Historic buildings appraisal, St Bathans, Otago

Post Office, Bank of New South Wales' Gold Office, Stone Cottage and Public Hall

DOC SCIENCE INTERNAL SERIES 185

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Published by
Department of Conservation
PO Box 10-420
Wellington, New Zealand

DOC Science Internal Series is a published record of scientific research carried out, or advice given, by Department of Conservation staff or external contractors funded by DOC. It comprises reports and short communications that are peer-reviewed.

Individual contributions to the series are first released on the departmental website in pdf form. Hardcopy is printed, bound, and distributed at regular intervals. Titles are also listed in the DOC Science Publishing catalogue on the website, refer http://www.doc.govt.nz under Publications, then Science and Research.

ISSN 1175–6519

ISBN 0–478–22601–2

In the interest of forest conservation, DOC Science Publishing supports paperless electronic publishing. When printing, recycled paper is used wherever possible.

This is a client report commissioned by Otago Conservancy and funded from the Science Advice Fund. It was prepared for publication by DOC Science Publishing, Science & Research Unit; editing and layout by Lynette Clelland. Publication was approved by the Manager, Science & Research Unit, Science Technology and Information Services, Department of Conservation, Wellington, New Zealand.

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A B S T R A C T

A geotechnical and structural appraisal of the Post Office, Bank of New South Wales' Gold Office, Stone Cottage and Public Hall in St Bathans, Otago, South Island, New Zealand was carried out. The aims of the appraisal were to assess the geotechnical setting of the buildings, comment on possible causes of any building distress, and recommend remedial measures, where appropriate. The findings of the report are principally based on a literature review, observations made during a walkover survey of St Bathans and inspections of the buildings. No signs of global mass slope instability that may impact on the subject buildings were observed. The condition of the buildings varies, as does the scope of remedial works required to ensure that they are preserved 'in perpetuity'. For example, the Gold Office is a sound wooden structure that requires little intervention to maintain in good order. Conversely, the Public Hall, which has recently undergone a programme of underpinning at the rear wall, requires significant further maintenance work. The Public Hall has been the subject of a number of structural assessment reports, and proposals for future works have been presented by others. Seismic risk assessment of the buildings is required to determine how best to safeguard them from earthquake damage. The need for careful archiving of all records of site and building inspections and maintenance work was identified.

Keywords: St Bathans, gold mining, historic, building preservation, New Zealand.

Harwood, N.; Woodmansey, P. 2004: Historic buildings appraisal, St Bathans, Otago: Post Office, Bank of New South Wales' Gold Office, Stone Cottage and Public Hall. *DOC Science Internal Series 185*. Department of Conservation, Wellington. 38 p.

1. Introduction

Opus International Consultants Limited (Opus) was commissioned by the Department of Conservation (DOC) to undertake a geotechnical and structural appraisal of the Post Office, Bank of New South Wales' Gold Office, Stone Cottage[1] and Public Hall in St Bathans, Otago.

The buildings are important assets of the Otago Goldfields Park (administered by DOC) that encompasses the historic gold-mining township of St Bathans. St Bathans' interesting gold-mining past and its present scenic qualities attract an increasing number of visitors.

The St Bathans Reserves Draft Management Plan (Department of Lands & Survey 1983) notes that one of its management objectives is to 'preserve in perpetuity' the historic buildings of St Bathans. The Otago Goldfield Park's guide to St Bathans (Department of Lands & Survey 1985) notes that there is now a responsibility to see that the area is preserved and managed for the public.

The four buildings under consideration are in various states of disrepair, ranging from a wooden structure that has been renovated and is in sound condition (Gold Office) to an earth brick building subject to severe subsidence and cracking (Public Hall).

Opus was commissioned to:

- Assess the geotechnical setting of the buildings.
- Comment on possible causes of any building distress observed.
- Recommend remedial measures, where appropriate.

2. Sources of information

The findings of the report are principally based on a literature review, observations made during a walkover survey of the St Bathans area, and inspections of each building.

Information sources accessed and reviewed during the compilation of this report include:

- Photos, notes etc. obtained during the walkover survey.
- Historic records, technical reports, DOC's archives etc.
- Discussions with residents of St Bathans, and staff of DOC and the Central Otago District Council (CODC).
- Geological report
- Central Otago District Plan.
- Building inspectors at the CODC.

Although much has been written about the history and landscape in and around St Bathans (e.g. Nicolson-Garret 1977), this report only contains information salient to the specific commission. The main references used for historic information were:

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[1] A.k.a. Blacksmith's or Cobbler's shop.

- Draft St Bathans Reserves Management Plan, Otago Goldfields Park. (Department of Lands & Survey 1983).
- St Bathans—an Historic Town, Otago Goldfields Park. (Department of Lands & Survey 1985).

3. Site details

3.1 SITE LOCATION

St Bathans is a small historic township that lies in the district of Central Otago on a loop road off State Highway 85. It is about a 2.5 h drive from Dunedin. St Bathans was established during the Central Otago gold rush of the 1860s. The focus of mining is now the site of the adjacent Blue Lake. This lake fills one of the largest and deepest holes dug by hydraulic elevators in New Zealand (Hamel 2001).

3.2 LANDSCAPE SETTING

Many of the original buildings at St Bathans no longer exist. Most of the remaining buildings are situated on the west side of the main street that runs NW–SE through the township. The Blue Lake dominates the eastern part of the township's scenery. The main street is at an altitude of c. 580 m. The land behind (to the west) of the buildings slopes up to a ridge (c. 660 m) that runs almost parallel to the main street (Fig. 1). Figure 1 also shows an old (disused) water-race that approximately follows the 620 m contour above the town.

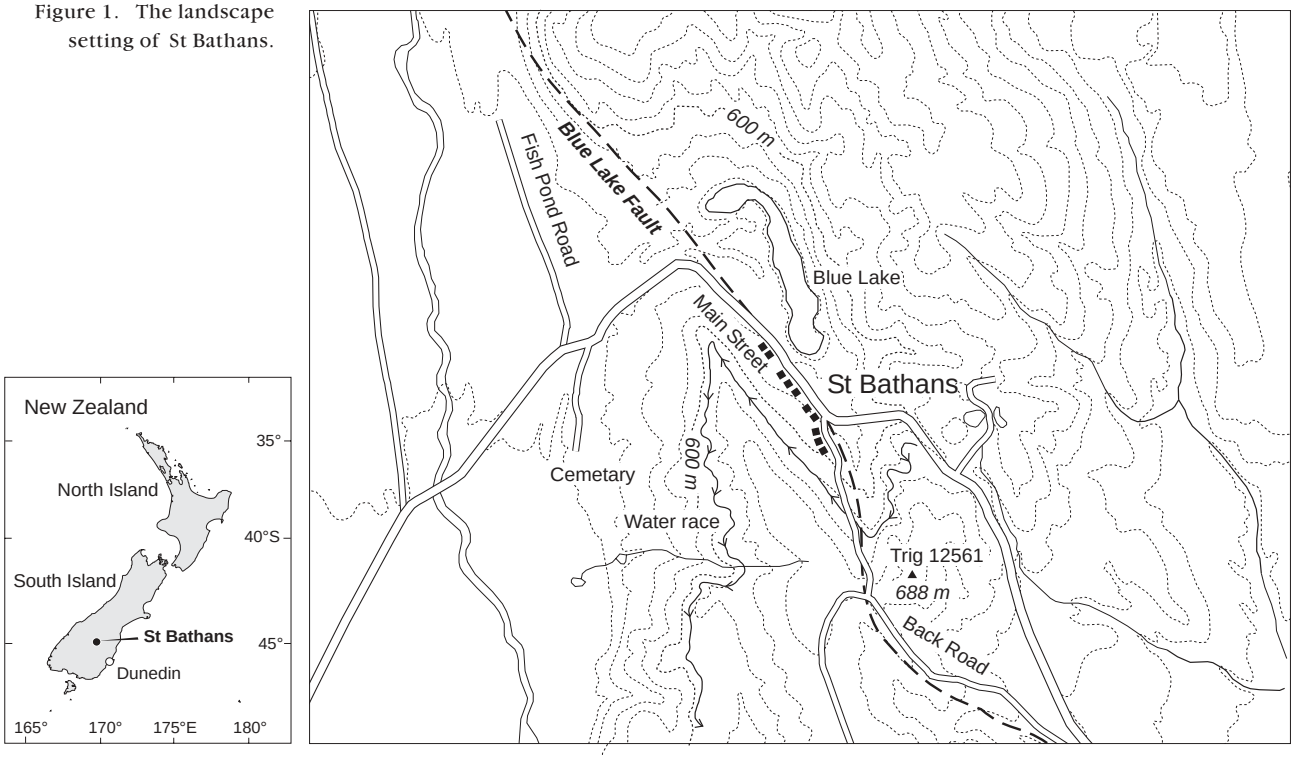

Figure 1. The landscape setting of St Bathans.

3.3 LOCATION OF SUBJECT BUILDINGS

The four buildings that are the focus of this study are the Post Office, Stone Cottage, Bank of New South Wales' Gold Office and the Public Hall. For the purpose of this report, these buildings are referred to as the 'subject buildings', to distinguish them from other buildings in the township.

The Public Hall is immediately south of and adjoins the Vulcan Hotel. The Public Hall, Stone Cottage, Gold Office and Post Office are alongside each other on the main street that rises to the south (Fig. 2).

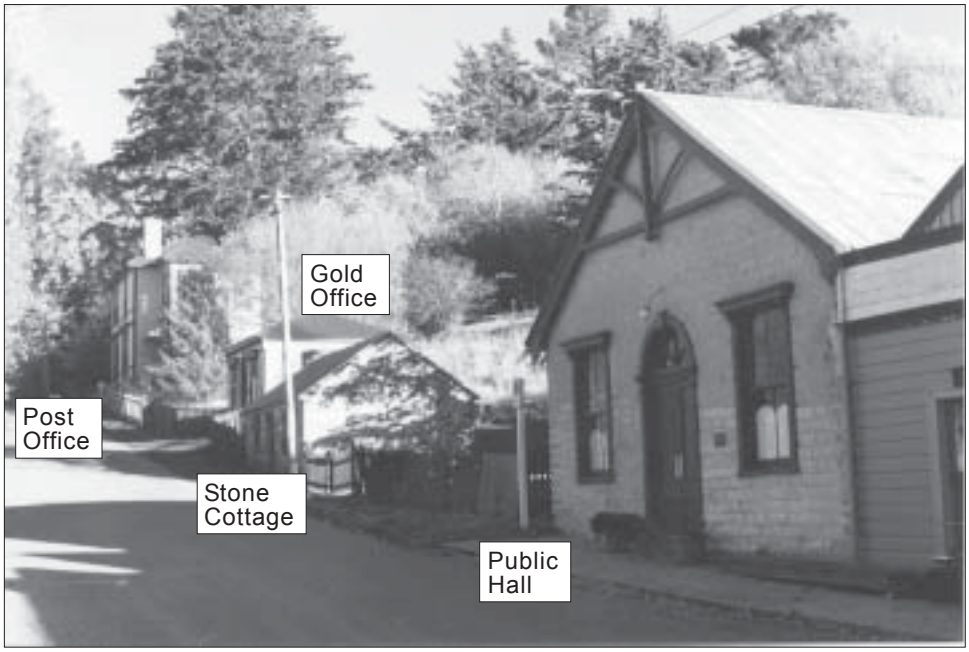

Figure 2. View south up the main street of St Bathans showing the locations of the Public Hall, Stone Cottage, Gold Office and Post Office.

3.4 HISTORICAL CONTEXT

Gold was discovered near St Bathans in 1862 and by 1864 the new township was flourishing. At its peak it had some forty business 'houses', ten hotels and approximately 1000 residents.

Starting in January 1864, Kildare Hill (c. 120 m high) was reduced to a pit 68 m deep by sinking shafts to bring the rich gold-bearing gravels to the surface for sluicing to extract the gold. In the 1880s a hydraulic elevator was used to raise the gravel. This was (reputedly) the deepest hydraulic mining lift in the world, and the enormous hole left after mining was abandoned in 1934 eventually flooded to become Blue Lake (Department of Lands & Survey 1985). A typical view of Blue Lake is shown in Fig. 3.

Given the economic uncertainty that plagued the gold mining industry, it is highly likely that few, if any, of the buildings were designed or intended to last any great length of time. Very few buildings survive from the gold mining days in St Bathans. It is, perhaps, more by chance than design that the four subject buildings remain. Their approximate dates of construction are as follows:

- Public Hall 1880s
- Stone Cottage 1880s
- Gold Office Late 1860s
- Post Office 1909

The literature review revealed the following (non-technical) references to historic ground stability issues at St Bathans:

'By 1933 the Kildare Consolidated Mining Company was elevating reputedly the world's greatest vertical lift—68.8 metres in two stages. The extreme depth, with the threat of undermining of the township caused the Maniototo County Council in 1934 to call a halt to mining operations' (Department of Lands & Survey 1983).

'Work at St Bathans by the Kildare Consolidated Company continued until it began to undermine the settlement's main street. The Maniototo County Council served a writ on the company to stop its operations, and in 1934 mining ceased' (Mobil New Zealand, date unknown).

'… it pays to step gently when crossing the street to the Vulcan pub from the picnic ground. The area has been undermined with diggings' (Convery 1987).

Issues relating to ground and building stability are discussed in detail below.

4. Geotechnical setting

4.1 OVERVIEW

Three dominant terrain features define the landscape of St Bathans. These are:

1. The hillside to the west that rises to a ridge behind the township.
2. Blue Lake, to the northeast of the buildings, which is surrounded by steep sluiced cliffs.
3. The hillside to the east of the lake.

An overview of the locality is shown in Fig. 4.

Figure 3. Blue Lake, the former site of the 120-m-high Kildare Hill, with exposures of west-dipping gold-bearing gravel.

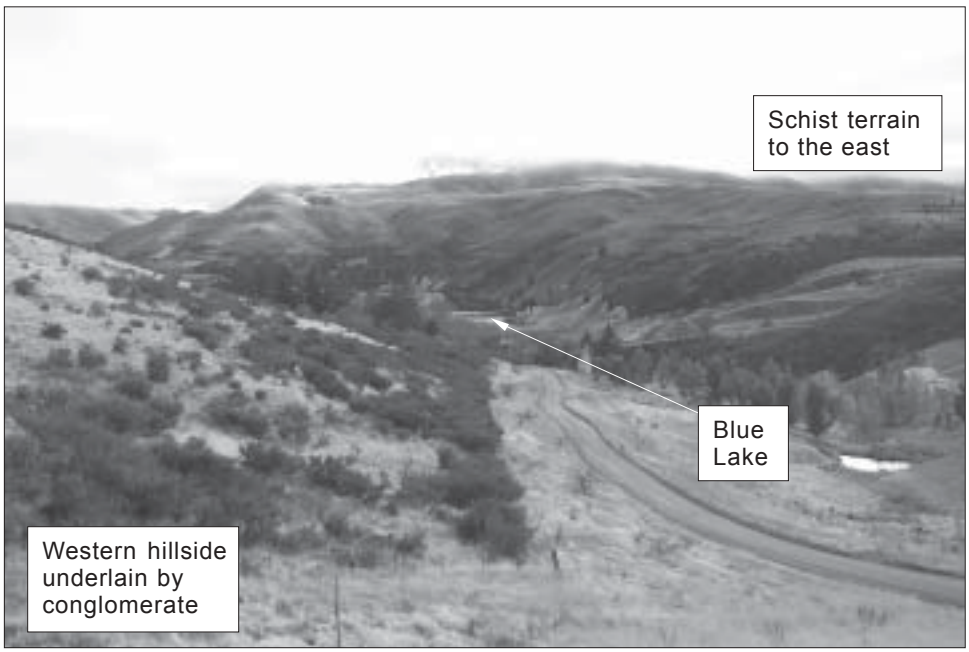

Figure 4. Overview looking north from southern approach to St Bathans on the Back Road.

Blue Lake, to the immediate north-east of the St Bathans township, was formed by hydraulic elevating and sluicing for alluvial gold in Manuherikia Group quartz conglomerates (Fig. 5). The conglomerates are overlain by sediments of the Hawkdun Group. These form the hillside and ridge to the west of the township (Forsyth 2001).

Both groups of sedimentary rocks dip steeply to the west at c. 45° and tend to inter-finger with each other. Rakaia terrane schist, a metamorphic rock, is exposed in the eastern face of Blue Lake where an unconformable contact between younger sediments and the much older schist can be observed.

The Manuherikia Group sediments typically comprise quartz conglomerate (sandy gravels) and sandstone, with minor mudstone and lignite seams overlain mainly by interbedded claystone and siltstone. The Hawkdun Group sediments typically comprise sandstone and well-rounded quartz conglomerate (sandy gravel and cobbles) (Fig. 6). The sediments exhibit no particular features or zones of weakness that are likely to impact on ground stability in St Bathans.

Interfaces between the rock units are inferred to be generally aligned sub-parallel to the main street, as is the active Blue Lake Fault, which runs through the heart of St Bathans (Forsyth 2001).

4.2 INFORMATION FROM EXPOSURES

Apart from the massive sandy gravel exposures in the cliffs surrounding Blue Lake, there are few cuttings or outcrops visible in St Bathans township itself. The ground under the township is inferred to be composed of Manuherikia and Hawkdun Group deposits that have been weathered, mixed and transported by recent natural colluvial processes and locally modified by human activity (e.g. cutting / filling around buildings and road embankment construction).

Figure 5. Typical exposure of Manuherikia Group quartz conglomerate in Blue Lake cliff face.

Figure 6. Typical exposure of Hawkdun Group conglomerate in road cutting north of St Bathans. The hillside above the township is composed principally of this rock unit.

A low cutting behind the private residence between the Public Hall and Stone Cottage exhibits a high variability in shallow soil conditions. Similar conditions probably prevail throughout the area occupied by the four subject buildings (Figs 7, 8 & 9). During recent underpinning works at the hall, non-engineered fill and topsoil was encountered under the hall's foundations (Hadley & Robinson, 2003a).

The near-surface ground conditions at the subject buildings are certainly more clayey and variable than would be inferred from observations of the lake cliffs alone.

4.3 SITE WALKOVER SURVEY

4.3.1 Scope of survey

Site walkover surveys and building inspections were carried out on 5 May 2003 and 27 May 2003. Attention was principally focused on the subject buildings and their immediate environs and the hillside above. The walkover also encompassed the main street, the land to the south and west of Blue Lake, and areas from St. Albans church in the south to the sharp bend in the road north of the village.

The locations of many of the details and features discussed below are shown on the annotated aerial photograph in Appendix 1.

Figure 7. Exposure in cutting of medium-dense, fine-to-medium sand.

Figure 8. Exposure in cutting of dense, angular, sandy gravel.

Figure 9. Exposure in cutting of firm–stiff clay/ silt.

4.3.2 Observations on western hillside

Generally, the hillside rises to the west of the village (and behind the buildings) at a quite steep but uniform slope (c. 25°), although there are almost-flat areas lower down; e.g. the levelled lawn area behind the Hall. The hillside is covered in dense shrub vegetation with some open areas of dense coarse grass. A subdued gully feature is present on the slope above the Hall and has grass cover only (Figs 10 & 11).

Although no running water or springs were observed, it is possible that the gully feature is the surface expression of a subterranean drainage route; with the higher ground moisture content not favoured by shrub vegetation.

No surface ruptures were observed and there are no signs of recent mass movement. Some trees on the slopes above the subject buildings lean, but many do not (Figs 12–14a).

Figure 10. View west overlooking St Bathan's main street and the western hillside. C = St Albans' Church (behind trees); P = Post Office; G = Gold Office; S = Stone Cottage; H = Public Hall; V = Vulcan Hotel; W = water race (part only—approximate location); Gy = gully feature.

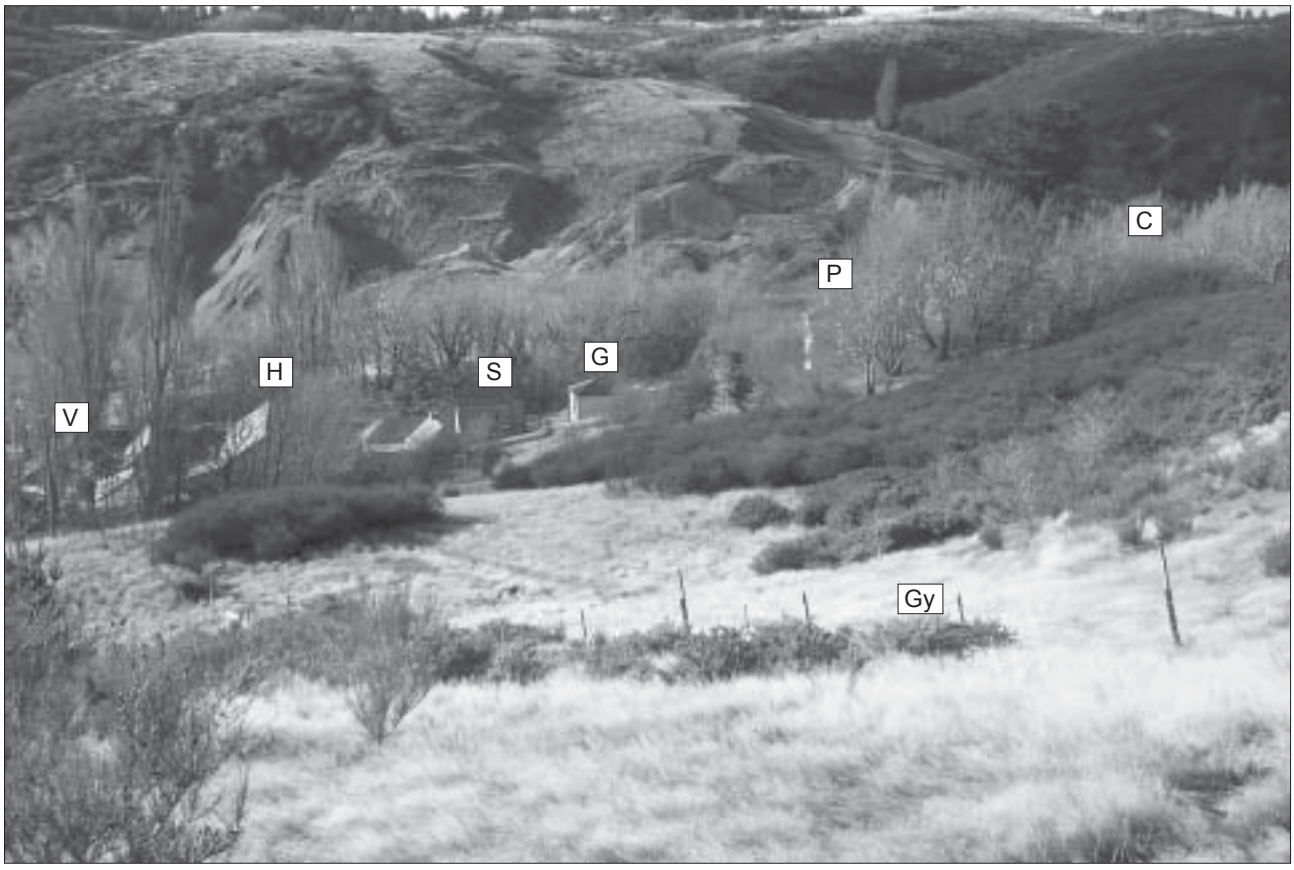

Figure 11. View (looking east) of buildings from the western hillside (labels as in Fig. 10). Water race is up the hill behind the observer.

Figure 12. View across hill slope above subject buildings. Fence post is normal to the c. 25° slope.

Figure 13. View across 'landscaped' lawn area behind Hall. Note tall vertical (not leaning) poplars in background.

Figure 14a. View across hillside at top of section behind Post Office.

Figure 14b. View south along line of 'old' leaning rail-iron power poles.

The 'modern' power poles that form a line across the slope above the subject buildings show no signs of tilt. Conversely, several disused 'old' rail-iron power poles on the road embankment through the township have a distinct lean.

Any slope movement, indicated by leaning trees or power poles, for example, is primarily attributed to hillside creep, which is a natural, very slow slope movement process. Movement of this nature is usually in the order of a few mm/year, but will vary depending on factors such as slope angle and ground moisture content.

Given that three of the subject buildings have been standing at their current sites for c. 100–130 years, it is possible that ground creep may have imposed very gradual long-term structural stresses on them.

The walkover survey encompassed observations on landform, surface features, vegetation and structures (e.g. power poles, fence lines). The survey has indicated that there are no signs of global mass slope instability that may impact on the subject buildings.

4.3.3 Groundwater

As noted above, no running water or springs were observed during the walkover survey that was carried out following a relatively dry spell[2]. There is, however, evidence that:

- The subsoil around the subject buildings is generally of a low permeability.
- There may be pockets of perched groundwater in the area of the buildings.
- The groundwater may be being recharged from the hillside.

Observations that support the above include:

- Residents note high surface run-off and saturated ground (retained surface water) following rainfall.[2]
- Drains to collect surface run-off have been installed behind St Albans church, the Post Office and Public Hall.
- A patch of reeds grows on the slope behind the hall. This is indicative of a persistently wet area with poor drainage.
- A recently installed drainage sump behind the hall was full of water at the time of inspection.
- Excavations for the recent underpinning work at the hall encountered 'a quantity of water' (Hadley & Robinson Ltd 2003a).
- Despite there being little rainfall in the weeks before the walkover survey, the ground along the access track to the rear of the hall was soft and wet underfoot.
- The trench along the left-hand side of the hall was very damp with a high groundwater level observed in a shallow pit beside the exposed foundations.
- There are stands of poplar and willow trees, particularly along the downhill side of the main street. These species tend to prefer ground with a high moisture content that many other species cannot tolerate.

The relevance of the various observations is explained in the comments on the individual buildings in Sections 5–8 below.

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[2] Comments by Sharon Hinds, resident of St Bathans and custodian of Post Office, May 2003.

4.3.4 Old water-race

The water race is a shallow open channel cut across the hillside. Its route is shown in Fig. 1, and the approximate location of part of it is indicated in Fig. 10. It is no longer used for water supply. The portion above the subject buildings was dry when inspected during the walkover survey.

4.3.5 Coal seams

The literature review found reference to underground fires in coal seams in St Bathans (Nicholson-Garret 1977). The coal seams are units of the Manuherikia Group (minor lignite, noted above) that generally dip to the west under the township.

The occurrence of fires has been confirmed in discussions with DOC staff and residents. The smouldering and smoking surface fires appear to have been extinguished or burnt out several years ago (exact date unconfirmed), although it is possible that underground combustion continues. Two burning areas were recalled by residents; one near the access track from the village to the lake, and the other somewhere in the inner 'elbow' area of the lake to the north of the township.

The site walkover confirmed the location of the former area, approximately halfway down the lake access track on the right-hand side (when looking towards the lake). An exposure of claystone shows signs of scorching (reddened rock with brittle, sharp fracture surfaces). When handled, fragments of the claystone gravel 'clink' like shards of baked ceramic. Adjoining scree slopes contain traces of coal and exposures are blackened.

The lakeside cliffs show that the Manuherikia Group deposits dip steeply under the township at c. 45°. The minor nature of the coal seams (i.e. thin beds) and the distance from the scorched ground to the main street (giving an overburden depth of more than 50 m) indicates that there is little risk of subsidence related to the burning coal seams affecting the buildings.

4.3.6 Historic slope instability

Under the heading 'Blue Lake, Car Park, Curling Dam', the Draft Reserves Management Plan (Department of Lands & Survey 1983) notes that '… a large slip has occurred in the car park. It was caused mainly by water.' Unfortunately, no further details or records can be located. There were no obvious signs of a slope failure feature observed during the recent walkover survey. Evidence of the slip has obviously disappeared in the 20 years since the plan was written.

Contact with a building inspector at the Central Otago District Council confirmed that there are no records of any slope instability hazard in the township[3].

[3] Comment by Max Burtells, Building Inspector, Central Otago District Council, May 2003.

4.3.7 Road cracking

In May 2001, a report was prepared for the Central Otago District Council (CODC) on road cracking along the main street through St Bathans (Montgomery Watson 2001), and was followed-up by a programme of monitoring. Between April 2001 and May 2002, the cracks were monitored five times (Montgomery Watson Harza 2002).

There are five areas of cracking, four of which are well removed from the subject buildings (see location plan in Appendix 2). The fifth (Site 5) is a longitudinal crack along the road adjoining the Post Office and Gold Office. Since the cracking was first observed there has been no significant further movement.

The reports produced by the consultants for the CODC should be consulted for full details of the crack investigation and monitoring. Opus concurs with the CODC records that cracking of the road surface and movement observed at the subject buildings are independent phenomena, i.e. whatever caused the road cracking is not related to any movement problems observed in the subject buildings.

4.3.8 Old dams

There is a disused curling dam across the road from the Post Office. The dam is a low earth berm, the area is heavily vegetated and the pond infilled with weed. The dam is downhill of the Post Office at a distance of at least 25 m. It is an antiquated feature and does not appear to be of any significance in the current study.

The section to the immediate left of the Post Office (i.e. to the south, uphill) is heavily overgrown with a number of distorted and tilted trees. Towards the back of the section there is evidence of a low earth berm (c. 1 m high) that is understood to be an old dam (Sharon Hinds, pers. comm. May 2003). In heavy rain, water issues from a pipe at the top of the section and ponds behind the dam. Water can be retained in the pond for several days and 'overtops' the ends of the dam, saturating the ground down-slope.

It is not entirely clear why the trees in this localised area tilt, but it may relate to periods when there is excessive wetting of the soil. There is no evidence of recent mass slope movement.

4.4 SEISMIC HAZARD

As noted above, the active Blue Lake Fault runs through the heart of St Bathans. The fault is one of a cluster of reverse faults that have developed in Central Otago in response to oblique compression across the Australian-Pacific plate boundary. Where it can be calculated, these faults typically have slip rates of 0.1–1 mm/yr, but the rate for the Blue Lake fault is presently unknown (Institute of Geological & Nuclear Sciences 2000).

The estimated maximum moment magnitude (M_{max}) and estimated recurrence interval of earthquakes on the Blue Lake Fault are 7.0 and 5000 years, respectively.

Although there are a number of other active faults in the St Bathans area of Central Otago, the major earthquake hazard for the South Island in general is the Alpine Fault. The estimated maximum moment magnitude (M_{max}) and recurrence interval of earthquakes on the Alpine Fault are 8.1 and 300 years, respectively.

In terms of earthquake hazard to the subject buildings, the Blue Lake Fault is a primary hazard due to its close proximity, and the Alpine Fault because of the huge potential magnitude and short recurrence interval of its earthquakes. A major event on either of these faults would probably cause severe damage to many of the buildings in St Bathans. Recent studies indicate that it is now more that 300 years since the last major movement on the Alpine Fault, so an earthquake could occur at any time.

5. Post Office

5.1 CURRENT CONCERNS

Despite two phases of re-piling and floor-levelling works (1984 and 2000), the Post Office continues to show signs of subsidence, particularly at the front right-hand corner (as viewed from the street). Subsidence is generally manifest as uneven floors and distorted frames leading to jamming doors and windows.

5.2 BRIEF HISTORY

1909	Current building constructed on site of former Post Office.
1984	Post Office re-piled and re-painted.
2000	Post Office re-piled and re-painted, followed by installation of trench drain at rear of building.
2000–2003	Gradual subsidence at front right-hand door manifest as increasing effort required to shut the door.
May 2003	Walkover survey inspection showed building to be in very good condition (Fig. 15). The front right-hand door has a tilt across its base (c. 25 mm) such that it cannot be locked.

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