landslip, since clothed by the timber it now bears. The character or this escarpment, as indeed the whole of the ground surrounding the landslip, furnishes an excellent idea of the quantity of rock, timber, and soil which was precipitated into the gully beneath. Upon

examining the head where the mass broke away, I found the greenstone to be highly laminated, and presenting a slope of 43°. Above this, there is a bank of drift from the higher ground 20 feet in depth and consisting of smaller fragments of greenstone and gravel imbedded in a matrix of yellow clay.

As this cataclysm occurred between 10 and 11 o'clock at night, no eye beheld what part of the mountain-side first gave way; but, taking into consideration the incoherent nature of the soil and surface of the bottom rock at this part, and also the very great incline, I am disposed to think that the dislocation happened at this point, through supersaturation and undermining by the great water-flow from the head of the mountain.

Upon extending my examination to the surrounding localities, I found that not an acre exists, having a mean inclination of 30°, but what bore the most convincing evidence of having been the scene of landslips in by-gone times. As a rule in this island, wherever traprocks obtain in the mountain having an inclination of between 25° and 30°, fallen masses of such rocks are usually met with at an average height of from 2000 to 3000 feet above the sea-level, thus affording, as I take it, countless examples of these landslips. Nor can this be regarded as a matter for marvel when the precipitous character of the mountain-system of Tasmania, wherever the trappean series of rocks abound, is taken into consideration.

The altitude of the head of this landslip I estimate to be about 3000 feet above the sea-level. I was, however, unable to determine it with precision, owing to my mountain-barometer having met with an accident. In arriving at this conclusion I am guided by a knowledge of the altitude of adjacent heights.

In looking at the watershed which collected the aqueous force necessary to remove so large an area of the surface of a mountain's side, and then remembering the terrible effects produced in the lower regions, the mind of the geologist is constrained to have recourse to an accumulation of such power and its sudden liberation. In traversing the bed of the rivulet it is seen that where the carboniferous limestone obtains in the lower levels, there the huge trees and rock-masses brought down by the torrent began to be deposited. But when the greenstone formation is reached, which, as before mentioned, rises in lofty hills on either side of the channel, giving to it its labyrinthine course, startling evidence of the force of the obstructed deluge is to be seen. The escarpments of these hills bounding the rivulet are so arranged that, could both sides of the gully be made to meet, they would fit into each other like the serrated edges of a cranial suture. The first thing which strikes the observer at this point is, that the water had swept every thing before it to a height of 60 feet on one side of the gully, and only reached to 12 or 15 feet on the opposite side. This feature is to be seen alternating until the foot of the landslip is reached. This phenomenon is to be accounted for, I believe, in this way.

When the first mass of earth gave way, at or near the head of the slip, it formed an embankment or dam where the angle of the incline is least; the accumulated water at last bursting its bounds, the whole mass was precipitated into the gully below, carrying all before it, and, striking the point of the hill at the bottom, a great wave of deflection would be hurled on the opposite side, where an indentation exists; and much of its force being now expended, another dam was formed by the huge trees and rocks; and thus a repetition of disruptions of bodies of water occurred. This is to be seen in several parts of the rivulet by the arrangement of the stones. When the first great body of water had been thrown to a height of 60 vertical feet on one side of the gully, it deposited at its edge the trunks of enormous trees. One of these I found upon measurement to be 103 feet long, without the sign of a branch, and 6 feet in diameter at its base. It had been snapped off short at the smaller end, which gave a diameter of 4 feet 2 inches. These trees were lying parallel to the direction of the wave. Close to this spot, on the same escarpment, stood trees of equal size without a vestige of bark, that had been broken off 30 feet from their base. A few hundred yards from this spot one large blue gum-tree had fallen right across the gully and snapped in three places. This tree measures in length 213 feet, with a diameter in the middle of 4 feet 9 inches. In some instances masses of greenstone had been driven into the solid wood as though propelled from a cannon.

That this landslip has been the greatest geological mutation in this island within the memory of man there cannot be a doubt; but it is only one of many thousands that have taken place on a similar scale during the Tertiary epoch.

For more than a square mile in the flat low-lying area occupied by the township of Glenorchy, water-worn masses of greenstone, limestone, and sandstone are seen to a depth of 3 feet on the average, wherever the diluvium of loam and clay has been removed by fluviatile agency. This deposit has been made by numerous floods of this nature. At such a time the channel is considerably altered—cutting away its bank on one side, and depositing material on the other. In this way the rivulet may be said to have travelled backwards and forwards through ages, ever rearranging the old rounded material. The period, however, required for these changes may be faintly conceived by the fact that in many parts there are 20 feet of Tertiary drift reposing on this bed of rounded stones. This fact has led some intelligent colonists to regard these rounded stones as indicating the bed of an ancient river. Wherever a rivulet, taking its rise from the mountain-regions in this island, disembogues its waters, a similar deposit of rounded stones is to be seen. At Sandy Bay, for instance, only two miles from this city, at the mouth of a rivulet, such a deposit is seen covered with comminuted shells of recent species to a depth of from 8 to 10 inches; and these again are overlain by two or three feet of vegetable soil*.

At the springs on the south-western side of Mount Wellington there are evidences of just such another landslip having taken place in former times. Here the side of the mountain has about the same angle as that at Glenorchy; but the altitude is somewhat greater at this spot, which is now densely timbered. Huge portions of greenstone columns, which have descended

from the head of the mountain, are seen reposing in actual contact with the *Endogenophyllites*-shale *(Endogenophyllites* being the name given by Professor M'Coy to a new plant-impression which I discovered in that formation). The "Ploughed Fields," as they are locally called, of this mountain, to which I referred in my "Sketch of the Principal Features of the Geology of Hobart Town," read before the Society a few years ago†, are also to be traced to the same cause.

Before I started upon my examination of the site of the slip, I made particular inquiry among the residents of the district respecting the sounds they heard when the event took place. One and all informed me that at first they thought an earthquake had happened—that at five miles distance a rumbling roar was heard at intervals, and it was not till some time had elapsed from the first sound that the destructive body of water made its appearance at the township. This statement fully coincides with the evidences of a series of embankments having been formed, as before mentioned.

Owing to the subject of this paper being one of no small importance at the stage of geological inquiry in this part of the globe, as showing the powerful effects of rainfall as a modifying geological agent, I have been induced to extend my remarks beyond what may be regarded as ordinary limits. Much I have left unsaid relating to more minute details, but hope to supply them at a future date.

DISCUSSION.

Mr. W. T. BLANFORD mentioned somewhat similar landslips as occurring in the eastern Himalayas, and on fully as extensive a scale. In some cases not only the loose soil, but large masses of solid rock were carried down.

Mr. DREW mentioned other instances in India of a similar character, but thought that in the western Himalayas frost also assisted in the work of destruction.

* *Vide* paper read by me before the Royal Society of Tasmania, on the 12th April, 1864.

† Quart. Journ. Geol. Soc. vol. xx. p. 465.

Extract from 'Guide to Excursionists' (1879)

In: *Guide to excursionists between Australia and Tasmania*. H. Thomas: Melbourne. pp.61-63.

LANDSLIP AT GLENORCHY.

The landslip of about a hundred acres in extent is, especially in its consequences, a subject of more wonder than has hitherto been given to it. Travellers observe a long yellow line running nearly horizontally along the blue sides of Mount Wellington; and at a distance below this line is seen a large patch of yellow deposit, freed from trees and shrubs, which in the immediate neighbourhood grow to a very great height, and are of immense thickness.

In June, 1872, there had been an unusually large fall of rain on Mount Wellington, causing great destruction of property on the banks of the mountain streams. One of these streams is Humphrey's Rivulet, which is formed by the union of two branches of small streams issuing from gullies of the mountain, and are known as the eastern and western branches of the rivulet. It was on the borders of the eastern branch of the rivulet that the landslip occurred on 4th June 1872.

The heavy rainfall had saturated a considerable extent of the upper side of the mountain, where the almost impenetrable scrub was interspersed with enormous blue gum and other trees, and the gravelly soil easily absorbed the water till it reached the rock on which it stood. It then, owing to the steepness of the side hill, slid down to the extent of a hundred acres into the narrow bed of the rivulet, taking with it thousands of trees, many of them 40 or 50 tons in weight, with the boulders of rock and clay, till it completely dammed up the rivulet, and kept back its swelling waters.

This dam increased in depth till it was 60 feet, causing an accumulation of water 300 yards wide and 60 feet high, and of a considerable length. About 11 o'clock in the morning the effect of this stoppage was seen from the front windows of *Tolosa* in the flow of the water in the rivulet three miles below the slip had nearly ceased, notwithstanding the heavy rain then falling. This continued through the day.

At ten o'clock at night, dark as Erebus, a concussion was felt as if a magazine of 100 tons of gunpowder had exploded; the country around was shaken; the noise was heard at Risdon many miles off; it shook the house of *Tolosa* which stands on a limestone rocky eminence, and down with the rushing torrent came thousands of tons of timber, trees, rocks and shrubs intermingled; the great trees holding among their roots large stones which had been there for centuries. These trees were thus torn up by the roots and hurled down with inconceivable force, their monstrous limbs and foliage buried and crushed with clay and soil, turning over and over in their rapid fall, and driven with the force of a thousand steam hammers.

At one level place where the descent became less rapid, there was an accumulation of trees like those described fully 50 feet high, while the whole course of the Rivulet and its banks for 3 miles were strewed with the trunks and limbs of these giant mountain trees. It has been estimated that the timber brought down and left along the course would if built up have made a hill a thousand feet high.

Of all the huge trees brought down, none had its bark remaining, the great limbs were crushed, splintered, or broken short off.

In the course of the flood stood the cottage of Buntingdale, in the midst of a rich little orchard and garden in a delta of the bank of the rivulet, and high above all former water marks. A tree eight feet in diameter and a hundred feet long came end-on like a huge battering ram to the cottage and it disappeared for ever, with the trees, flowers, and vines, with which it was covered and surrounded, and the bed of the garden was torn up to the primitive limestone rock on which the alluvial soil stood.

All this destruction took three quarters of an hour in its operation.

One life was alone lost, but gardens and orchards, outbuildings and fences, were rushed away to the broad bay of the River Derwent; and even now, so many years afterwards the thousands of large logs lying all along, mark the destruction line of the landslip, and carry the attention of travellers along it to the broad yellow line near the highest point of Mount Wellington.

Round the Fireside: Reminiscences of an old Glenorchy resident

T.J.M. Hull, 1940. Unpublished manuscript supplied by D. Fullard, Margate, to Glenorchy City Council, 2002. Lodged at Glenorchy Library (LINC).

REMINSCENCES OF AN OLD GLENORCHY RESIDENT.

(T. J. M. HULL)

On the fourth of June of this year 1940 was the sixty-eighth anniversary of the Great Flood, in the history of Glenorchy.

I call it the Great Flood, because in all the years that have passed since then, no flood (and there have been many) has ever come anywhere near in size, nor has it done anything like the damage to property as did this Great Flood of the year 1872.

THE WEATHER - The sky became overcast and a very strong southerly buster set in. The rain came down in torrents and kept on coming down day and night without a break for many days. Humphrey's Rivulet over which O'Brien's Bridge now spans was converted from a peaceful rivulet into an angry turbulent torrent, until eventually large boulders commenced rolling and grinding along the bed of the river making a noise like the roar of distant cannon. As the hours went by, the noise increased and the flood waters rose until most of the residents who were living anywhere near the rivulet, decided to vacate their homes fearing they would otherwise be washed away during the night. Well, the storm raged for days.

The climax came when at about midnight on 4th June 1872, with a mighty roar and crash that could be heard for many miles away, the side of the mountain gave way, carrying hundreds of thousands of tons of stones, large gum trees, scrub, logs, etc. This debris collected in a very narrow part of the rivulet, where the banks on both sides are high and steep, and before long a mighty dam was created. Eventually, this temporary dam had to give way to the great pressure of water behind it. This head of water with all that it had collected by way of trees, large logs, etc., came rushing down the rivulet and taking before it. Some of the logs and trees were about five feet in diameter, and one can imagine the destruction such a head of water would cause when racing down the steep side of the mountain. The residents of Glenorchy whose homes were on both sides of the rivulet had some very thrilling experiences. One family in particular (Thomas Lane's) who lived in a typical old English thatched cottage, not far from where the present Water Lane Bridge spans the rivulet. This cottage was completely surrounded by swift running flood waters, and the occupants were standing on top of their furniture while the angry water swirled through their house. Rescue parties were trying to reach them without avail. Finally, a strong draught horse was bought to the scene with the object of riding the horse through the flood waters to rescue the marooned people. However, the rush of water was too great, and the horse was soon washed off his feet.

AN ACT OF PROVIDENCE - When the landslip occurred, and whilst the temporary dam was being formed high up on the side of the mountain, naturally the flood water below the dam subsided. This proved to be the salvation of the Lane family. It allowed them time to escape from what had previously seemed certain death to them all. It was not long after they had vacated their doomed cottage, the temporary dam gave way with a mighty crash. The noise could be heard miles away, many people thought it was an earthquake. This time the flood came down with a vengeance, taking all before it and Lane's cottage was swept bodily away. This incident reminds one of the Act of Providence shown in the Biblical story which tells how Moses and his followers crossed the Red Sea, and if one may digress for a moment of another act of Providence. Probably there are only a few people in Hobart who know why Providence Valley was so named (now Newdegate Street). Well the fact was,

Mr. W. Shoobridge owned this valley in the early days, and one day when he was working in his garden, a bushranger shot at him. The bullet struck a carpenter's foot rule (which Mr. Shoobridge had in his pocket) and glanced off. Thereafter the place was named Providence Valley.

Another family by the name of Oswell, who lived opposite to where Messrs. Cruickshank Bros. now live, lost their cottage. A huge log went right through it. Fortunately the family had vacated it previously. O'Brien's Bridge was so named because a very brave and daring man, James O'Brien, with a long pole in his hand managed to save the bridge by deflecting the logs during the flood which appeared likely to destroy the bridge. This bridge was ever after known as "O'Brien's Bridge". If one of the large flood logs had struck the piles of the bridge, poor Jimmie O'Brien (as he was called) would have gone to perdition. However, I believe the residents of Glenorchy fittingly recognised his gallant act by way of presenting him with a gold watch and chain. When the flood waters overflowed at O'Brien's Bridge and went along the main road towards St. Paul's Church of England, and then turning down the present Agricola Street, and right on until it entered the Derwent. A boat could have been sailed on the low lying land where the present Glenorchy State School is situated. The Post Office in those days was where Hutt's Produce Store is at present. This low lying place was about two feet deep in water and mud. The huge logs and stones carried along so swiftly by the flood waters acted like battering rams against the walls of buildings etc., and wrought great havoc in a short time. The names of some of the residents whose homes were close to this rivulet were the late William Murray, Tasman Morrisby, Richard Shoobridge, and Henry J. Hull, each having gardens and orchards washed away.

William Murray's properties suffered mostly, such as Soap and Candle Factory, Wine and Cider Factory, Tannery, Hop Grounds and Orchards. Casks of wine were afterwards found in the Derwent, washed up on the beach near "Elwick" quite intact and some beachcombers had a very hilarious time whilst the wine lasted. There was only one sad fatality during the flood. Some workmen were trying to secure the piling of a bridge near Murray's Tannery when one of them (T? Ranahan) slipped and fell into the water. He was carried away like a cork on a stream. His body was afterwards found by John Wilkinson washed up on the beach near Elwick. In those days, Elwick was the home of the late John Wilkinson, the founder of the present Wilkinson's Pharmacy in Elizabeth Street.

There was a very picturesque old flour mill on the bank opposite "Murrayfield" which derived its power from the turning of a huge water wheel. [It] was considered to be the largest wheel in the Southern Hemisphere at that time. This mill with the mill pond and water race, with its crystal like waters cascading over the wheel, and all surrounded by green grass and beautiful willows, made a very fine setting for an artist's painting. The old rustic bridge near the mill was washed away and deposited down stream. The late William Murray's work gave employment to many men and their families. Mr. L. N. Murdoch's present home "Murrayfield" was originally the home of the late Stone Kellaway who was at that time Manager for William Murray.

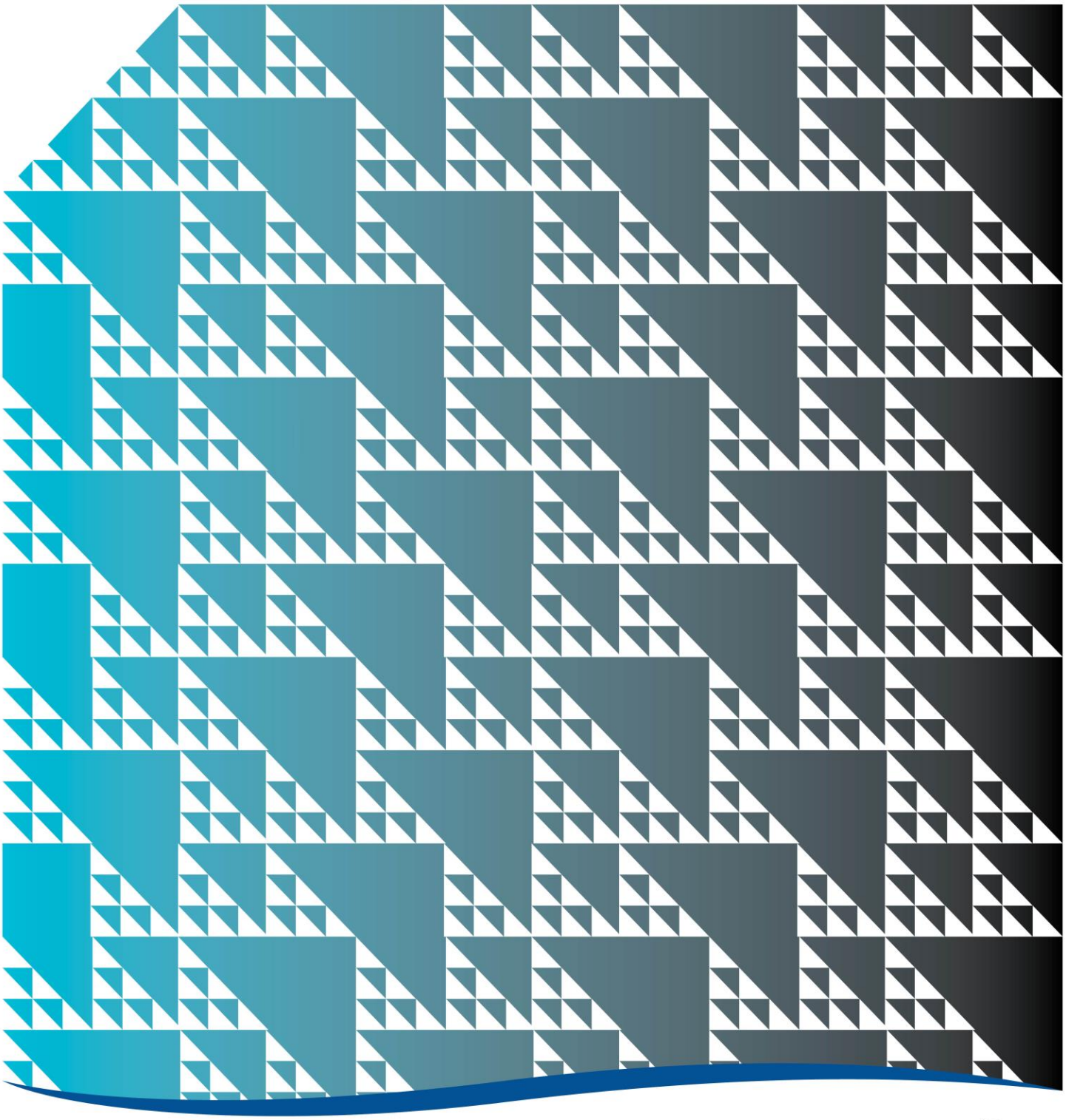
Mr. Kellaway's wife kept a private school here for many years. This beautiful old stone building on the corner of the street with its large poplar trees near the front gate, is often referred to now by old residents, as Kellaway's corner. One can hardly imagine that such a small rivulet, as seen in the summer months, could change to such an angry torrent in the winter. The rivulet has its source on the low lying land near Collins Bonnet on Mount Wellington. In my boyhood, I often listened to the water running far underneath the huge rocks at the head of the spot now known as the Landslip! The water evidently collected here and eventually pushed away a huge slice of the mountain side. Grim reminders of the past (old logs) can now be seen at low tide, embedded in the sand on the beach near Elwick, having been deposited there 68 years ago.

Extract from 'Highway in Van Diemen's Land'

G.H. Stancombe, 1968. *Highway in Van Diemen's Land*, 1st edn. Halstead Press: Sydney. p.84.

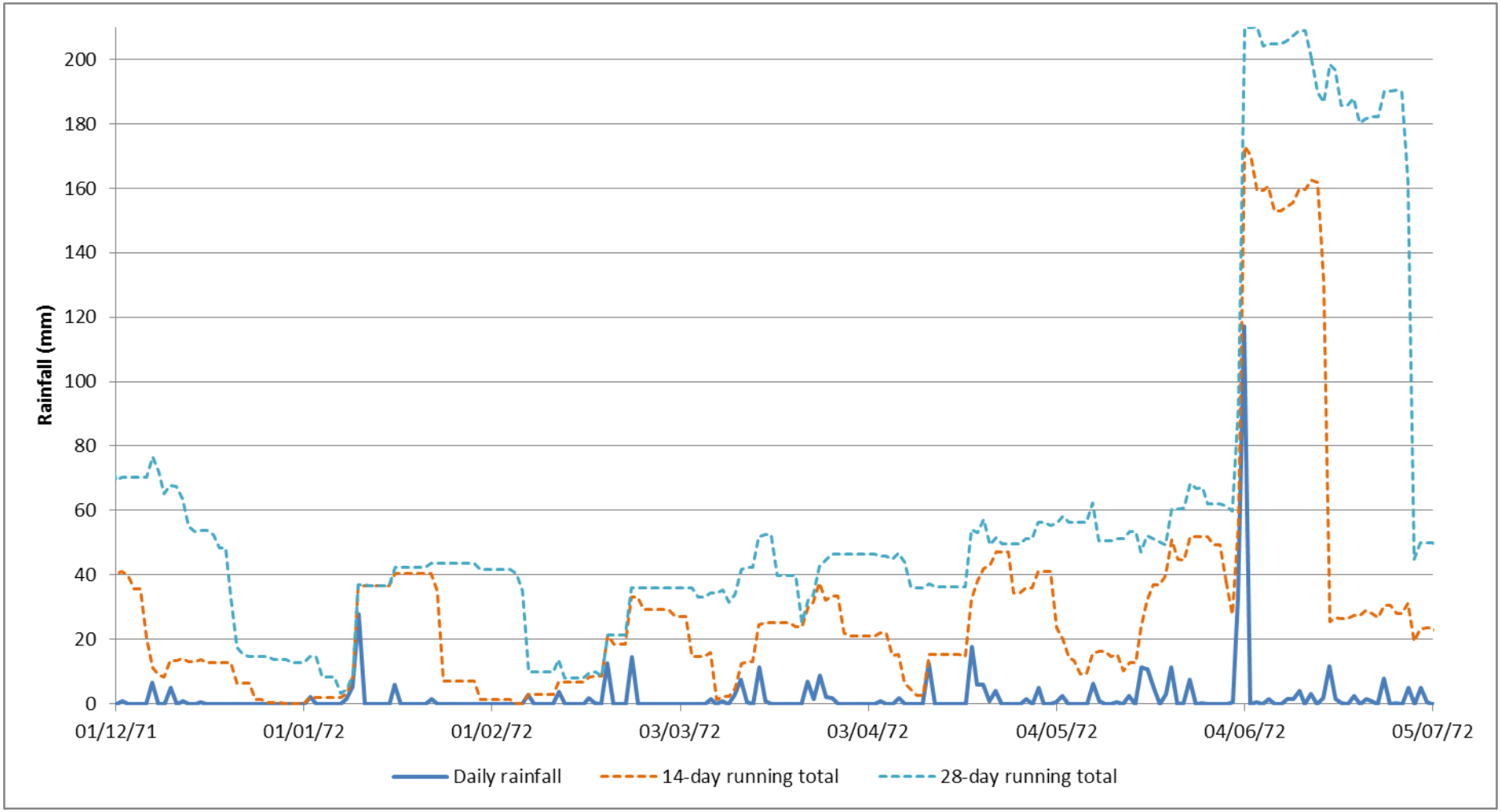
One would have thought that, after the liquidation of the bushrangers and the moonlighters, the little town would have settled down to an uneventful future, but one night in 1872 disaster befell the valley. Winter rains had filled the streams and saturated the forest, but more, it had loosened the soil on the steep slopes of the mountain, so that a great landslide carried huge trees, boulders and thousands of tons of earth into the bed of Humphrey's Rivulet some distance above the town, forming a dam some sixty feet high. The flood waters rose higher and higher all day, until, at one o'clock in the morning, the dam broke with a roar that was heard far across the Derwent. The deluge raced down carrying all before it - homes, orchards and gardens were hopelessly destroyed, but only one life was lost, because the people had been moved to safety. Nowadays, even the yellow gash of the landslide has been softened by time and few have ever heard the story.

Appendix 2
Francis Abbott's Daily Rainfall Data for November 1871 to July 1872



Mineral Resources Tasmania
Department of State Growth

Tasmanian Government



Francis Abbott's daily rainfall data for the 1st of December 1871 to the 5th of July 1872, showing the antecedent rainfall as 14-day and 28-day running totals. Note: the rainfall shown for the 4th of June, 1872, is the adjusted total of 117.3mm (4.62 inches) derived from Dr Hall's records – the total rainfall event is reported over 3-4 June, 1872.

Date	Daily rainfall (inches)	Daily rainfall (mm)	14-day running total (mm)	28-day running total (mm)
1 November 1871	0	0		
2 November 1871	0.02	0.5		
3 November 1871	0.38	9.7		
4 November 1871	0	0		
5 November 1871	0	0		
6 November 1871	0	0		
7 November 1871	0	0		
8 November 1871	0	0		
9 November 1871	0	0		
10 November 1871	0.19	4.8		
11 November 1871	0.26	6.6		
12 November 1871	0.10	2.5		
13 November 1871	0.02	0.5		
14 November 1871	0.18	4.6	29.2	
15 November 1871	0.34	8.6	37.8	
16 November 1871	0.06	1.5	38.8	
17 November 1871	0	0	29.1	
18 November 1871	0	0	29.1	
19 November 1871	0.05	1.3	30.4	
20 November 1871	0.17	4.3	34.7	
21 November 1871	0	0	34.7	
22 November 1871	0.60	15.2	49.9	
23 November 1871	0.62	15.7	65.6	
24 November 1871	0.08	2	62.8	
25 November 1871	0.03	0.8	57.0	
26 November 1871	0	0	54.5	
27 November 1871	0	0	54.0	
28 November 1871	0	0	49.4	78.6
29 November 1871	0.04	1.0	41.8	79.6
30 November 1871	0	0	40.3	79.1
1 December 1871	0	0	40.3	69.4
2 December 1871	0.03	0.8	41.1	70.2
3 December 1871	0	0	39.8	70.2
4 December 1871	0	0	35.5	70.2
5 December 1871	0	0	35.5	70.2
6 December 1871	0	0	20.3	70.2
7 December 1871	0.25	6.4	11.0	76.6
8 December 1871	0	0	9.0	71.8
9 December 1871	0	0	8.2	65.2
10 December 1871	0.20	5.1	13.3	67.8
11 December 1871	0	0	13.3	67.3
12 December 1871	0.03	0.8	14.1	63.5
13 December 1871	0	0	13.1	54.9
14 December 1871	0	0	13.1	53.4
15 December 1871	0.02	0.5	13.6	53.9
16 December 1871	0	0	12.8	53.9
17 December 1871	0	0	12.8	52.6
18 December 1871	0	0	12.8	48.3
19 December 1871	0	0	12.8	48.3
20 December 1871	0	0	12.8	33.1
21 December 1871	0	0	6.4	17.4
22 December 1871	0	0	6.4	15.4
23 December 1871	0	0	6.4	14.6
24 December 1871	0	0	1.3	14.6
25 December 1871	0	0	1.3	14.6
26 December 1871	0	0	0.5	14.6
27 December 1871	0	0	0.5	13.6
28 December 1871	0	0	0.5	13.6
29 December 1871	0	0	0	13.6
30 December 1871	0	0	0	12.8
31 December 1871	0	0	0	12.8
1 January 1872	0	0	0	12.8
2 January 1872	0.08	2.0	2.0	14.8
3 January 1872	0	0	2.0	14.8
4 January 1872	0	0	2.0	8.4
5 January 1872	0	0	2.0	8.4
6 January 1872	0	0	2.0	8.4
7 January 1872	0	0	2.0	3.3
8 January 1872	0.05	1.3	3.3	4.6
9 January 1872	0.21	5.3	8.6	9.1
10 January 1872	1.10	27.9	36.5	37.0
11 January 1872	0	0	36.5	37.0
12 January 1872	0	0	36.5	36.5
13 January 1872	0	0	36.5	36.5

Date	Daily rainfall (inches)	Daily rainfall (mm)	14-day running total (mm)	28-day running total (mm)
14 January 1872	0	0	36.5	36.5
15 January 1872	0	0	36.5	36.5
16 January 1872	0.23	5.8	40.3	42.3
17 January 1872	0	0	40.3	42.3
18 January 1872	0	0	40.3	42.3
19 January 1872	0	0	40.3	42.3
20 January 1872	0	0	40.3	42.3
21 January 1872	0	0	40.3	42.3
22 January 1872	0.05	1.3	40.3	43.6
23 January 1872	0	0	35.0	43.6
24 January 1872	0	0	7.1	43.6
25 January 1872	0	0	7.1	43.6
26 January 1872	0	0	7.1	43.6
27 January 1872	0	0	7.1	43.6
28 January 1872	0	0	7.1	43.6
29 January 1872	0	0	7.1	43.6
30 January 1872	0	0	1.3	41.6
31 January 1872	0	0	1.3	41.6
1 February 1872	0	0	1.3	41.6
2 February 1872	0	0	1.3	41.6
3 February 1872	0	0	1.3	41.6
4 February 1872	0	0	1.3	41.6
5 February 1872	0	0	0	40.3
6 February 1872	0	0	0	35.0
7 February 1872	0.11	2.8	2.8	9.9
8 February 1872	0	0	2.8	9.9
9 February 1872	0	0	2.8	9.9
10 February 1872	0	0	2.8	9.9
11 February 1872	0	0	2.8	9.9
12 February 1872	0.15	3.8	6.6	13.7
13 February 1872	0	0	6.6	7.9
14 February 1872	0	0	6.6	7.9
15 February 1872	0	0	6.6	7.9
16 February 1872	0	0	6.6	7.9
17 February 1872	0.07	1.8	8.4	9.7
18 February 1872	0.01	0.3	8.7	10.0
19 February 1872	0	0	8.7	8.7
20 February 1872	0.50	12.7	21.4	21.4
21 February 1872	0	0	18.6	21.4
22 February 1872	0	0	18.6	21.4
23 February 1872	0	0	18.6	21.4
24 February 1872	0.57	14.5	33.1	35.9
25 February 1872	0	0	33.1	35.9
26 February 1872	0	0	29.3	35.9
27 February 1872	0	0	29.3	35.9
28 February 1872	0	0	29.3	35.9
29 February 1872	0	0	29.3	35.9
1 March 1872	0	0	29.3	35.9
2 March 1872	0	0	27.5	35.9
3 March 1872	0	0	27.2	35.9
4 March 1872	0	0	27.2	35.9
5 March 1872	0	0	14.5	35.9
6 March 1872	0	0	14.5	33.1
7 March 1872	0	0	14.5	33.1
8 March 1872	0.05	1.3	15.8	34.4
9 March 1872	0	0	1.3	34.4
10 March 1872	0.03	0.8	2.1	35.2
11 March 1872	0	0	2.1	31.4
12 March 1872	0.11	2.8	4.9	34.2
13 March 1872	0.30	7.6	12.5	41.8
14 March 1872	0.02	0.5	13.0	42.3
15 March 1872	0	0	13.0	42.3
16 March 1872	0.45	11.4	24.4	51.9
17 March 1872	0.03	0.8	25.2	52.4
18 March 1872	0	0	25.2	52.4
19 March 1872	0	0	25.2	39.7
20 March 1872	0	0	25.2	39.7
21 March 1872	0	0	25.2	39.7
22 March 1872	0	0	23.9	39.7
23 March 1872	0	0	23.9	25.2
24 March 1872	0.27	6.9	30.0	32.1
25 March 1872	0.06	1.5	31.5	33.6
26 March 1872	0.35	8.9	37.6	42.5
27 March 1872	0.08	2.0	32.0	44.5

Date	Daily rainfall (inches)	Daily rainfall (mm)	14-day running total (mm)	28-day running total (mm)
28 March 1872	0.07	1.8	33.3	46.3
29 March 1872	0	0	33.3	46.3
30 March 1872	0	0	21.9	46.3
31 March 1872	0	0	21.1	46.3
1 April 1872	0	0	21.1	46.3
2 April 1872	0	0	21.1	46.3
3 April 1872	0	0	21.1	46.3
4 April 1872	0	0	21.1	46.3
5 April 1872	0.03	0.8	21.9	45.8
6 April 1872	0	0	21.9	45.8
7 April 1872	0	0	15.0	45.0
8 April 1872	0.07	1.8	15.3	46.8
9 April 1872	0	0	6.4	44.0
10 April 1872	0	0	4.4	36.4
11 April 1872	0	0	2.6	35.9
12 April 1872	0	0	2.6	35.9
13 April 1872	0.50	12.7	15.3	37.2
14 April 1872	0	0	15.3	36.4
15 April 1872	0	0	15.3	36.4
16 April 1872	0	0	15.3	36.4
17 April 1872	0	0	15.3	36.4
18 April 1872	0	0	15.3	36.4
19 April 1872	0	0	14.5	36.4
20 April 1872	0.70	17.8	32.3	54.2
21 April 1872	0.23	5.8	38.1	53.1
22 April 1872	0.23	5.8	42.1	57.4
23 April 1872	0.03	0.8	42.9	49.3
24 April 1872	0.16	4.1	47.0	51.4
25 April 1872	0	0	47.0	49.6
26 April 1872	0	0	47.0	49.6
27 April 1872	0	0	34.3	49.6
28 April 1872	0	0	34.3	49.6
29 April 1872	0.06	1.5	35.8	51.1
30 April 1872	0	0	35.8	51.1
1 May 1872	0.20	5.1	40.9	56.2
2 May 1872	0	0	40.9	56.2
3 May 1872	0	0	40.9	55.4
4 May 1872	0.02	0.5	23.6	55.9
5 May 1872	0.09	2.3	20.1	58.2
6 May 1872	0	0	14.3	56.4
7 May 1872	0	0	13.5	56.4
8 May 1872	0	0	9.4	56.4
9 May 1872	0	0	9.4	56.4
10 May 1872	0.24	6.1	15.5	62.5
11 May 1872	0.03	0.8	16.3	50.6
12 May 1872	0	0	16.3	50.6
13 May 1872	0	0	14.8	50.6
14 May 1872	0.02	0.5	15.3	51.1
15 May 1872	0	0	10.2	51.1
16 May 1872	0.10	2.5	12.7	53.6
17 May 1872	0	0	12.7	53.6
18 May 1872	0.45	11.4	23.6	47.2
19 May 1872	0.42	10.7	32.0	52.1
20 May 1872	0.19	4.8	36.8	51.1
21 May 1872	0	0	36.8	50.3
22 May 1872	0.12	3.0	39.8	49.2
23 May 1872	0.44	11.2	51.0	60.4
24 May 1872	0	0	44.9	60.4
25 May 1872	0.01	0.3	44.4	60.7
26 May 1872	0.30	7.6	52.0	68.3
27 May 1872	0	0	52.0	66.8
28 May 1872	0.01	0.3	51.8	67.1
29 May 1872	0	0	51.8	62.0
30 May 1872	0	0	49.3	62.0
31 May 1872	0	0	49.3	62.0
1 June 1872	0	0	37.9	61.5
2 June 1872	0.02	0.5	27.7	59.7
3 June 1872	**1.29**	**32.8**	55.7	92.5
4 June 1872	**3.46**	**87.9**	173.0	209.8
5 June 1872	0	0	170.0	209.8
6 June 1872	0.02	0.5	159.3	210.3
7 June 1872	0	0	159.3	204.2
8 June 1872	0.06	1.5	160.5	204.9

Dr Hall's data suggest this should be 4.62 inches (117.3mm)
(Note: 117.3mm is used in the graph and running totals)

9 June 1872	0	0	152.9	204.9
Date	**Daily rainfall (inches)**	**Daily rainfall (mm)**	**14-day running total (mm)**	**28-day running total (mm)**
10 June 1872	0	0	152.9	204.9
11 June 1872	0.06	1.5	154.1	205.9
12 June 1872	0.05	1.3	155.4	207.2
13 June 1872	0.16	4.1	159.5	208.8
14 June 1872	0	0	159.5	208.8
15 June 1872	0.12	3.0	162.5	200.4
16 June 1872	0	0	162.0	189.7
17 June 1872	0.07	1.8	131.0	186.7
18 June 1872	0.46	11.7	25.4	198.4
19 June 1872	0.05	1.3	26.7	196.7
20 June 1872	0.01	0.3	26.5	185.8
21 June 1872	0	0	26.5	185.8
22 June 1872	0.09	2.3	27.3	187.8
23 June 1872	0	0	27.3	180.2
24 June 1872	0.06	1.5	28.8	181.7
25 June 1872	0.03	0.8	28.1	182.2
26 June 1872	0	0	26.8	182.2
27 June 1872	0.31	7.9	30.6	190.1
28 June 1872	0	0	30.6	190.1
29 June 1872	0.01	0.3	27.9	190.4
30 June 1872	0	0	27.9	189.9
1 July 1872	0.20	5.1	31.2	162.2
2 July 1872	0	0	19.5	44.9
3 July 1872	0.20	5.1	23.3	50.0
4 July 1872	0.02	0.5	23.5	50.0
5 July 1872	0	0	23.5	50.0
6 July 1872	0	0	21.2	48.5
7 July 1872	0	0	21.2	48.5
8 July 1872	0	0	19.7	48.5
9 July 1872	0	0	18.9	47.0
10 July 1872	0.90	22.9	41.8	68.6
11 July 1872	0	0	33.9	64.5
12 July 1872	0	0	33.9	64.5
13 July 1872	0.38	9.7	43.3	71.2
14 July 1872	0	0	43.3	71.2
15 July 1872	0	0	38.2	69.4
16 July 1872	0.07	1.8	40.0	59.5
17 July 1872	0	0	34.9	58.2
18 July 1872	0	0	34.4	57.9
19 July 1872	0	0	34.4	57.9
20 July 1872	0.02	0.5	34.9	56.1
21 July 1872	0.03	0.8	35.7	56.9
22 July 1872	0.02	0.5	36.2	55.9
23 July 1872	0.02	0.5	36.7	55.6
24 July 1872	0.12	3.0	16.8	58.6
25 July 1872	0.01	0.3	17.1	51.0
26 July 1872	0.05	1.3	18.4	52.3
27 July 1872	0.03	0.8	9.5	52.8
28 July 1872	0	0	9.5	52.8
29 July 1872	0	0	9.5	47.7
30 July 1872	0	0	7.7	47.7
31 July 1872	0	0	7.7	42.6

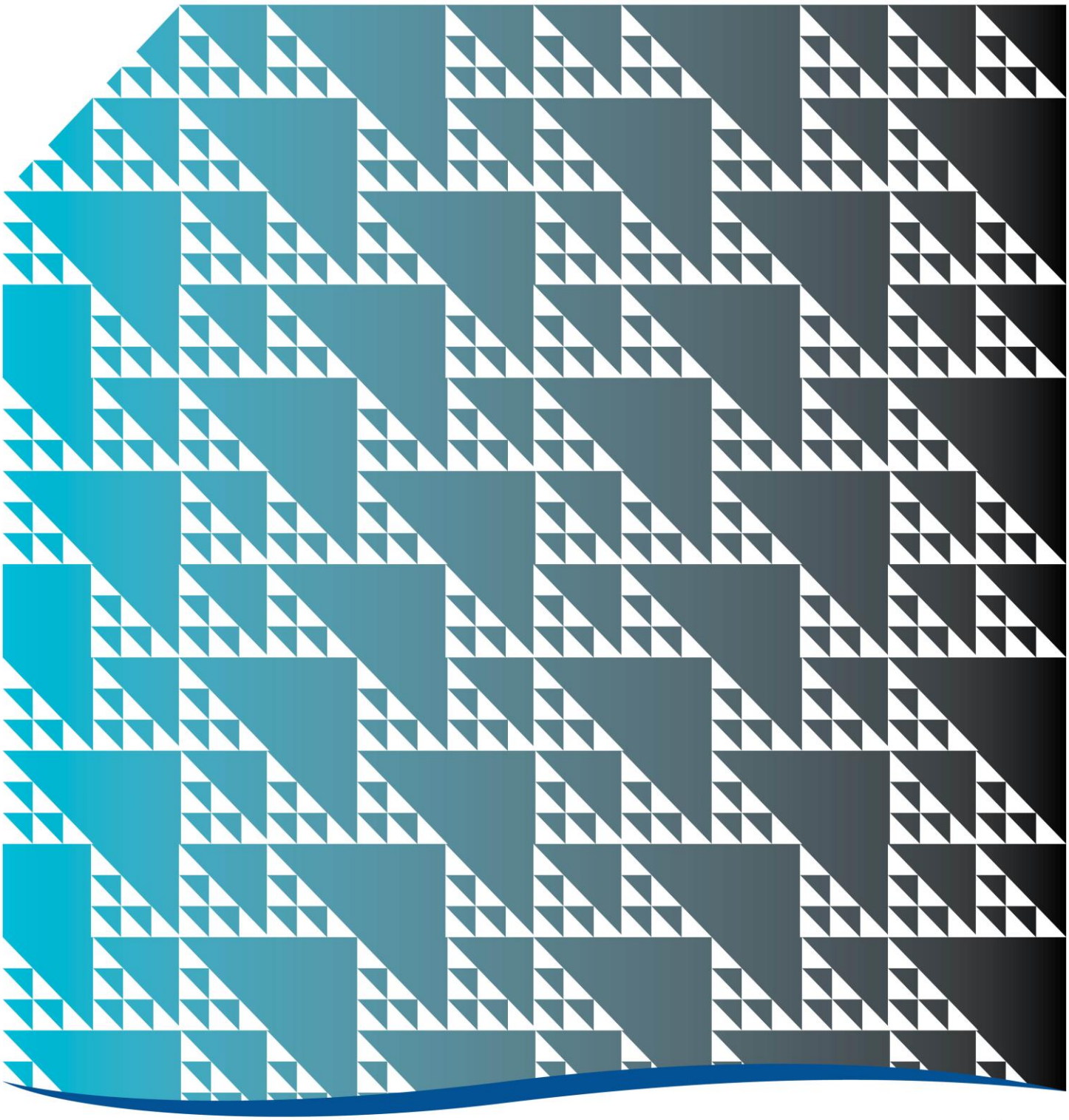
Notes on Francis Abbott's Daily Rainfall Data

Standard meteorological observation times were not instituted until well after 1872.

Francis Abbott's observations:

- Three daily observations at 7am, 1pm and sunset (Abbott, 1866; Ashcroft*, et al.*, 2014).
- Only the compiled daily data has survived and was published in The Mercury (Hobart) newspaper (Abbott, 1872a) and the Papers and Proceedings of the Royal Society of Tasmania (Abbott, 1872b) as monthly reports.
- It is clear that Francis Abbott's daily rainfall totals were taken as of the 7am observation time and assigned to the previous day. This is apparent given that The Mercury (5 Jun. 1872) reports that significant rainfall started after midnight on the night of the 3rd of June, 1872, and Abbott reports 1.29 inches of rain for the 3rd, and also by comparison with Dr Hall's three observations per day (10am, sunset, 10pm, see Appendix 3).

Appendix 3
Compiled Meteorological Data for early June 1872



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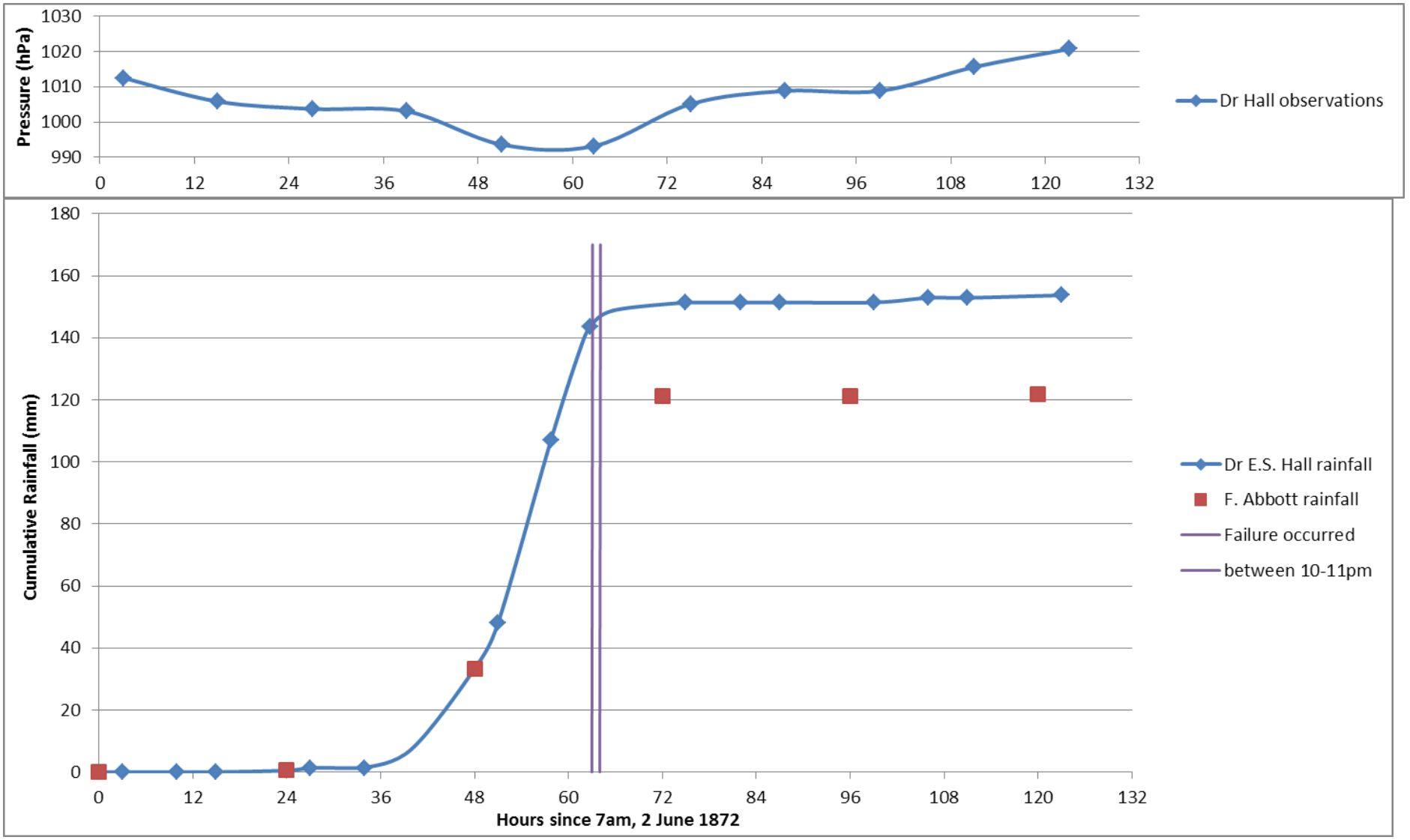


Cumulative rainfall from 7am on the 2nd of June to 10am on the 7th of June, 1872, as independently recorded by Dr Edward Swarbreck Hall and Francis Abbott. Also shown is the atmospheric pressure as recorded by Dr Hall and the period within which the landslide and debris flow are known to have occurred (10-11pm on the 4th of June, 1872).

Date and Time	Hours Elapsed	Dr E.S. Hall Rainfall			F. Abbott Rainfall			Dr E.S. Hall Barometer		Dr E.S. Hall Weather Description	Dr E.S. Hall Temperature		F. Abbott Temperatures (daily min. & max.)			
		Rain (inches)	Rain (mm)	Cumulative (mm)	Rain (inches)	Rain (mm)	Cumulative (mm)	Pressure (in. Hg)	Pressure (hPa)		Temp. (deg. F)	Temp. (deg C)	Low Temp. (deg. F)	High Temp. (deg. F)	Low Temp. (deg. C)	High Temp. (deg. C)
2 June 1872 7:00 am	0	0	0	0			0						40		4.4	
2 June 1872 10:00 am	3	0	0	0				29.900	1012.5	Cloudy before 10am, fresh NW wind	40	4.4				
2 June 1872 5:00 pm	10	0	0	0						beautiful mild sunny day with fresh NW wind				60		15.6
2 June 1872 10:00 pm	15	0	0	0				29.700	1005.8		42	5.6				
3 June 1872 7:00 am	24				0.02	0.5	0.5						40		4.4	
3 June 1872 10:00 am	27	0.05	1.3	1.3				29.640	1003.7	Cloudy & obscure, mizzling rain, faint NW wind	42	5.6				
3 June 1872 5:00 pm	34	0	0	1.3						day as morn but without rain				59		15.0
3 June 1872 10:00 pm	39							29.620	1003.0	mizzling again now 10½ pm	48	8.9				
4 June 1872 7:00 am	48				1.29	32.8	33.3						37		2.8	
4 June 1872 10:00 am	51	1.84	46.7	48				29.340	993.6	Sky obscured, blowing a gale South with heavy rain	50	10.0				
4 June 1872 4:45 pm	57.75	2.32	58.9	106.9						Heavy rain and strong Southerly wind, w flood of great strength				56		13.3
4 June 1872 9:45 pm	62.75	1.44	36.6	143.5				29.330	993.2	5.60 [inches - total rain]	44	6.7				
5 June 1872 7:00 am	72				3.46	87.9	121.2						44		6.7	
5 June 1872	75	0.31	7.9	151.4				29.680	1005.1	Sunny & fine, fresh wind E	45	7.2				

10:00 am																
5 June 1872 5:00 pm	82	0	0	151.4						fine sunny day, light wind E				64		17.8
5 June 1872 10:00 pm	87	0	0	151.4				29.790	1008.8	clear starlight night	35	1.7				
6 June 1872 7:00 am	96				0	0	121.2						42		5.6	
6 June 1872 10:00 am	99	0	0	151.4				29.790	1008.8	Frost, clouds & sunshine, light wind NW	41	5.0				
6 June 1872 5:00 pm	106	0.06	1.5	152.9						after 12 some rain, wind light SE				62		16.7
6 June 1872 10:00 pm	111	0	0	152.9				29.990	1015.6	after 10 pm rain gauge 0.03	38	3.3				
7 June 1872 7:00 am	120				0.02	0.5	121.7						32		0.0	
7 June 1872 10:00 am	123	0.03	0.8	153.7				30.140	1020.7	Hoar frost, sunny morng, light NW wind	35	1.7				

The landslide and debris flow occurred between 10pm and 11pm on 4 June, 1872 - i.e. at 63-64 hours from 7am on 2 June, 1872.

Notes on 1872 Meteorological Data

Standard meteorological observation times were not instituted until well after 1872.

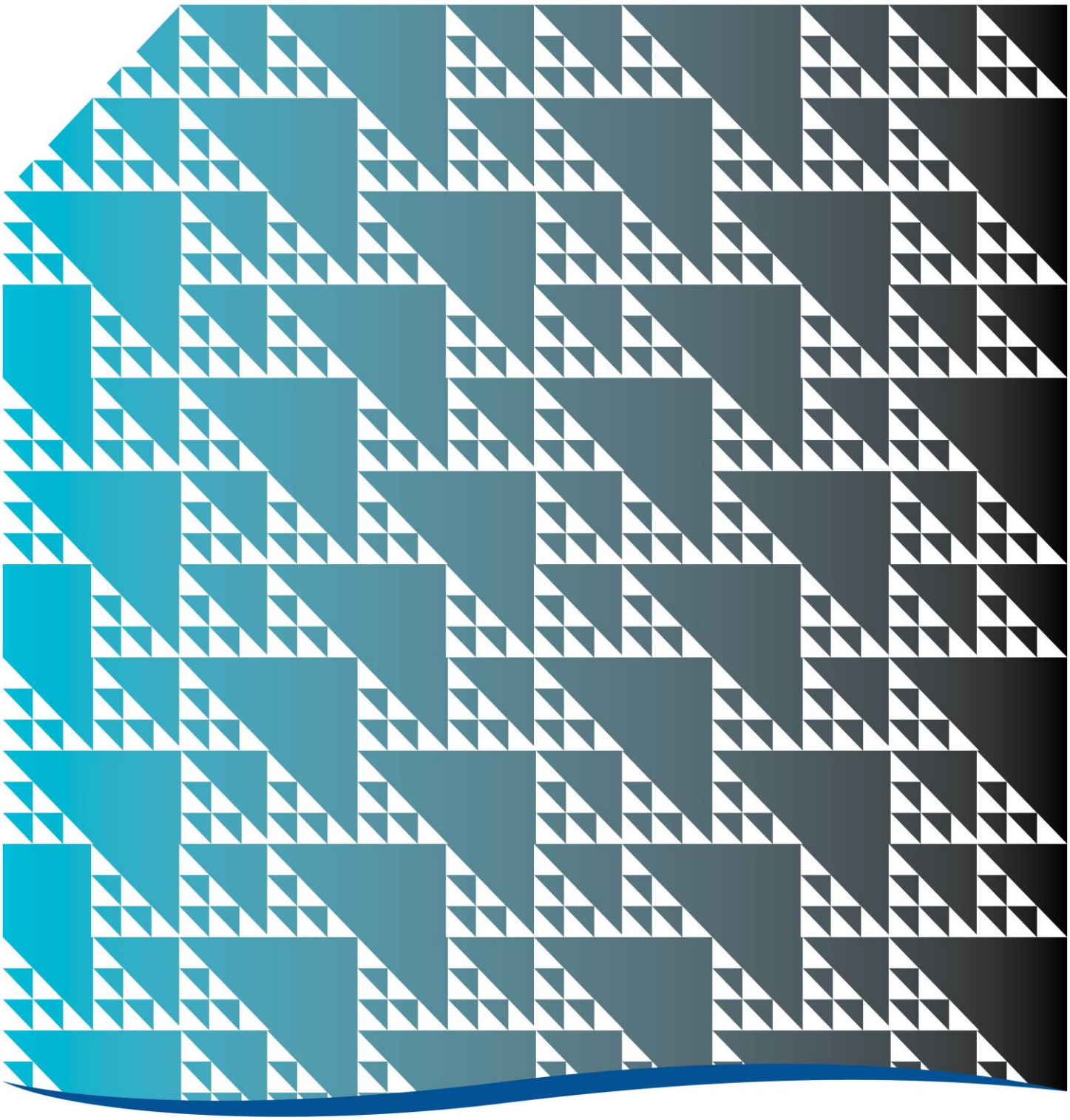
Dr Edward Swarbreck Hall:

- Three daily observations at around 10am, sunset and around 10pm.
- Observations were recorded in meteorological diaries, some of which have survived and are available from the Tasmanian Archives and Heritage Office (Hall, 1872).
- Many rainfall measurements (one, two or three per day) are not recorded with a time, but reference to the weather descriptions makes it clear at which of the three observation times the measurement was recorded in each case.
- The atmospheric pressure and temperature were recorded at the 10am and 10pm observation times.

Francis Abbott:

- Three daily observations at 7am, 1pm and sunset (Abbott, 1866; Ashcroft, *et al.*, 2014).
- Only the compiled daily data has survived and was published in The Mercury (Hobart) newspaper (Abbott, 1872a) and the Papers and Proceedings of the Royal Society of Tasmania (Abbott, 1872b) as monthly reports.
- It is clear that Francis Abbott's daily rainfall totals were taken as of the 7am observation time and assigned to the previous day. This is apparent given that The Mercury (5 Jun. 1872) reports that significant rainfall started after midnight on the night of the 3rd of June, 1872, and Abbott reports 1.29 inches of rain for the 3rd, and also by comparison with Dr Hall's three observations per day.
- The minimum and maximum daily temperatures were recorded using self-registering thermometers (Abbott, 1861). These have been included in the table at the 7am position (lowest temperature) and the 5pm position (highest temperature) for each day.
- Abbott's minimum temperature of 42°F for the 6th of June, 1872, appears to be a reporting error given that Dr Hall records a frost that morning – which suggests the minimum temperature should be more like 32°F (i.e. 0°C).

Appendix 4
Compilation of Properties and Places Affected by the 1872 Glenorchy Debris Flow



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Property/Location Name	Owner	Occupier	Modern Address	Extract & Notes	Source	Site located by Reference To Document(s)
Sites of reported damage on 4th of June 1872						
"Murrayfield" lands	William Murray		100-132 Tolosa Street and most of Murrayfield Court (possibly also refers to Houghton Mill and Tannery property?)	"Mr. Murray has been by far the greatest sufferer, ….. his lands submerged, and thousands of tons of fallen timber and other debris scattered over his ground"	Mercury, 6 Jun 1872	Survey diagrams LTO Buckingham 2A/114 (1850s), LTO Buckingham 38/20 (1889) and LTO Buckingham 12/33 (1889), and "Murrayfield" house still exists
				"Mr. Murray's garden .... has had the top soil washed away, boulders and drift timber remaining"	Mercury, 7 Jun 1872	
				"Before the late flood, chicory had been grown very successfully for some years, but the part of the estate upon which this was grown was left covered with stones and debris. The quantity of land under chicory was about two acres."	Mercury, 22 Oct 1872	
				"It will be a long time before the traces of the last flood are all removed. Part of the estate is still covered with immense boulders and smaller stones brought down by the torrent, and in one place extending over an area of about 50 yards square the logs that floated down are lying packed close together."	Mercury, 22 Oct 1872	
				Some of the residents with homes close to Humphreys Rivulet that had "gardens and orchards washed away"	Thomas J.M. Hull (1940)	
Soap manufacturing works - "Murrayfield"	William Murray		Likely to be building that was behind 11-13 Murrayfield Court - adjacent to the Rivulet	"one corner of the building used as a soap manufactory and store-house was carried away"	Mercury, 7 Jun 1872	Historic photos of Murrayfield estate and 1946 aerial photo (showing foundations)
				"the soap manufactory at Murrayfield .... the building in which this branch of the business is carried on is a wooden one, two stories high"	Mercury, 22 Oct 1872	
Candle manufacturing works - "Murrayfield"	William Murray		Likely to be two buildings formerly at 13 Murrayfield Court	"the buildings used for the manufacture of candles and vinegar have not been destroyed .... the former are surrounded by a densely packed mass of dead timber"	Mercury, 7 Jun 1872	Historic photos of Murrayfield estate, 1946 aerial photo (showing buildings and foundations), and Survey diagram LTO Buckingham 38/20 (1889)
				"there are two candle houses"; "upon first entering the candle house we were taken to the fat loft"; "the second candle house, which is not always in use"	Mercury, 22 Oct 1872	
Vinegar manufacturing works - "Murrayfield"	William Murray		Likely to be group of buildings formerly at 3 Murrayfield Court - NPWS depot	"in another part of the premises [*in association with the Vinegar manufactory*], where a number of sheds that were destroyed by the last flood are in course of repair"	Mercury, 22 Oct 1872	Historic photos of Murrayfield estate and 1946 aerial photo (showing buildings and foundations) - one wall of one building existed up until 2014
				"Mr. Murray has been by far the greatest sufferer, the whole of his manufacturing works being [*affected (later correction)*]"	Mercury, 6 June 1872	
"Murrayfield" - farm buildings	William Murray		Cattle stalls likely to be building formerly at 15 Murrayfield Court	"close to where the soap and candle manufactories are situated there is a large shed where seventeen head of cattle are fattened in stalls for the market"	Mercury, 22 Oct 1873	Historic photos of Murrayfield estate and Survey diagram LTO Buckingham 38/20 (1889) - shows building likely to be cattle stalls
				"there are over a dozen pig styes near the cattle shed, and each has two or three tenants"	Mercury, 22 Oct 1873	

Property/Location Name	Owner	Occupier	Modern Address	Extract & Notes	Source	Site located by Reference To Document(s)
"Murrayfield" flood embankment	William Murray		Likely to be in the area of 128 Tolosa Street and 3-7 Murrayfield Court - adjacent to the Rivulet	*Andrew Ranaghan, Mr Murray's foreman, drowned in the preceding flood* "attempting to make more secure a wooden embankment which kept the water in the creek [*Humphreys Rivulet*] from flooding the premises"	Mercury, 6 Jun 1872	Descriptions in Mercury, 7 Jun 1872, and Mercury, 22 Oct 1872, and remains still existing of replacement stone wall
				During the debris flow event "an embankment built to protect Mr. Murray's property ...., which was considered an impregnable barrier to any flood, was carried away for over thirty yards of its course" - *this embankment failure almost drowned three young men (including Mr. Kellaway's son)*	Mercury, 7 Jun 1872	
				"To prevent further damage, Mr. Murray is having a fine embankment constructed where his land abuts on the creek. This embankment extends 40ft. into the creek and is 200ft. long. It is made of large stones, with a slope on the water side of one foot in five."	Mercury, 22 Oct 1872	
On Mr Murray's estate	William Murray	??	*location unknown*	"some of the houses on Mr. Murray's estate have been miraculously preserved by the barricades of wood which accumulated before them .... and saved, besides Mr. Murray's buildings, several dwelling houses"	Mercury, 7 Jun 1872	
	William Murray	Andrew Ranaghan (Henry Ranahan in fact)	*location unknown*	*Henry Ranahan was the foreman on "Murrayfield" who drowned during the flood preceding the debris flow*	Mercury, 6 Jun 1872 Mercury, 6 Jul 1872	The Valuation Rolls (1871-1872) show "Henry Ranaghan" in a cottage on the Murray estate
??	??	Mr Craig	*location unknown*	"The hut of a man named Craig was knocked through by heavy trees in three places"	Mercury, 7 Jun 1872	
"Buntingdale"	Rev. C. Simson	John Oswald (Oswell in fact)	23A Norman Circle (vacant land) - southwest end	"the cottage of Buntingdale, in the midst of a rich little orchard and garden in a delta of the bank of the Rivulet, and high above all former water marks .... a tree eight feet in diameter and a hundred feet long came end-on like a huge battering ram to the cottage and it disappeared for ever .... the bed of the garden was torn up to the primitive limestone rock on which the alluvial soil stood"	Guide to Excursionists (1879)	Title deeds LTO 3/3661 (1848) and LTO 4/9105 (1860), and Valuation Rolls (1858, 1870-1872)
				"four-roomed cottage not a vestige is left"	Mercury, 6 Jun 1872	
				"the case of the man Oswald, at O'Brien's Bridge, who had lost everything, and had only received £20"	Mercury, 7 Aug 1872	
		Mr Oswell		"Oswell, who lived opposite to where Messrs. Cruickshank Bros. now live [*i.e. Burnside*], lost their cottage"	Thomas J.M. Hull (1940)	
Presumably "Buntingdale"			Description very similar to that for Oswell's house	"About half-a-mile from the bridge, in the direction of the mountain, [*Mr. Hull, Council Clerk*] drew attention to the ruins of a house which had been built by his ancestor, situate at a distance of about one hundred yards from the rivulet. It presented a spectacle of confusion worse confounded–a truly heterogeneous heap of broken bricks, shingles, shattered glass, pieces of furniture, onions, and potatoes embedded in a matrix of tenacious sludge. Driven through the south-eastern wall, for several yards into the interior of the building, was a huge battering-ram of a gum tree. This had done the work of demolition at a blow, and if anything else had been left undestroyed, it was accomplished by another tree of equal size being brought down and deposited at right angles upon the former."	S.H. Wintle (1872)	

Property/Location Name	Owner	Occupier	Modern Address	Extract & Notes	Source	Site located by Reference To Document(s)
Kensington Flour Mill	Edwin Morrisby (miller)		23A Norman Circle (vacant land) - northeast end	"mill race washed away"	Mercury, 6 Jun 1872	Title deed LTO 3/3661 (1848), Survey diagrams LTO Buckingham 2A/114 (1850s) and LTO Buckingham 38/20 (1889), showing private bridge, Valuation Rolls (1872-1873), and 1946 aerial photo (showing excavated mill race)
				"private bridge .... washed away"	Mercury, 6 Jun 1872	
				"old flour mill on the bank opposite Murrayfield .... the rustic bridge near the mill was washed away and deposited down stream"	Thomas J.M. Hull (1940)	
	W. E. Morrisby			"driven by an overshot water wheel 35ft. in diameter, set against the side of the mill"; "about 84ft. of troughing conveys the water from the dam to the wheel .... The dam is a fine large one, and the race that conducts the water to it from the creek is about 200 yards long. This race was almost choked up by the late flood, and had to be cleaned out."	Mercury, 26 Oct 1872	
property name?	Rev. C. Simson	Thomas Laing (Lane in fact)	14-14A Brent Street	"premises were carried away"	Mercury, 6 Jun 1872	Survey diagram LTO Buckingham 2/49 (1855) and Title deed LTO 4/3216 (1856), and Valuation Rolls (1871-1873)
		Thomas Lane		*Thomas Lane's family* "lived in a typical old English thatched cottage, not far from where the present Water Lane Bridge spans the rivulet. This cottage was completely surrounded by swift running flood waters .... angry waters swirled through the house."; *during the subsequent debris flow event* "Lane's cottage was swept bodily away"	Thomas J.M. Hull (1940)	
	William Murray (?)	Mr Cane (Mr Lane possibly?)	*location unknown*	"house occupied by Mr. Cane .... completely knocked in"	Mercury, 6 Jun 1872	
"Glen Lynden" (now 20 Walgett Place)	Henry J. Hull		11-13 Brent Street and 1-11 Ballard Street	*Some of the residents with homes close to Humphreys Rivulet that had* "gardens and orchards washed away"	Thomas J.M. Hull (1940)	Survey diagram LTO Buckingham 2/49 (1855) and Title deed LTO 4/3216 (1856)
"Ravensdale"	Tasman Morrisby (Edwin's brother)		77-79 Chapel Street	"portion of his garden destroyed"	Mercury, 6 Jun 1872	Title deed LTO 5/4164 (1866), Valuation Rolls (1871-1873), and 1946 aerial photo (showing "Ravensdale" house)
				Some of the residents with homes close to Humphreys Rivulet that had "gardens and orchards washed away"	Thomas J.M. Hull (1940)	
Probably "Martindale" ("Clydesdale" house was out of reach of floodwaters)	Richard Shoobridge		21 Balmain Street	"portion of his house destroyed"; "his grounds partially inundated"	Mercury, 6 Jun 1872	Title deed LTO 5/8827 (1872) - "Martindale" house still exists and 1946 aerial photo shows the location of "Clydesdale" house
				Some of the residents with homes close to Humphreys Rivulet that had "gardens and orchards washed away"	Thomas J.M. Hull (1940)	
				"Shoobridge's farm" - *Richard Shoobridge (?)*	Mercury, 30 Jan 1873	
??			Includes behind Chelmsford Place and Farnell Place	"[*upstream*] of O'Brien's Bridge I found that the torrent had cut in many places a new channel for itself"	S.H. Wintle (1872)	Original course based on remains of 1858 flood wall and 1946 aerial photo
St Paul's Church of England			toward 480 Main Road	"the flood waters overflowed at O'Brien's Bridge and went along main road towards St. Paul's Church of England, and then turning down the present Agricola Street [*i.e. Grove Road*], and right on until it entered the Derwent"	Thomas J.M. Hull (1940)	Church still exists

Property/Location Name	Owner	Occupier	Modern Address	Extract & Notes	Source	Site located by Reference To Document(s)
property name?	H. Cook	Rev. Edward Symonds	Area of Northgate Shopping Centre, facing Main Road	"the residence and grounds of the Rev. Mr. Symons was .... submerged"	Mercury, 5 Jun 1872	Title deed LTO 3/5738 (1850), Valuation Rolls (1871-1873) and The Mercury (8 Apr 1873)
				"water rising a little over the doorstep"	Mercury, 6 Jun 1872	
Barnett's Store	H. Cook	S.H. Barnett	Area of Northgate Shopping Centre, facing Main Road	"Barrett's store was one of the places flooded on Tuesday night, about a foot of water going into the shop and filling the cellars. The road at this point is still covered some inches deep with sludge."	Mercury, 7 Jun 1872	Title deed LTO 3/5738 (1850) and Valuation Rolls (1871-1873)
property name?	H. Cook		Area of Northgate Shopping Centre, next to Humphreys Rivulet	"the splendid garden of Mr. H. Cook was flooded .... washed away a quickset hedge and then overspread the garden, which is about 3.5 acres in extent"	Mercury, 6 Jun 1872	Title deed LTO 3/5738 (1850) and Valuation Rolls (1867-1873) - 3.5 acres is entire property?
				"the creek at this point [*opposite Stephen Wright*] has made for itself an entirely new channel, running through the properties of Mr. Isaac Wright, and Mr. Cook"	Mercury, 7 Jun 1872	
Post Office			Area of Northgate Shopping Centre, facing Main Road	"The Post Office in those days was where Hutt's Produce Store is at present. This low lying place was about two feet deep in water and mud."	Thomas J.M. Hull (1940)	Sketch maps in Alexander (1986), "Glenorchy 1804-1964" - p68 (showing "Old Post Office, c1880), p257 (showing "J. Hutt's Shop", 1935)
Kensington Tannery	Isaac Wright		Area of Northgate Shopping Centre, next to Humphreys Rivulet	"has suffered extensively; the walls of his tannery are gone and the tan pits filled with debris"	Mercury, 6 Jun 1872	Title deed LTO 3/5661 (1850) and Valuation Rolls
				"the creek at this point [*opposite Stephen Wright*] has made for itself an entirely new channel, running through the properties of Mr. Isaac Wright, and Mr. Cook"	Mercury, 7 Jun 1872	
				"men were yesterday engaged in putting Mr. Isaac Wright's tanneries in order"	Mercury, 7 Jun 1872	
				"the premises, which abut on the main road, consist of a range of large wooden and brick buildings"; "The water for all the pits is brought from the creek, which runs close to the premises, and there is always a good supply. The last flood did great damage at the Kensington tannery, as it did elsewhere in the vicinity, and Mr. Wright was a considerable loser. All the pits were filled with water and sludge, and the expensive liquors wasted, while many of the buildings were injured."	Mercury, 11 Nov 1872	
"Kensington"	Mr Reed (Read in fact)		East side of Humphreys Rivulet, downstream of Main Road and the properties of Wright and Cook	"the properties of Messrs. Wright, Reed, and the Rev. Mr. Symons, have also suffered much injury"	Mercury, 5 Jun 1872	Land grant TAHO RD1/1/2/16 (1837) and Title deed LTO 1/5389 (1835), and Valuation Rolls (1867-1872)
	T. G. Read			"Mr. T. G. Read has four-and-a-half acres of hops on the side of the creek opposite to Mr. S. P. H. Wright's hop-grounds. The flood destroyed about one acre of hills [*bines?*] in June last"	Mercury, 14 Mar 1873	
"The Grove"	Stephen P.H. Wright		Eastern part of McKay timber yard	"on the opposite side of the creek [*to Isaac Wright*], had five acres of hops destroyed"	Mercury, 6 Jun 1872	Title deed LTO 5/5456 (1868), Valuation Rolls, and ruins of "Grove" house still exist
				"the top soil has been carried away over a large area, and the ground in many places is strewn with rocky boulders"	Mercury, 7 Jun 1872	

Property/Location Name	Owner	Occupier	Modern Address	Extract & Notes	Source	Site located by Reference To Document(s)
downstream of O'Brien's Bridge			Area of Northgate Shopping Centre and western car-park, Glenorchy Transport Museum, McKay timber yard, etc.	"On the river side of O'Brien's Bridge, where the land lies the lowest, a terribly weird and wild scene presented itself. A vast, entangled, heterogeneous mass of enormous trees, casks of wine, vinegar, &c., fences, agricultural implements, house-building materials, and rock masses, covered the soil-swept locality for many acres."	S.H. Wintle (1872)	
				"A fine orchard .... covering some acres, had been most completely removed, and in its stead, had been deposited huge, branchless, barkless, rootless trees, ponderous fractured boulders of the adamantine greenstone, and gravel."	S.H. Wintle (1872)	
O'Brien's Bridge			Main Road bridge over Humphreys Rivulet	"the bridge has been severely assailed …. [*a tree*] some six feet in circumference lies stretched entirely across the creek and jammed against the bridge"; "one of the centre stays has also given way, but the bridge still seems tolerably secure"; "the bridge was completely submerged, the archway became choked with debris, and the water escaped over both sides and covered the road to a depth of several feet"	Mercury, 6 Jun 1872	Bridge still exists, but is now widened on downstream side
				"men were yesterday engaged in …. clearing the road and bed of the creek at O'Brien's Bridge"	Mercury, 7 Jun 1872	
				"immense heaps of timber and gigantic boulders which strewed the bed of the rivulet, and lined its banks on either side of the bridge"	S.H. Wintle (1872)	

Other sites mentioned in 1872 reports

"Hope Farm"	F.A. Downing (Hull son-in-law)	Mr Stansfield (Thomas W. Stanfield in fact)		"the residence of Mr. Stansfield, about a mile and a half from the main road" – *the property is on the upstream side of the Tolosa property (owner: George Hull) and also includes a large block on the northern side of Humphreys Rivulet and Knights Creek*	Mercury, 12 Jun 1872	Title deeds LTO 3/5515 (1850) and LTO 4/155 (1854), and Valuation Rolls (1872-75)
"Murrayfield"	William Murray	Mr Calloway (Kellaway in fact)	120 Tolosa Street	*Mr Murray's manager living in "Murrayfield" house*	Mercury, 7 Jun 1872	
		Mr Calloway (Kellaway in fact)		"Calloway's farm" – *presumably refers to "Murrayfield"*	Mercury, 30 Jan 1873	
		Stone Kellaway		*Mr Murray's manager - lived at "Murrayfield"*	Thomas J.M. Hull (1940)	
"The Junction"				*the junction of Humphreys Rivulet and Knights Creek*	Mercury, 12 Jun 1872	
"Tinker's Corner"				*probably at the junction of Humphreys Rivulet and Knights Creek*	Mercury, 30 Jan 1873	
"Black Rocks"				*upstream of The Junction*	Mercury, 12 Jun 1872	

Property/Location Name	Owner		Modern Address	Notes		Site located by Reference To Document(s)
Buildings and structures that survived into the 1900s						
"Grantleigh" / "The Whitehouse"	Sawyer (1900s?)		On ridge within Dominic College - 204 Tolosa St	*Still exists*		Aerial photo
"Tolosa"	George Hull		Approx. area of 161 Tolosa Street	*Removed*		1946 aerial photo (showing location of "Tolosa" house)
"Burnside"	Cruickshank Bros.		8A Sanders Street	*Still exists - Not built until c1903*		Aerial photo
"Murrayfield"	William Murray		120 Tolosa Street	*Still exists*		Aerial photo
"Maryville" or "Maryvale"	W.M. Davidson (Hull son-in-law)		132A-134 Tolosa Street	*House removed 1900s (?)*		Title deeds LTO 6/6806 (1880) and LTO 10/1315 (1900), and Valuation Rolls (1867-1873)
"Clydesdale"			Approx. area of 76 Tolosa Street (?)	*Removed*		1946 aerial photo (showing location of "Clydesdale" house)
??			80 Tolosa Street	*Still exists - built 1840s*		Aerial photo
??			78 Tolosa Street	*Still exists - built early 1800s (?)*		Aerial photo
??			72 Tolosa Street	*Still exists - built mid-1800s*		Aerial photo
"Ravensdale"			Approx. area of 87 Chapel Street	*Removed*		1946 aerial photo (showing "Ravensdale" house)
"Martindale"			21 Balmain Street	*Still exists - built 1835, was 99th Fusiliers Officer's Quarters*		Aerial photo
Houghton Tannery building			At entrance of Guilford Young College - 71 Bowden Street	*Some walls still exist*		Houghton Mills and Tannery plan - TAHO NS1305/1/1 (late 1860s?)
Houghton Mill residence			At Mill Lane entrance to Guilford Young College	*Still exists*		Houghton Mills and Tannery plan - TAHO NS1305/1/1 (late 1860s?)
Wesleyan Methodist Church			1A Chapel Street	*Still exists - built 1828-30 - now the Old Chapel Tearooms*		Aerial photo
??			6 Kensington Street	*Still exists - built 1850s*		Aerial photo
??			8 Kensington Street	*Still exists - built 1850s*		Aerial photo
??			14 Kensington Street	*Still exists - built 1850s*		Aerial photo
??			16 Kensington Street	*Still exists - built 1850s*		Aerial photo
Kensington Inn	William Bastian		Area of Northgate Shopping Centre, facing Main Road	*Became the Racecourse Hotel - now removed*		Title deed LTO 5/6332 (1869) and Houghton Mills and Tannery plan - TAHO NS1305/1/1 (late 1860s?)
St. Matthews Presbyterian Church			2 Tolosa Street	*Still exists - built 1842*		Aerial photo
"The Grove"	Stephen P.H. Wright		22 Wrights Avenue - McKay timber yard	*Still exists - burnt out shell remains*		Aerial photo

Property/Location Name	Owner		Modern Address	Notes		Site located by Reference To Document(s)
Humphreys Rivulet Flood Wall			from about 128 Tolosa St down to the Railway	*Built 1858 - parts are still standing but much is demolished (upstream end extended by Wm. Murray after 1872 flood?)*		Aerial photo
Club Hotel			457 Main Road	*Still exists - Not built until c1881*		Aerial photo

Sites that have changed name since 1872

O'Brien's Bridge			Main Road bridge over Humphreys Rivulet	*Still exists beneath modern bridge, which has been widened on the downstream side*		
Dusty Miller Lane			Tolosa Street			
Watch-house Lane			Chapel Street			
Water Lane			Brent Street			
Agricola Street (1900s)			103-116 Grove Road	*Off Main Road - now part of north-south section of Grove Rd*		

LTO – Land Titles Office document (General Law Deed, Certificate of Title, or Land Grant) with document number and year.

TAHO – Tasmanian Archive and Heritage Office document with Item number and year.

Valuation Rolls – published annually in the colonial government's *Hobart Town Gazette* (1825-1880).

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