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Goldmining and Enclosure on the Middle and Upper Shotover River, Central Otago, New Zealand

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ABSTRACT

Gold was first found on the Shotover River in 1862. Today most of the middle and upper Shotover River presents a remarkably well preserved technological ensemble of goldmining and high country pastoralism. A selective aerial survey covered the area from south of Deep Creek through Maori Point and Skippers to the Shiel and Polnoon Burns, a total area of about 90 km^2 including most of the river terraces. The aerial photographs were used to map the pattern of supply race/dams/head races/sluice face/tailrace, the domestic and related pastoral enclosures associated with the mining, and other pastoral features. Almost all the ditch and bank enclosures contain much-reduced sod houses and relate to the domestic arrangements of the goldminers. One ditch and bank fence at The Neck is a pastoral control structure. All these structures date to the period after 1862 and before about 1880, when post and wire fences were introduced.

Keywords: Mount Aurum, Skippers,The Branches Station, Coronet Peak Station, historical archaeology, aerial photographs, goldmining, pastoralism, ditch and bank fences, dams.

INTRODUCTION

From the first discovery of gold in Otago, there was often a conflict between pastoralists and goldminers. The conflict is conventionally understood to have culminated in the 'bursting up' of the 'great estates' in the 1890s as the labour-intensive phase of mining ran out and miners, among other small farmers and new settlers, looked for new economic opportunities in a maturing farming economy (Sinclair 1959: 173–179). However, the conflict was probably there at all phases of mining and pastoralism. Historical archaeology should have a contribution to make to this debate. Capital works such as fences, dams and races, and domestic enclosures all survive in the Shotover landscape. They reflect an extensive use of the land and particular enclosures of domestic space which are not recorded on official documentation.

The Shotover River is an important historic landscape, where the Department of Conservation administers large areas of Crown Land, principally the former Mt Aurum Station. The present project involved aerial photography and mapping of historic and industrial archaeological sites, primarily on the terrace lands and in the side valleys of the Shotover River, Central Otago. It has been briefly reported elsewhere (Jones 2007a). The photographs were taken at 4100 feet (1200 m) AGL (above ground level) and gave very

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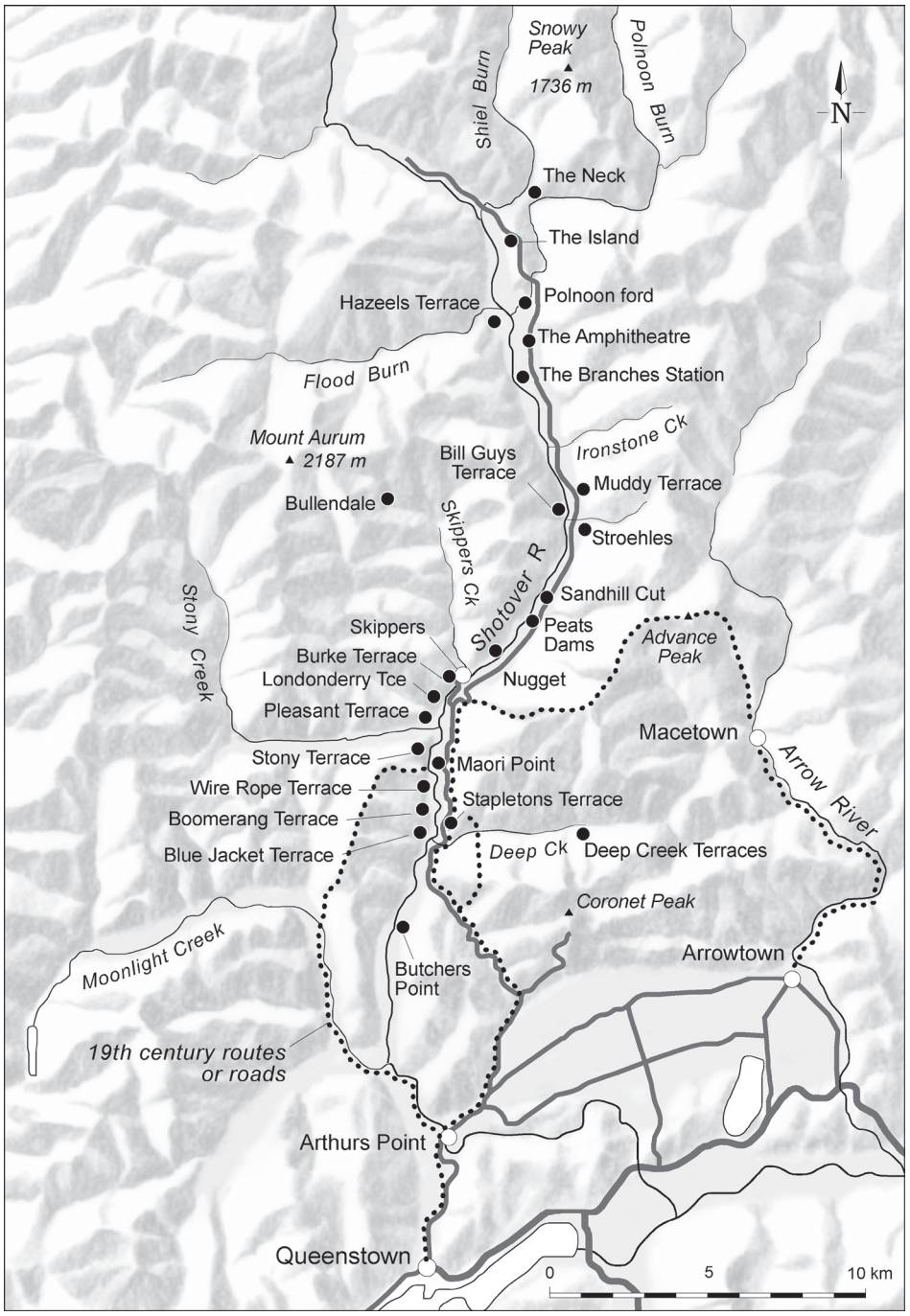

Figure 1: The general setting and place names of the middle and upper Shotover River.

detailed coverage of small features such as stone house floors, ditch and bank enclosures and fine detail of water races.

High-resolution aerial photographs have seldom been used to document extensive sites over such wide areas. Mapping covered complete goldmining systems from head races to tailings and many newly recorded domestic and pastoral enclosures. Maps and descriptions of archaeological features have been partially published as New Zealand Archaeological Association site records and the relevant site record numbers are used in this paper.

GENERAL SETTING

The area covered was from the northern part of the Shotover River gorge at Butchers Point (2 km south of the confluence of the Shotover and Long Gully), through Skippers to The Branches Station (pastoral lease, privately managed), Mount Aurum (recreation reserve, Department of Conservation), and Coronet Peak Station (pastoral lease, privately managed) (Fig. 1). In terms of stream catchments, coverage is from Butchers Point (about 11 km south of Skippers Bridge) to 'The Neck' a low-lying area between the Shiel and Polnoon Burns. Areas not covered include the hard rock mining area of Bullendale towards the head of Skippers Creek and most other lode areas. The total area covered by general survey was about 90 km^2 including most of the river terraces, which are distributed about the modern flood plain and form a strip about 30 km long. (Most of the terraces are named after individual miners and their proper topographical names do not include apostrophes, so Stapletons Terrace.)

Geologically, the Shotover River is hollowed out of a fault in schist. The general form of the land is dictated by the bedding planes of the schist rising from west to east, leaving bluffs to the west of the river and steep slopes to its east. The country is slip-prone and there is much rock fall. Along with winter floods, in the nineteenth century these factors took a heavy toll in the lives of men and horses. The valley floor is marked by small areas of terraces, especially on the west between Skippers Creek and Wire Rope Terrace, and by larger areas on both sides in the open valley north of Stroehles Hut (the area of The Branches Station). The surfaces of the terraces are up to 90 m above the river bed and, south of Stroehles Hut, they fall to the river bed, terminating in a bedrock cliff up to 30 m high. Elsewhere, particularly in the gorge between Skippers and Stroehles Hut, there are small alluvial deposits perched on cliffs up to 90 m above the river bed. All the alluvial deposits have been exploited for gold.

The main gold-bearing lodes are in the west of the catchment in the Stony Creek, at Bullendale on the slopes of Mount Aurum in the headwaters of Skippers Creek, and further north in the Flood Burn (Williams 1965: 51–52). The principal hard rock mining area was at Bullendale, which is accessed from Skippers. It is a subject in itself (Petchey 2006) and not readily covered by aerial photographic methods. There is a lesser lode at The Nugget on the Shotover River itself and others, poorly known, on the eastern side opposite Skippers and in the upper part of the Polnoon Burn.

The lodes on the aptly named Mount Aurum were especially rich. As they eroded during the Pleistocene (ice ages), deposits of gold-bearing gravels entered the Shotover and were worked into the bases of a series of deep terrace deposits. From Skippers Creek southwards, these are: Skippers itself, Burke Terrace (site of the Skippers School, still standing), Londonderry Terrace, Pleasant (once called Johnsons) Terrace, Stony Terrace and Wire Rope Terrace. They may have formed in the bed of a lake created by a large landslide further downstream. "The best of the gold is found at or near the schist bottom, and in the

layers of coarse wash that in places occur a few feet or a few yards above the bottom" (Park 1909: 96). The gravels were worked continuously for 40 years up until 1909. Together, these terraces extend for some 4 km along the floor of the Shotover and they vary in width from 200 to 500 m. There are minor terrace deposits further to the south.

On the upper Shotover, Hazeels Terrace, immediately south of the Flood Burn, is another similar important terrace deposit. The Flood Burn rises to the west in the lode areas to the north of Mount Aurum. Terraces formed on the other (east) side of the Shotover valley or from the outwash of the Polnoon valley appear to have been less rich in gold. An example is Muddy Terrace, which has only ever been partially exploited, suggesting that despite a large investment in races and dams, its proved gold resources were poor or difficult to exploit (too much fine silt loess on the terrace surface). The Shotover River bed itself, a natural riffle channel, has always been an important source of gold, not least in the initial rushes (Salmon 1963: 94–95). It has been the scene of some dramatic engineering endeavours such as The Nugget Battery, the Sandhills Cut and the more recent sheet-piled dam and flumed diversion at Maori Point. Except in the gorged areas, the surface of the river bed is mainly recent flood gravels and there is no readily visible surface archaeology.

HISTORICAL BACKGROUND

Shepherds Robert and Archie Cameron took up a land claim for the Shotover River country in 1859. In 1860 W.G. Rees took up a claim for the north-east side of Lake Wakatipu and, once settled, bought out the interests of the Camerons. Gold was found on the Shotover in November 1862 in the Arthurs Point vicinity (not far from Queenstown and downstream from the area covered in this research). At the beginning of 1863 the Shotover, "wild country, where the squatters had hesitated to drive their sheep, had been transformed into swarming settlements" (Salmon 1963: 88). Access was always rather difficult, and continues to be so. The gorges immediately north of Arthurs Point and Queenstown were impassable by foot or water. Access from Queenstown was either up the Moonlight and across Jones Saddle to the Shotover or more or less on the route of the modern Coronet Peak and Skippers Road. The first pack track followed the Long Gully valley floor more closely than the Skippers Road and swung north into the Green Gates Creek to avoid the bluffs at Devils Elbow and the crossing of Deep Creek. There was also a track and route from Macetown on the Arrow River across Advance Peak and down to the Skippers vicinity. The Skippers Road was constructed between 1883 and 1890 (http://www.historic.org.nz/Register/ListingDetail. asp?RID=7684&sm=advanced).

At the advent of World War I, mining ceased on the Shotover. There was mining in the late 1920s and 1930s involving diversion of the river through elaborate flumes at Maori Point and some dredging. In the 1980s a large hydraulic digger was used to scour the gravel flats and bedrock crevices of the river.

FIELD METHODS

Wernham and Doo, working as part of the Clutha Valley Development project, used historical records compiled by the late Peter Chandler to survey and record many sites in the area of this survey (records on file in the New Zealand Archaeological Association site recording scheme). Chandler's extensive manuscripts are in the Hocken Library with copies in the Lake Districts Museum. Wernham and Doo provide reasonable summaries of

Chandler's papers but his material is understood not to be referenced. It is probably derived from AJHR (parliamentary) and other Mines Department reports but it is difficult to be certain. There is still a large programme of work to be done relating historical documentation to the archaeology.

AERIAL PHOTOGRAPHY AND CONTROLS

There is a small number of conventional vertical aerial photograph runs of the Shotover and use has been made of New Zealand Aerial Mapping S.N. 842 R.N. 2289–2290 (1954), small-scale coverage S.N. 8996 E/23, E/24 (1998) and coverage by Geosmart ref. no. 644359–60 (2004). I first took oblique photographs of Shotover sites on 5 September 1995. I have subsequently carried out several further oblique aerial photographic runs. On 23 June 1996 trial vertical photographs on 35 mm film were taken of sites under partly melted snow at Macetown (on the Arrow River), Muddy Terrace and the Skippers area. For this project, on 28 April 2003 and 20 April 2006, selected areas were flown with a Bronica 6 x 6 cm (80 mm lens) at an altitude of 6100 feet or 4100 feet AGL. This gives an original scale (i.e., the scale on the negatives) of about 1:25,000 to 1:16,000, enlarged for mapping at scales from 1:1800 to 1:4300. This reveals greater detail than conventional vertical photographs (see Jones and Tanner 2002 for more details of methodology). Additional near-vertical colour photographs (12 March 2005) covered The Neck, Hazeels and the Bullendale area and further recent 6 x 6 cm verticals (20 April 2006) covered Hazeels, Deep Creek and the Shotover River gorge from the Stroehles Hut vicinity to the Nugget settlement area.

The field tasks carried out 13–25 March 2005 were designed to check details of the archaeological sites to enable controlled mapping from aerial photographs. Sites covered by the purpose-flown vertical aerial coverage were visited on the ground and GPS and tape and compass observations made of natural controls (ground features able to be distinguished on the aerial photograph), to geo-reference the photographs and enable reliable scaling and orientation of individual photographs. Single photographs can be joined and area maps made. This also allows the work to be registered on the New Zealand Map Grid. Some details of sites not visible in aerial photographs were also recorded, such as sluice gates beneath dams and other control mechanisms.

Almost all of the sites in the project area were visited except those on Stony Terrace, on the west side of the valley downstream from Wire Rope Terrace/ Sainsbury's Terrace, and the west side of the gorge between the Nugget area and Stroehles Hut/Terrace. Selected control points were observed using a Garmin GPS 12XL. The point features, visible in the aerial photographs, included intersections of races, fences, road edges and dams, particular bright rocks and the edges of buildings. Precision of the readings was ± 20 m, which is acceptable for mapping at the scales between 1: 1800 and 1: 4300 used in this paper. Errors were calculated by comparing scales calculated between up to four different points on the one photograph or juxtaposed photographs. In addition, some site features were given relative controls by measuring the length and compass bearing between control points or along particular lengths of bank or fences recognisable in the photographs.

Throughout the area there is a number of amorphous ruins of walls/fences or buildings. I have chosen to describe these as 'sod walls/fences' or 'sod huts', meaning that they were originally constructed of large blocks of silt topsoil with the grass or grass roots intact. The alternative, building in sun-dried mud bricks or cob, seems less likely. 'Soddies' are commonly referred to in nineteenth century writing. Rabbits or a "lively family of rats could soon make a ruin of a sod hut… " (Beattie quoted in Orsman 1997: 756).

METHODOLOGY FOR WATER RACES AND DAMS

During the survey, special attention was paid to recording water races and dams.

The surface and subsurface sections (where the latter could be observed) of selected water races were recorded by placing a ranging pole vertically in the race and then measuring horizontal offsets to the sides of the race. Gradients were measured to a precision of ± 2 cm over distances of 30–100 m using a dumpy level. Using the formulae in Gordon's (1894: 259–264) *Mining and Engineering; and Miners' Guide*, combining measures of the 'hydraulic section' and gradient, it should be possible to determine the volume of water supplied per unit of time. However, when I calculated the volumes using my field data, the results were wildly too high. Head races were quite often steeper than allowed for in the *Miners' Guide* tables (Gordon suggests a maximum gradient of 16 feet per mile or about 1:300) and there was an obvious discrepancy between the modern surface profile and the original profile of any particular cross-section. Furthermore, I observed aerial photographic and field evidence of many instances of 'blow-outs' where water in races had been deliberately let out to races at a lower level or to dams. On Muddy Terrace the base of races exposed in section at the top of the working face showed considerable infilling and contained lenses of gravel. This can only have been sorted and carried there by fast-moving water. Control, maintenance and cleaning out of races would therefore have been a constant duty. No results are presented for this aspect of the fieldwork apart from the descriptions of the race gradients on Muddy Terrace and the Pleasant terrace outlier (see below). All the races measured were head races. Supply races would be big, lasting investments and would require meticulous planning and execution according to the prescriptions in the *Miners' Guide*.

The distinction between a dam and a reservoir has sometimes been laboured over by archaeologists. The relevant definitions might be drawn as follows. A *dam* is an earthwork bank constructed to hold water. It will usually have entry or supply races coming into the area behind it and there will be control structures in the bank where the water was drawn out of the reservoir into the head races. Usually, a dam is the only remnant recorded in archaeological survey. A *reservoir* is the body of water contained by the dam and may also have an implied reference to the dam itself. The *reservoir area* may be determined not only by some traces observable archaeologically, such as a strandline or the termination point of the supply race, but also by observing an inferred water level at a specific height below the dam crest and mapping where that level intersects the slope plane uphill from the dam (i.e. the inferred shoreline). That gives both the perimeter and the area of the reservoir; water volume stored can be calculated from the area and surveyed or averaged depth.

On the Shotover, most dams are built on sloping terraces. There is only one dam known to survive in a river bed (the Skippers Creek dam) but others, long destroyed by floods, may have existed, especially at the intake point for supply races. An example in The Amphitheatre area is discussed later in this paper. The Skippers race supplied the Skippers, Burke, Londonderry and Pleasant Terraces. Figures 2, 3 and 4 show examples of dams and the inferred reservoir areas.

To calculate the volume of reservoirs, the plan of the crest of dams was recorded off the calibrated aerial photographs. Because it does not determine the upslope boundary of the water body, this simple plan will not give an indication of the area of the water held in the reservoir. (Sometimes this could be determined from the photographs — e.g., where the area of the reservoir had been excavated out to put into the dam wall or where supply races peter

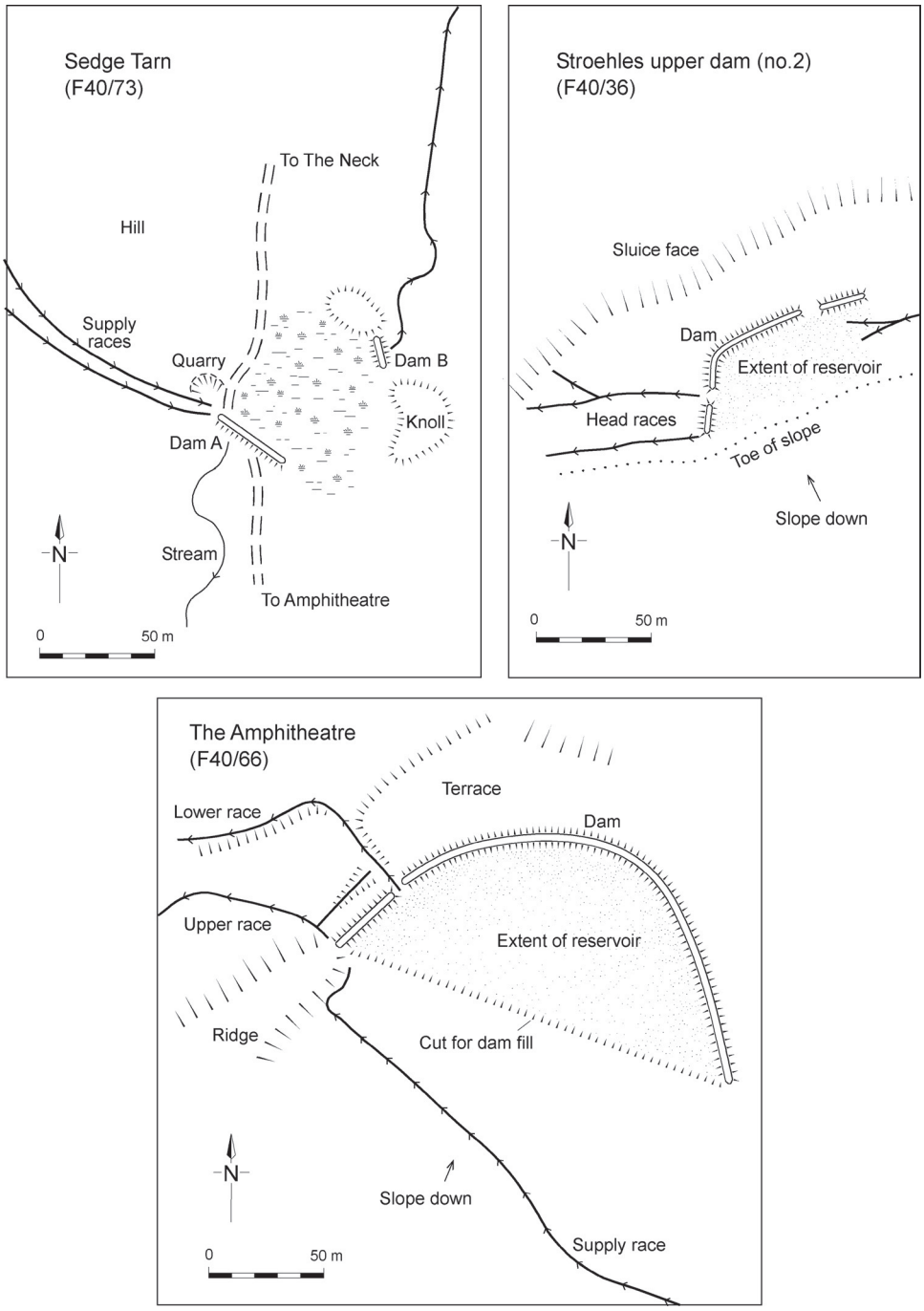

Figure 2: Examples of smaller dams in the upper Shotover River: Sedge Tarn, Stroehles no. 2 and The Amphitheatre. All site plans are based on the purpose-flown aerial photographs mentioned in the text.

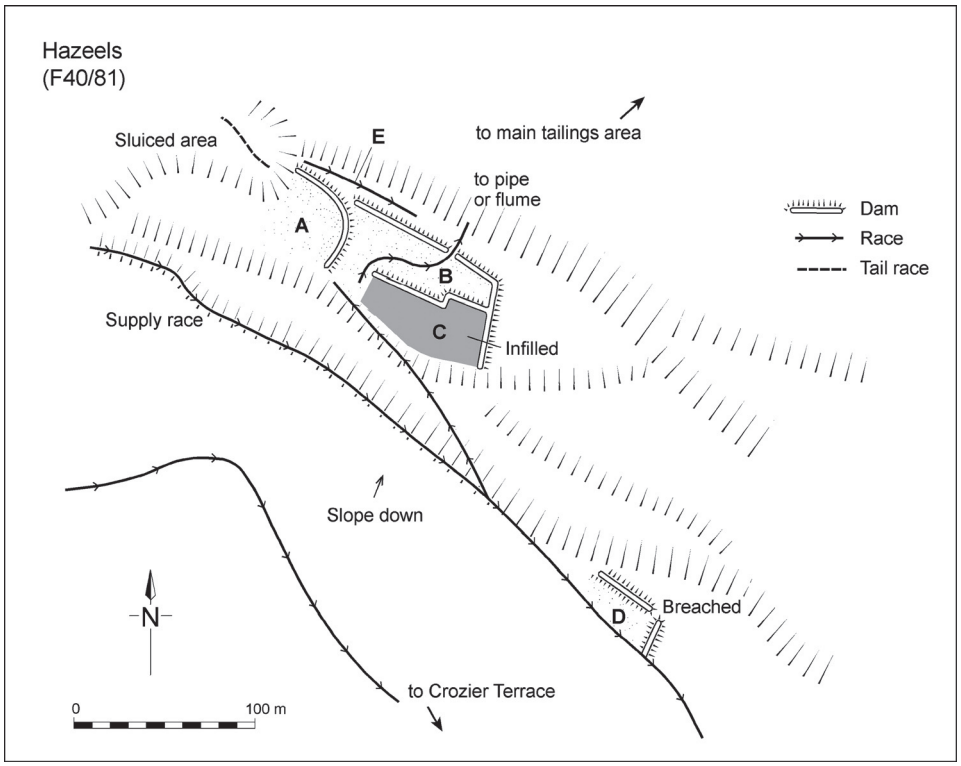

Figure 3: Example of a larger dam complex: E40/53 within the larger Hazeels complex (F40/81).

out as they enter the reservoir or skirt around it.) To make up this deficiency, distance, bearing and level of various points on the dams and the area behind (upslope) were measured using a dumpy level and prismatic compass.

Behind large dams, 200 m or more long, the reservoirs would be subject to reasonably choppy waves in high winds. No risk would be taken of a breach at the top of a dam because, once started, it would not have been easy to stop. For large dams a maximum operating height was assumed to be 60 cm beneath the crest; the water body behind would be at or below this level. (This is much less than the safety margin suggested by Gordon (1894: 251) who recommended a height above water level of 10–12 feet (3–4 m) for a dam crest with exposed water of 20 chains (approximately 400 m). However, as I have noted elsewhere, Gordon's advice seems to be remarkably conservative when examined against generally small and informally engineered projects such as those of the Shotover. I also observed that there may have been some settling and erosion of dams and dam crests, since the levels along the crest varied by up to a metre, generally less, so this also may need to be allowed for. Using these data, the contour of the depth of water was graphed at 20 cm intervals and summed graphically using squares of known area (from the survey plan) and constant depth. The cumulative error of these methods is estimated to be ± 15% of the volume.

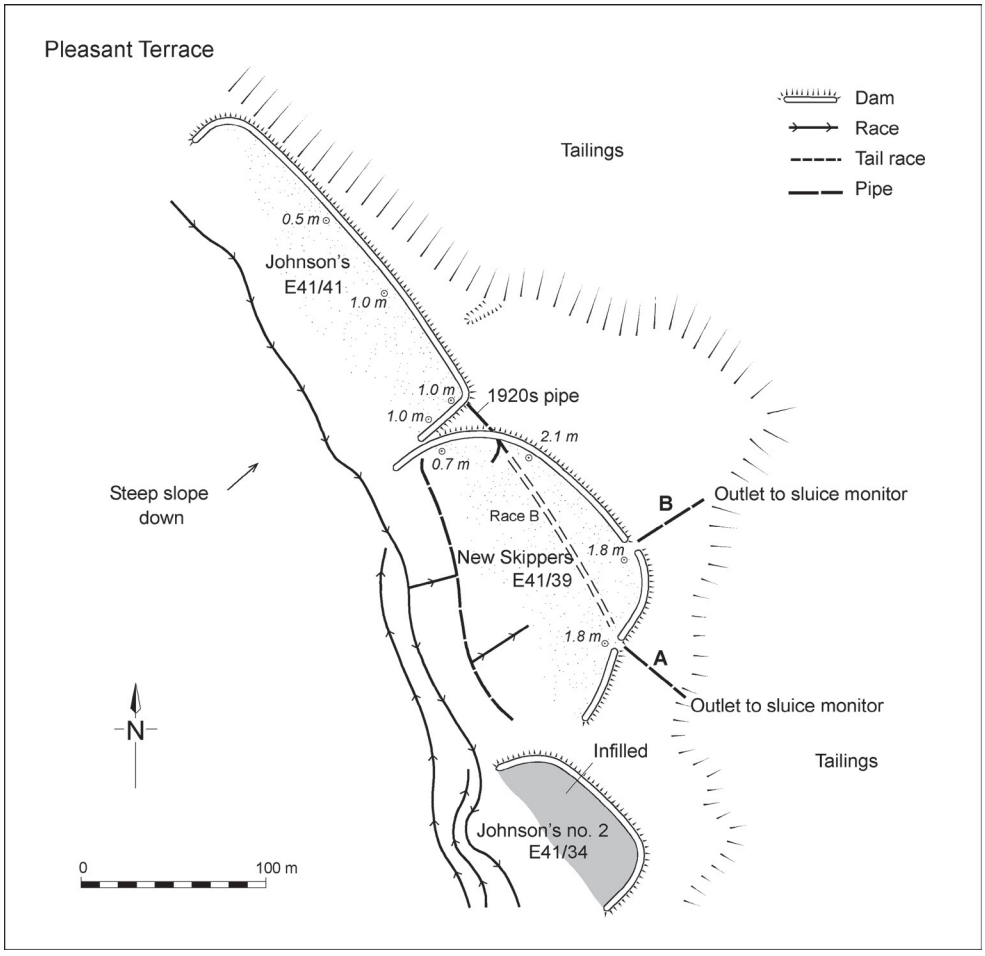

Figure 4: Example of a complex of larger dams: three dams on Pleasant Terrace.

RESULTS (1): SITES BY LANDSCAPE AREA

The field results are arranged by named area from north to south (see Fig. 1). Not all areas are illustrated.

SHIEL AND POLNOON BURNS

The surface of The Neck is a Pleistocene-era palaeochannel between the Shiel and Polnoon Burns (Fig. 5).[2] The Shiel Burn is in a precipitous gorge which comes from the north and

[2] The Neck, The Island and The Amphitheatre (discussed below) are official topographical names, probably of long-standing use on The Branches Station. They appear on the NZMS 260 Wanaka map, F40.

then turns west into the Shotover River. The Polnoon Burn, steep-sided, comes from the east and then turns and runs south to the Shotover River. The two burns come close together at The Neck but do not meet. The vicinity is mainly known for the tunnel (F40/17) completed in 1934 which takes water from the bed of the Polnoon Burn out on to the precipitous wall of the gorge of the lower-lying Shiel Burn.

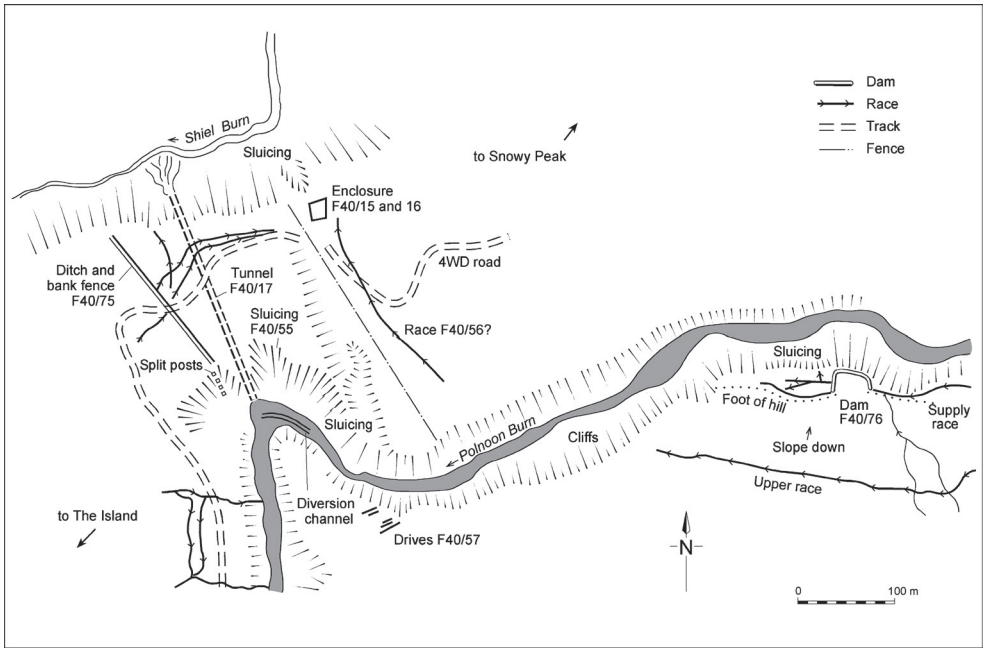

Figure 5: The Neck area, Polnoon Burn.

A ditch and bank enclosure (F40/15, 16) lies at the far north-east corner of the low-lying area of The Neck and about 15 m east of the northern end of a post and wire fence and gate. It had earlier been recorded as a dam. A puzzling site which is difficult to interpret, it is not a dam since the crests of the banks are on a slope and the enclosure would not have held water. The site is a more or less rectangular ditch and bank enclosure but the eastern side is more open and appears to have drawn in a race from further up the terrace. There are also banks on the terrace at the foot of and at right angles to the base of the hill. A simple interpretation might be that this is a huts grouping with an attached garden enclosure and that a race has been let into the enclosure for watering a crop. Alternatively, the races may be a modification of a pre-existing ditch and bank enclosure. Races may have been used to create the small possible area of sluicing immediately north of F40/15, 16.

A ditch and bank fence (F40/75) runs across the narrowest part of The Neck more or less parallel to the line of the Polnoon diversion tunnel and 50 m to the west. The fence is 175 m long and straight (i.e., not curving to follow the contour). The feature is 80 cm from top of bank to outer edge of ditch and 40 cm from base of ditch to top of bank. In its original form it may have been a high sod fence with an adjacent ditch. At its ends there are steep impassable slopes to the Shiel Burn and to the Polnoon Burn. At the latter (south-east) end it has been supplemented at some stage by a split-post fence down a sluice face (F40/55). Corresponding in function to the modern post and wire fence further to the east, this ditch

and bank fence undoubtedly controlled stock movement from The Island through The Neck to the high country to the east (Duries Peak and Snowy Peak). The ditch is to the south-west of the bank, i.e., on the side where sheep would be contained in autumn in anticipation of snow on the tops.

There is a dam (F40/76) about 500 m up the Polnoon Burn from The Neck on the true left side and 30 m above the river bed. The bank is hockey-stick shaped in plan, 31 m long on the outside, 20 m across the face, forming an enclosure on the terrace and at the foot of the hill with an average depth of about 1.6 m. An overflow takes water to a race which follows west around the foot of the hill. A head race runs from the western face of the dam to a small area of sluicing about 40 m to the north-west and above the river.

The Polnoon Burn has a number of wing dams in its bed, a substantial diversion cut through bedrock and a number of holding dams, races, ditch and bank enclosures and tailings on the small terraces on either side. Wing dams were built in creek beds to divert water away from areas that were being searched for gold. They consisted of lines, sometimes double lines, up to 15 m long, of 40-cm-wide schist slabs stacked horizontally on their edge, flat surface to flat surface. A similar arrangement is sometimes seen finishing the top of schist stone walls. Some, lasting through a century or more of floods, are surprisingly stable.

A dam (F40/14) (not in figures) is on the slopes on the true right of the Polnoon Burn just below and visible from the 4WD track and 250 m downstream from the tunnel entrance. It is approximately 50 m long and 20 m wide at its maximum; it is curved in plan and has a mean depth of about a metre. A companion dam (F40/74) about 700 m south of the The Neck is similar in its general form and setting. The dam, its south wall cut through by the 4WD track, is a substantial bank up to 2.5 m tall forming a dog-leg in plan, 55 m along the general run (north–south) of the contour; the south wall is 16 m long. Average depth is estimated to be 2 m.

A ditch and bank enclosure (F40/72) (not in figures) is on the true right of the Polnoon Burn, below the 4WD track, and 400 m north of the Sedge Tarn dam complex. The site appears to be a miner's residence with a mined area nearby. The ditch and bank enclosure is rectangular and 16 x 8 m in plan. The sluicings are to the north-east of the enclosure. They are fed by races coming from the north and probably from the Sedge Tarn dam complex (see below). The sluicings and tailings cover an area of about 2 ha and there are more on the opposite (true left) bank of the stream. On the edge of the sluiced area is a peculiar banked enclosure, oval in plan and about 7 m in diameter. It is not unlike a Victorian puddling pond (see 'puddler' in http://etext.teamnesbitt.com/books/etext/etext03/ggold10.txt.html; for New Zealand usage, see Orsman 1997: 639). Puddling was necessary when the gold was found in hard clay unsuitable for conventional washing.

F40/52 is a hut, tailings and wing dam complex on a prominent bend in the Polnoon Burn about 2.5 km south of The Neck (Fig. 6). The hut is in the midst of an area of tailings on the point (true left of stream) under a single large poplar tree. The wing dam is in the stream bed west of and adjacent to the hut and is about 25 m from the true right bank. The enclosure is a rectangular stone wall, 2.4 x 4.8 m in plan, with a yard and the hut inside. The hut is formed by an internal wall and doorway within the enclosure and is about 2.4 x 3 m in plan. There was a small enclosed porch or an open yard on the hut's northern side. Broken bottles found in the vicinity of the hut were: (1) base with 'NB994', whisky bottle, age post-1900, (2) base and body portion, champagne/beer late nineteenth/early twentieth century age, (3) top/neck portion, beer or similar, applied lip, age pre-1880s (identified by Warren Gumbley pers. comm. 2005). They pre-date by many decades the building of the

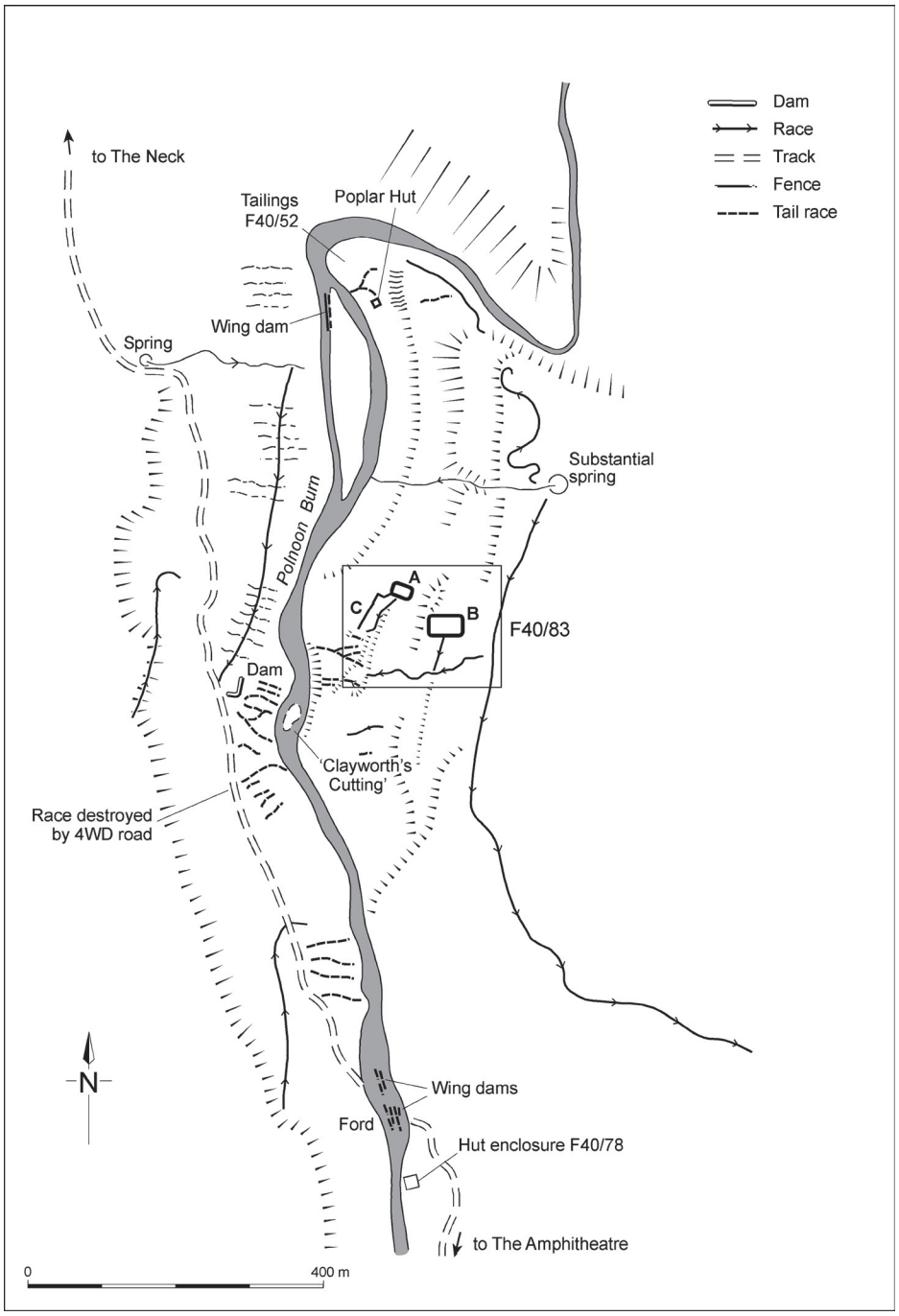

Figure 6: The middle reaches of the Polnoon Burn above the ford. See Figure 7 for detail of F40/83.

tunnel at The Neck so, even allowing for a long period of re-use, there must have been extensive attempts at goldworking in the Polnoon over some period in the nineteenth century. There is no particular evidence that the workings were carried out by Chinese, but that is possible.

The tailings are amorphous but cover all the lower surfaces of the point. The water supply is from races coming from a prominent spring 350 m south-east of the point. The race can be traced in places. The wing dam is formed of two lines of stones (each line has two courses of stone). It is about 10 m long at its best preserved section (it may have been much longer).

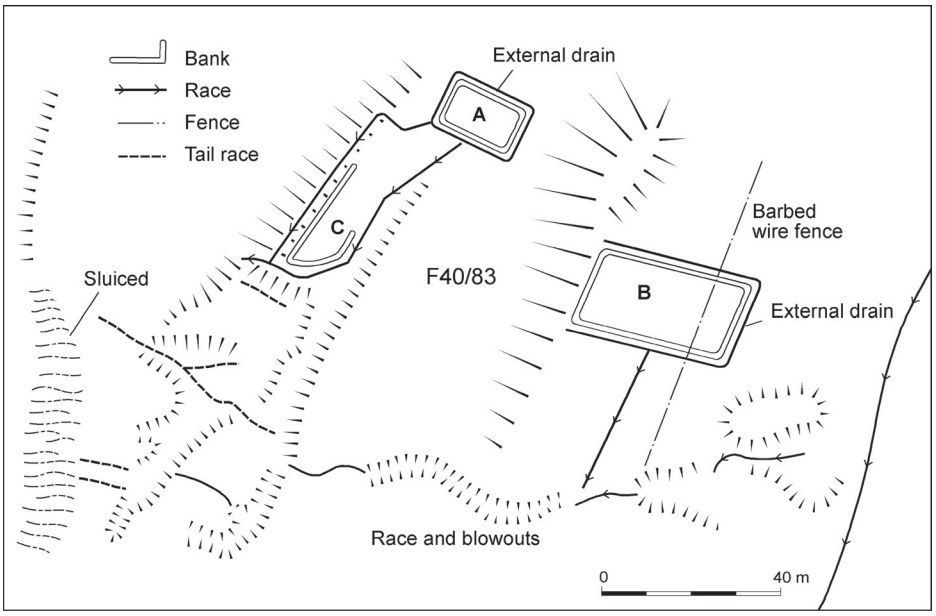

Figure 7: Detail of enclosures (F40/83) on the west side of the Polnoon Burn. See Figure 6 for location.

There are ditch and bank enclosures on either side of the middle reaches of the Polnoon, 400–700 m north of the 4WD ford across it (Figs 6, 7). On the true left of the Polnoon on several rather indistinct terrace levels is a notable complex (F40/83) with a focal point on the ditch and bank enclosures (A, B) and terrace enclosure (C). Enclosure A is 12 x 20 m in plan with an exterior ditch. Enclosure B is a parallelogram in plan, 46 x 21 m. Both enclosures have a drain running off to the south which may have been deliberately fed into the head races. Area C is difficult to interpret; 36 x 18 m in plan, it is probably a domestic enclosure. Enclosures A and B were presumably for holding stock or protecting yards or gardens. South of the suggested domestic enclosure C is an area of tailings supplied by a downslope race with many blow-outs. The latter was fed in turn from an upper level race which follows the contour to a substantial spring 300 m to the north.

The western side of the Polnoon in the same vicinity as F40/83 has a much wider area of tailings and finely spaced tail races. A dam supplied from a race about 400 m to the north is the focal point. The dam is 20 x 7 m and dog-leg in plan; average depth is about 50 cm. There is a further area of tailings to the south (200 m upstream from the ford) fed by a

separate race. The western area of tailings all seems to be in a naturally wet place with possibly natural gullies not dissimilar to tail races running down the slope. They cut through the prominent western race. They may be best interpreted as natural gullies enhanced by the miners to check for the gold-bearing properties of the gravels. However, there are no obvious areas of tailings. Also on the west bank there is a prominent cutting through bedrock, 'Clayworths Cutting', which is perhaps 2.5 m wide at the base and 50 m long, to divert the Polnoon from a natural deeply incised channel in the bedrock.

The Sedge Tarn (F40/73) (Fig. 2) is a modified lakelet on the 4WD track, 300 m north-east of Lindsay's Tarn. A dam has been placed over its natural exit (A) and a further control dam (B) across a small valley to the east which forms the channel through which water was taken to sluicings on the western side of the Polnoon. There is a control structure on dam B and a race leads out to the east and north from there to the areas near the Polnoon ford. On the north-west end of dam A is a small quarry in the hillside, used for the dam. The supply races (two) enter the dam here and come from a spring/gully about 300 m to the north-west.

A hut with a stone wall and ditch and bank enclosure (F40/78) (Fig. 6) is about 100 m south of the Polnoon ford and on the true left side immediately above the stream bed (Jones 2007b: 57 centre). The site appears to be an enclosure extended out from a hut constructed where there is natural shelter below some large bedrock outcrops. The barrier formed by the bedrock has been enhanced by schist stones stacked in a line on their edges with the flats contiguous, similar to a wing dam. The stone barrier is a continuation of a sod wall or bank and ditch enclosure and on the north side a steep natural bank, which together enclose the main stream bank. The overall size of the enclosure is about 25 x 15 m or .04 ha.

Overall, in the Polnoon, many of these features — the ditch and bank enclosures and the settlements they represent — date back to the 1860s. Bottles from the 'Poplar Hut' and tailings complex (F40/52) and a number of ditch and bank enclosures suggest that the sites recorded in this area represent goldmining of an era well before 1934, when the stream was diverted through the tunnel at The Neck. The ditch and bank fences will date to the period before 1880.

THE AMPHITHEATRE

The Amphitheatre (F40/66) dam and race complex is on the northern and lowest of the broad terraces constituting the hill country west of the middle and upper Shotover River and south of the Polnoon Burn. The dam is shown in Figure 2. A large shallow reservoir area (average depth about 0.6 m) has been made by a bank forming a hook shape in plan. On the upslope (south) side the slope has been dug into for fill for the bank and to extend the area of the dam. The upslope cut is about 150 m long and the maximum width of the enclosed water was about 65 m. The supply race comes from the eastern side of The Amphitheatre (from the same source as that of The Branches Station electricity generator). There are two exits, one at the foot of the hill to the south (upper), where it fulfils Gordon's (1894: 250) recommendation that such outlets should be cut in 'solid ground' (i.e., not through fill), and a lower exit which made full use of the water in the dam. The upper race could be diverted into the lower just north-west of the dam, perhaps at times of peak supply of water to the dam when the overflow could be routed into the lower race. The aerial of 12/3/05 shows that the races peter out some 200 m to the south, over the edge of the slope down to the Shotover River. There is an unusual race or perhaps a ditch holding a pipe

(now removed) which has been cut directly down quite a steep slope, perhaps to work sediments on the flood banks of the Shotover itself.

In the course of the survey, The Amphitheatre supply race was the only one that we traced back to its source. Part of the original supply race has been maintained for The Branches Station generator sited to the east of the floor of The Amphitheatre. This race curves around the high terrace forming the southern margin of The Amphitheatre and can be traced back to a low sill dam built at the exit of a bedrock cleft in the stream bed (at about GR F40/724007). Water is piped a short distance from the dam into a race. It has probably been maintained from the original nineteenth century structure and may be a model of what such intakes were like. Apart from the infilled Skippers Creek supply dam (which is a properly engineered concrete structure some 8 m high, built in 1934–1935 according to site record E41/53), in all of my experience I do not know of any other surviving supply-race intake in the Shotover. They are often remote and would always have been vulnerable to flood damage.

FLOOD BURN/HAZEELS TERRACE

The main Hazeels complex (F40/81), on the true right Pleistocene outwash plain of the Flood Burn, is a medium-sized area (12 ha) of tailings with associated settlement, races and dams (Figs 8, 9). The site area steps down through eight to ten Pleistocene terrace levels. To the east there are three major north-south tail race areas, while on the west the tailraces are shorter and drop to the Flood Burn. There is generally more intact terrace area at the western end. The main area for settlement (F40/50) was on the lower terraces above the Flood Burn. The upper (southern) edge of the sluicing presents a distinct pattern of small (20 m long), evenly spaced gullies (11 m apart). This pattern appears to have developed from a rake-like plan of head races, one parallel to the slope and the others (tines) leading off down the slope in sequence (see G on Fig. 8). There are no races leading to the head races from the dam complex (E40/53), so the water must been piped or flumed into the short lengths of race running across the head of the planned sluice area. The terraces have a slight slope down to the south (towards the risers) so that water could not be brought up to the northern edges by races. The eastern aspect of the terraces appears to be naturally eroded by wind from the north.

The hut sites/settlements and dams at Hazeels have been recorded as separate sites. An outstanding group of hut sites and ditch and bank enclosures (F40/50) lies on the modern flood plain amongst willows and also on the first Pleistocene terrace level (Fig. 8 detail). An area about 80 m in length occupying the full width (13 m) of the lowest terrace has been enclosed in three main segments. The most salient is at the western end where a ditch and bank runs up the terrace riser and on to the second terrace. The western end of the enclosure has been sluiced away but it was a minimum of 25 x 30 m in area. On the north-east corner of this enclosure is a rectangular excavated area (H), 8 x 10 m in plan, probably a hut floor, abutted against the eastern bank. Adjacent (to the east) is a ‘yard’ (I), about 18 x 13 m, enclosing the full width of the terrace. It has indistinct banked structures at its western end. On the farthest eastern end is a further ditched or drained enclosure (J), 21 x 13 m in plan, with a bank running across the terrace at its eastern end, which may be a garden. Features I and J are probably incremental increases in the enclosure of the terrace since they appear to be banked at the eastern end only. A path runs down the forward (northern) face of the terrace from enclosure I to the previously recorded hut chimney (F40/50, the number adopted for the whole complex).

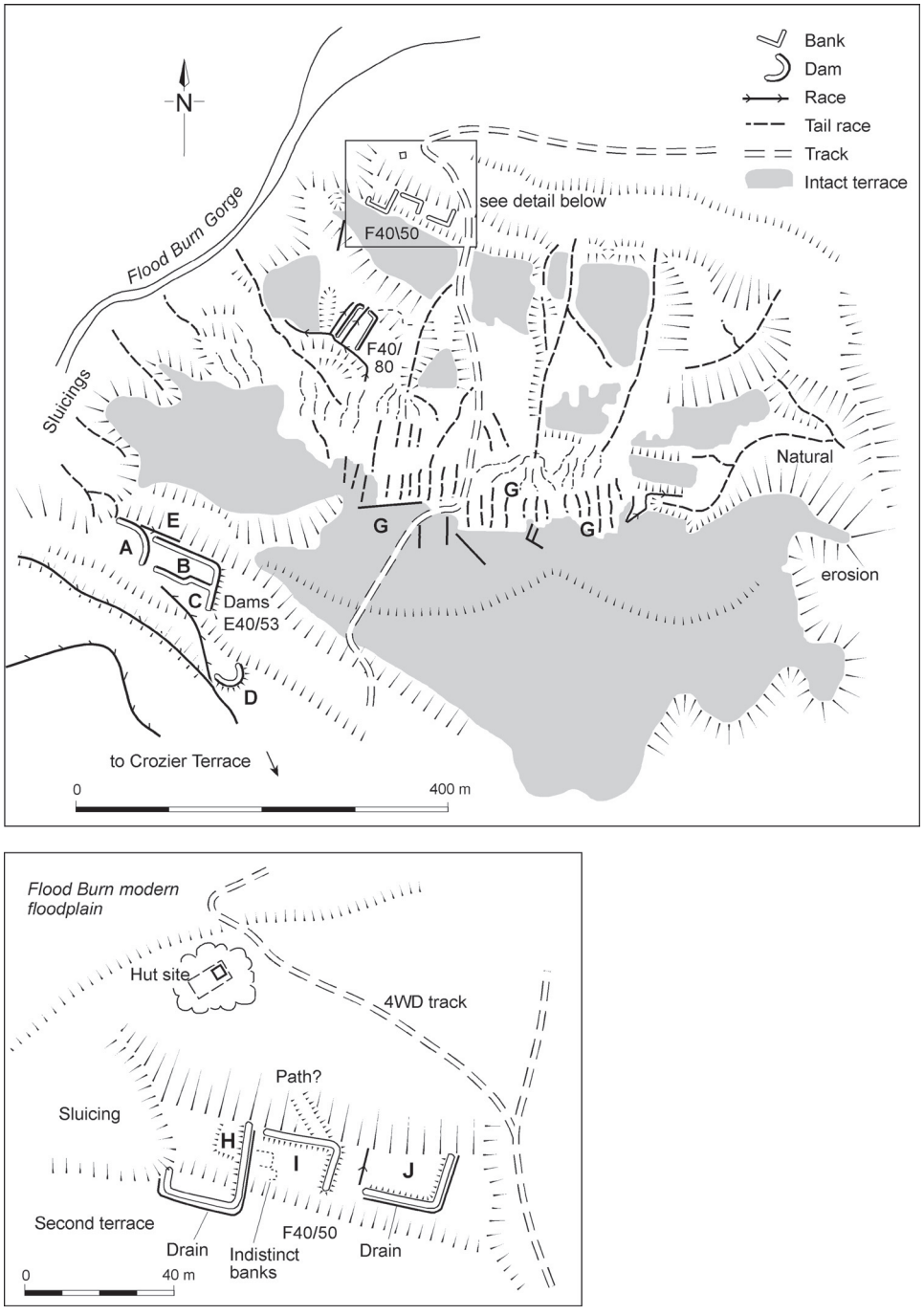

Figure 8: Plan of Hazeels Terrace and detail of the domestic enclosures (F40/50). See Figure 3 for details of the dam complex.

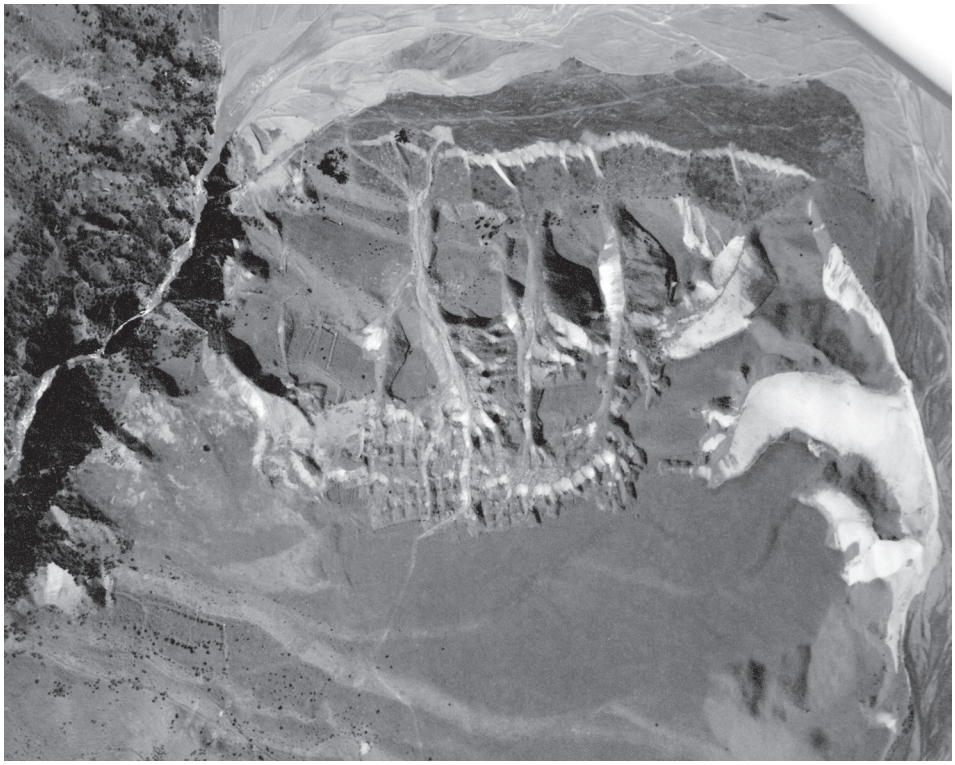

Figure 9: Near-vertical oblique aerial photograph (12 March 2005) of Hazeels Terrace. North is at the top.

The dams (E40/53) are on the far south-western part of Hazeels Terrace on the top flights of the terraces of this area and directly above the debouchment of the Flood Burn (Fig. 3). This is the most accessible and highest level ground that could take water from supply races coming from further up the Flood Burn. The site consists of a complex of dams, two adjacent (A, B-C) on one terrace level and a third (D) on a higher terrace level 150 m to the south-east. Dam A, part C of dam B-C and dam D have all been infilled by race wash. A is oval in plan. Dam B-C has an interior bank designed to stop it filling completely with the race wash, thereby retaining some water storage capability. It is more or less rectangular in plan, 90 x 43 m; its greatest depth is 1.2 m. D is approximately 50 x 30 m in plan and has an ancient breach in the north-east corner. The dams are fed by the lower of two supply races (the upper leads around to Crozier Terrace to the south). There is an exit structure but not an exit race from B, suggesting that water must have been carried from there by pipe. A may have been used for the adjacent sluiced area. There is a length of earlier (?) race (E) parallel to the A B-C dam walls which has been carried down the forward scarp.

The last of the dams (F40/80) lies on a remnant of an intermediate terrace 130 m to the north-west and about half way up the 4WD track where it rises through the terraces (Fig. 8). It is more or less rectangular in plan with one edge butted against the terrace riser to the south. The dam is about 37 x 15 m in plan and was 0.3 to 0.6 m deep. Side races were taken along the outside of the north-south banks and there was a race built on the floor of the reservoir area through an apparent breach of the dam on the north side, i.e., a late use

when the reservoir was empty. It appears to have fed an area of sluicing to the north and the side races must have fed the amorphous ground sluicings adjacent and to the north.

Dam (F40/61) (not in figures) is on the easternmost ridge (nearest the Shotover River) above the flood plain on the true left of the Flood Burn outwash plain and about 100 m above the stream bed. It is a single dam created by a bank across a mild slope with a return at each end. The bank is 66 m long, the northern return wing 12 m and the southern 27 m. Fill for the bank has come from hollowing out the reservoir area (marked by a depression). The depth of the reservoir varied from 1.4 to 1.7 m. There are outlets to the north and south. The southern one is marked by a race that ceases at the top of the slope down to the river and water must have been taken away by pipe. The northern race can just be detected on the aerial and appears to have led to a small area of sluicing in a gully 130 m north-east of the dam. There is a prominent ridge with eroding slopes to the east of the dam; the slopes on first glance appear to have been sluiced. The crest of the ridge is actually higher than the dam crest, so water could not have been taken to it for sluicing. The erosion is on the northern side, exposed to the north-west winds, and thus was probably caused by the action of wind and rain, as were the slopes on the eastern end of Hazeels Terrace.

IRONSTONE CREEK AND MUDDY TERRACE VICINITY

There are two main areas of terrace here. The Ironstone Creek terrace dams (F40/69) are located in the far north-east of an irregularly surfaced terrace suite, immediately above and on the true left of the Stockyard Creek and about 700 m east of the Shotover (Fig. 10). To create a reservoir, the two dams had to be built across a fairly level Pleistocene palaeochannel constrained by bedrock on either side; the water was contained between the two dams. A major race comes in from the north-east from the Stockyard Creek and appears to have fed the reservoir between the dams. This race continues on south at a high level and eventually must have been carried over the Ironstone Creek by flume or siphon. A lower race comes out of the south dam wall and fed a small area of sluicing on the far south-west of the terrace complex. Further afield on this terrace suite, there is an additional high-level race which shows on my oblique aerial photograph but not on the vertical coverage. There is an area of erosion on the north-west faces of the terrace complex but it is not fed by races and appears likely to have resulted from a combination of unstable ground at the terrace edge and the action of wind.

To the south, the Muddy Terrace complex (F40/41) covers all the northern part and north and west edges of the terrace country between Ironstone Creek to the north and Muddy Creek to the south. The focal features are the two dams in the north-east part of the terrace, the *upper* (earlier) and *lower* (later) dams (Fig. 10 detail, Fig. 11 vertical aerial photograph). The *upper dam* was built over a rectangular ditch and bank complex. This dam has a hockey stick outline in plan and is about 140 m in its longest dimension, formed by a substantial bank about a metre high at its maximum. The exit is marked by stone revetting on the inner dam face and through a gap in the dam wall and a stone-lined race outside the bank. No signs of a control structure such as a gate are visible. This dam was fed by races and a substantial spring on the slopes above (showing as a dark mark on Fig. 11). The races probably came from up Ironstone Creek. The upper dam appears to have fed head races leading to the sluice faces on the northern side of the terrace. Some water may also have gone in small races (showing as very thin and spidery on the aerial) to the south-west. These races may have been for proving ground in an earlier phase but were never enlarged.

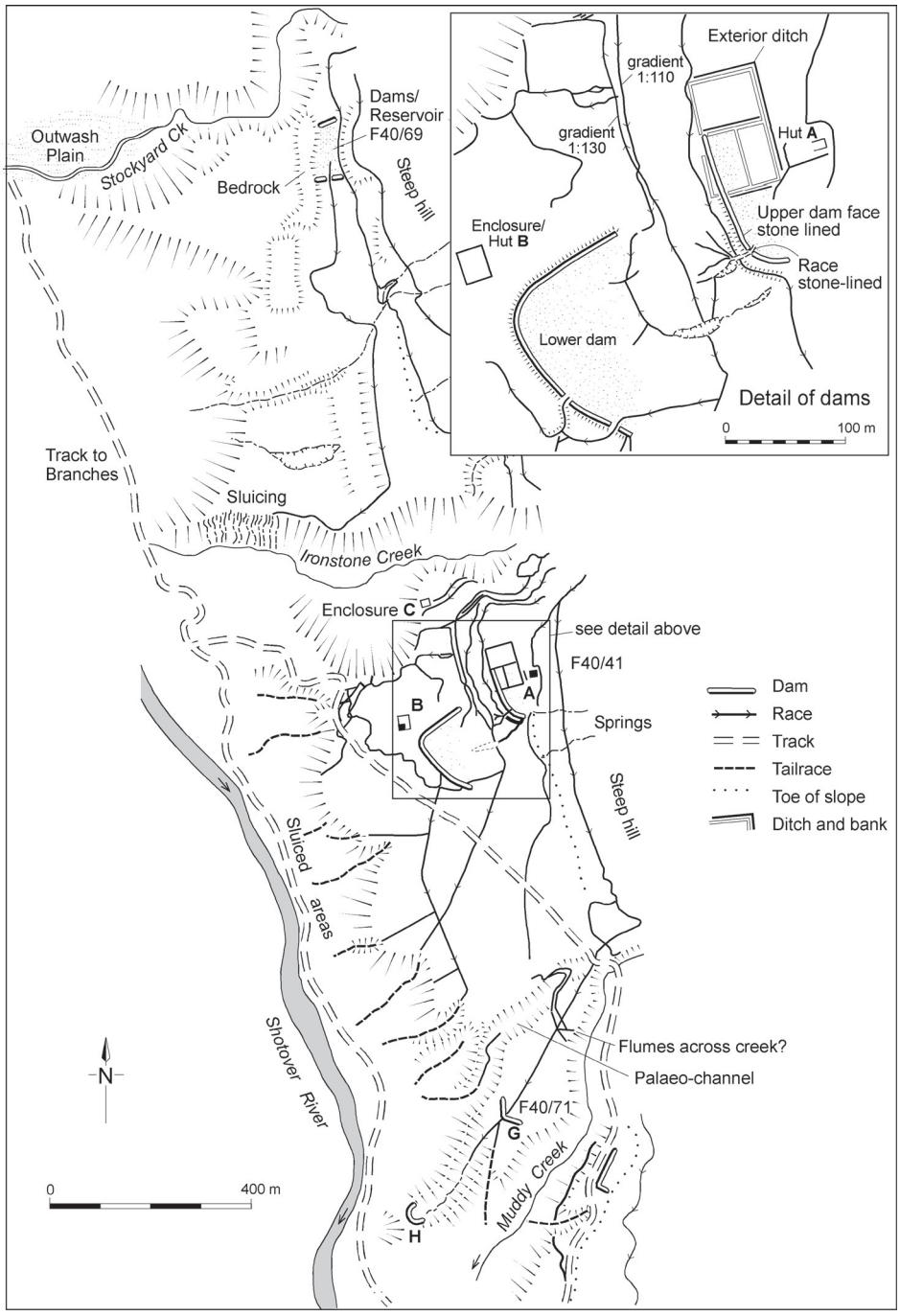

Figure 10: Muddy Terrace and Ironstone Terrace, with detail of F40/41 on Muddy Terrace.

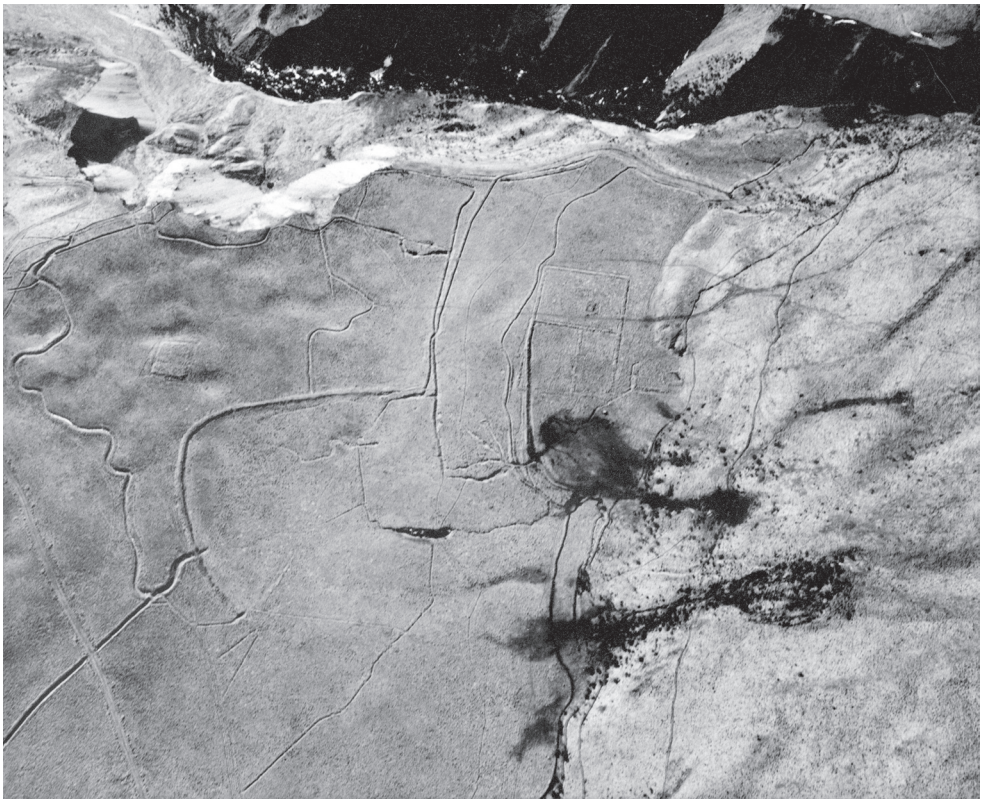

Figure 11: Vertical aerial photograph (28 April 2003) of the upper and lower dams on Muddy Terrace (F40/41).

The *lower dam* is boomerang-shaped in plan and about 160 m across at its widest point where the bank enters the slope of the terrace. It has several exits, some of which appear to be merely races run through the dam when it was empty. It was fed by the races that fed the upper dam via a circuitous series of falls and also a major race that must have been fed by a siphon or flume from the terrace country to the north of Ironstone Creek. Just above the dam two supply races had average gradients measured over about 120 m of 1:110 and 1:130. The lower and later dam fed races that went to the north-west of the terrace and all points to the west and south-west. Both dams were fed by a head race which takes in prominent springs at the foot of the main hillslope to the east (see Fig. 11).

There are three ditch and bank fence enclosures on Muddy Terrace (Fig. 10). The most prominent is a large multiple enclosure built over by the upper (earlier) dam. Overall this is some 92 and 98 m on the long sides and 55 m at either end. The earliest part is probably the southern part since this has an external ditch and bank on its north side enclosed by a further ditch and bank. This earliest enclosure may have been a house yard. The northern enclosure has an amorphous mound within (see Fig. 11) which may be a sod hut, so this may also have been a domestic enclosure. At the foot of the hill there is a further fairly amorphous cut into the base of the slope (hut A) with drains running around and away from it. These probably domestic enclosures are the earliest features on the flat and have a more pastoral appearance/function than a goldmining one, or they may have been both.

Hut B (Fig. 10 detail) is another domestic enclosure. It has an irregular quadrilateral plan (30 x 26 x 27 x 27 m in plan) with an elevated central area and a further indistinct ditch and bank within. This seems likely to have been a sod hut within a ditch and bank enclosure, possibly re-built in phases, and now much reduced. Enclosure C to the north was noticed on the vertical photograph after we left the field. It is on a lower terrace segment to the north of Muddy Terrace (part of a late Pleistocene outwash plain of the Ironstone Creek). It is 13 x 10 m in plan and is associated with two races abandoned early in the sequence of sluicing on the north face of the terrace.

The surface profiles and subsoil sections of selected races on the northern working face of Muddy Terrace above Ironstone Creek were recorded (not in figures). These sections suggest that the original races had a base about 50 cm wide and were 35–45 cm deep, cut through a grey silt loess (hence 'Muddy Terrace'). The races had been much eroded and infilled and it was difficult to distinguish fill from the original silts. Only the distinct lenses of gravel wash at the bottom of the races gave an indication of depth and width.

Muddy Terrace south (F40/71) has been recorded as a separate site on the far south-western lobe of Muddy Terrace. The lobe is cut off or marked by a palaeochannel of Muddy Creek. Races come down on to the lobe from the upper races on the hillslope above Muddy Terrace. The palaeochannel itself has a race running across its head derived from the upper dam of the main Muddy Terrace complex (F40/41). This appears to have been made to overflow into the channel and was then gathered into a race at the bottom of the channel. A similar situation appears to have occurred between dams G and H. Dam G forms a boomerang in plan and the reservoir had a maximum depth of 1 m. It has been constructed by throwing up the bank from a ditch on either side. The lower dam is a semi-circle in plan, again thrown up from a ditch, and has an average depth of 90 cm. These dams and races fed sluice faces on the western end of the palaeochannel and around to the south-west of the lobe.

STROEHLES TERRACE

These dams and sluice faces (F40/36) are on the true left bank of Stony Creek on a point on the highest terrace level about 140 m above the Shotover bed. The site consists of two dams linked by a major race from the upper (no. 2) (see Fig. 2 upper right) to the lower (no. 1) dam. The lower dam is about 30 x 15 m in plan; the upper about 60 x 25 m in plan. There is a minor area of sluicing above Stony Creek north-west of the upper dam and races are fed to it. The main area of sluicing is on the point which leads down west to Stroehles hut and this appears to have been mainly fed by the lower dam.

THE NUGGET

The Nugget lode mines, settlement and battery (F41/20, 21, 23) (not in figures) are a late nineteenth century hard rock mining complex on a small area of heavily reworked terrace on the true right of Shotover, 1 km upstream of Cape Horn/ Skippers Creek. It is the only hard rock mining complex on the Shotover valley floor. A formed road, still largely intact, leads to and from Skippers along the slopes above the Shotover. It sidled Cape Horn and was once bridged across Skippers Creek. We found one surviving survey peg (140 years old?) on the Queen's Chain and edge of this road.

The main mines appear to have been about a kilometre (elevation 760 m) up the unnamed ('Nugget') stream north of the site and also in the cliff below the settlement. There is a

drive (F41/18) in the cliff opposite on the eastern side of the river. The settlement consists of large terraces on the south-west and north-west of the site perched on slopes above the cliffs. A road runs up the back to the mine. An upper race comes in from the cliffs above the 'Nugget' stream into a dam of about 600 m^2, average depth 60 cm, and then carries on to the south-west. A lower race may have fed a penstock to the battery although the dam may also have fed the race. The age of the settlement is indicated by a Ransome and Sims no. 22 chaff cutter and a coal range with Art Nouveau swag type decoration (Jones 2007b: 46 centre). There are also barbed wire fences. The age is therefore suggested as post-1890 to 1910. Hall-Jones (2005) notes that the mine returned gold for 11 years up until 1896. Overall, the story of this complex, like that of Bullendale, must have been an epic in its own right and I can only do justice to salient features of its archaeology.

A focal point is a large revetted 'pylon' or earth-filled outcrop well drawn by Wernham and Doo, with a later stone hut (F40/21) (a forge?) at its base. This revetting is well engineered and it seems likely that it would be the upper support for a pipeline/penstock to the Pelton wheel at river level which drove the stamper. The point to the east is marked by tailings (F41/21) and the original high-level alluvial deposits have been heavily reduced. South of the 'pylon' and F41/21 is a steep V-plan gut cut into the exposed lode. The gut appears to have been mined. The battery (F41/23) is at the foot of this gut below the Nugget settlement and at the back of the river beach, just above the level of peak Shotover floods. There is no trace of an aerial ropeway from the upper mine so it is more likely that ore was carted down and tipped into a chute lodged in this gut where it would fall into the battery hopper. The battery has 10 stampers; the belt drive wheels are still mounted and the stamper feet and boxes are intact. Remains of the ore hopper and Pelton wheel foundations are in an area of seepage and well cemented over with a carbonate-like precipitate. Washed away and a little downstream on the flood plain are a large spoked belt-drive wheel, cast iron stamper feet, stamper boxes and fragments of ore. Some of the battery foundations, such as those for the large spoked wheel, must have been long washed away. They may have been sited on the terrace downstream of a stone slab and a curiously detailed flood-protection wall made of schist and pieces of cast iron machinery.

SKIPPERS TOWNSHIP

Today most of this famous site complex has an impenetrable cover of larch and Douglas fir. There is an excellent 1908 fold-out plan of the area from Skippers to Pleasant Terrace (see below) in the Geological Survey Bulletin (Park 1909). Most of Skippers township would have been located on the terraces between Londonderry and Skippers Creek. Sawyers Creek cuts through the original terrace lands of the town. In 1884 Aspinall had been working on his claim for 18 years (i.e., since 1866). This makes it one of the earliest documented large sluicing operations on the middle Shotover River (AJHR 1884 C-4: 23). In 1894 it was reported as "one of the best claims in the Shotover district" (AJHR 1894 C-3: 117).

Much of the town area (E41/70) (not in figures) appears to have been sluiced away post-1900 with scraps surviving near the main race at the foot of the hill country and on the relatively untouched land where the road runs immediately north-west of the bridge. Key focal points are the cemetery, the schist walls of the Otago Hotel and the surviving race which brought water from the Skippers Creek dam to this terrace and also further south to the Londonderry and Pleasant terraces. In 1908 it was owned by the New Skippers G.M. [Gold Mining] Company.

The Skippers School (opened 1879, closed 1927) and Mt Aurum Homestead (E41/72) (built 1876), both standing buildings, are on Burke Terrace to the south of Sawyers Creek. Sluicing had come all the way to the margins of the school grounds by 1908.

LONDONDERRY TERRACE

Londonderry Terrace (E41/47) (not in figures) is the first terrace area south of Mt Aurum homestead. Key focal points of this terrace are the races and yards at the centre of the eastern side, and the two dams in the top far north-west corner near the Department of Conservation work hut. In 1894 the Miller brothers had a claim on this terrace and were reported to have a "splendid supply of water" (AJHR 1894 C-3: 117).

The dams are large. The upper is a fairly full circuit of bank about 30 x 40 m, hook-shaped in plan and about 2 m high with a subdividing wall. The lower dam is banana-shaped in plan and about 60 m long with a 1.6 m bank. These dams probably fed from the upper to the lower and out via a blown out exit race from the lower. There is a large race running the full length of the uphill edge of the terrace. This was the race that goes to Pleasant Terrace from Skippers Creek, taken across the Londonderry Creek and Pleasant Creek by siphon.

The stockyards at the centre of the terrace were probably the main yards for Mount Aurum Station. By the yards is a cryptic set of ditches and banks which align alongside what may have been the original track. These are races with a bank on one side, so they may have had an enclosure function for the yards. The races are variously stopped by earth banks within and the east-running ones originally fed the sluicings downslope. The races and the track are paralleled by the bank of the field which is upslope to the west. This particular bank can be traced straight for about 150 m parallel to the track and then it takes a few turns up slope following the alignment of the top of the slope which falls to Pleasant Creek. It appears to have no corresponding ditch. There are posts and scraps of wire on the top of the bank and it is incorporated into the stockyards. The post and wire may post-date the building of the bank. Taken with the upper race, the total area of the terrace that would have been enclosed is 1.4 ha.

More or less in the centre of the terrace and south of some rocky mounds is a levelled area which may be a playing field and site of the annual Macetown-Skippers cricket match, a rural legend.

PLEASANT TERRACE

There are three surviving dams (numbered from south to north, E41/34, E41/39, E41/41) on Pleasant Terrace (Figs 4, 12). The largest, which obviously had various phases of use and modification, is the central one, *New Skippers* (E41/39). *Johnson's* (E41/41) is immediately to the north adjacent to Sainsbury's Hut and *Johnson's no. 2* (E41/34) is to the south with the bank under old willows. Names come from the 1908 Crawford map published in the Geological Survey report (Park 1909).

Johnson's No. 2 (E41/34) may be the oldest since it is at the south end of the terrace adjacent to the bulk of the pre-1908 workings. The Crawford map of 1908 shows it to have taken water from the major supply race originating in Skippers. Water was taken from this dam to the other two dams at this period. E41/34 has been infilled by gravel carried from the race.

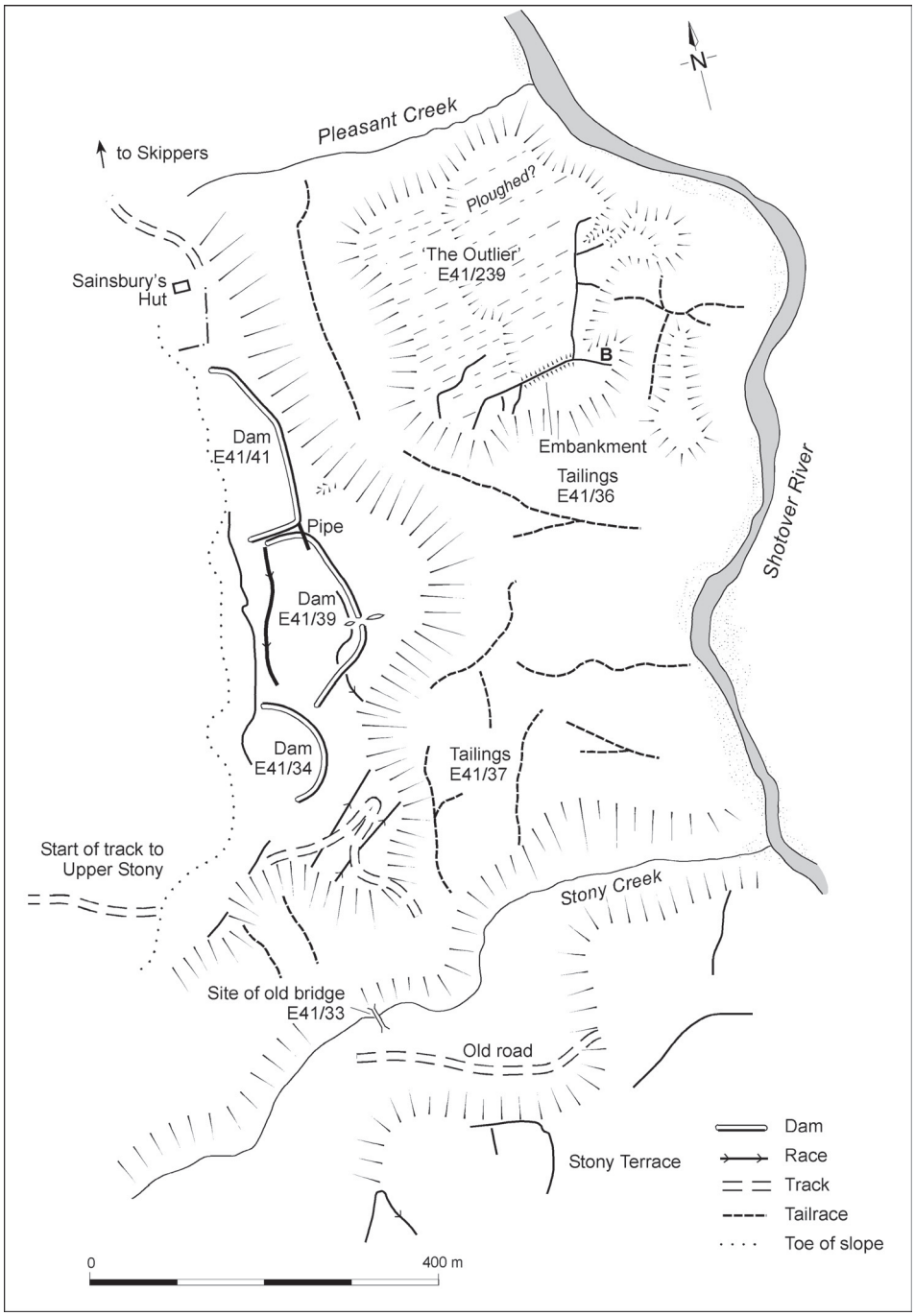

Figure 12: Pleasant Terrace and surrounding area. See Figure 4 for details of the dam complex.

New Skippers (E41/39) has had multiple phases of use. The earliest was presumably for ground sluicing in the southern area of the terrace. The dam was supplied by a massive race arising in Skippers Creek. There were two exits. One (by pipe) was fed by a race built on the floor of the dam (i.e., the dam was not filled at that time). Late in the history of the site it must have fed a sluice monitor working or re-working ground on the southern end of the flat. Site E41/39 appears to have been fed by a pipe from the south end of E41/41.

Johnson's (E41/41), the northernmost of the trio, appears never to have been fully functional, since the northern end never quite filled (to judge from our levels) or perhaps has been infilled by gravel from the race. In 1908 R. Johnston had a sluice face on the north of the terrace overlooking Pleasant Creek which eventually widened to the broad gully of 'the outlier'. This face into Pleasant Creek was started in 1895 (AJHR C-3 1895: 142–143).[3]

There are lands (strips of ploughed ground) (Walton 1982) and races (E41/239) on 'the outlier', a terrace about 300 x 150 m in area due east of Sainsbury's hut across the deep gully sluiced post-1908 by Johnson. The ploughing must therefore be nineteenth century in age, probably late nineteenth century, since there are no ditch and bank fences protecting the ploughed area. These lands appear to predate the races and the formation of the outlier itself. In this district such a field may have been for oats for the horses or possibly for beet/turnips for winter fodder for sheep, which would have been wintered over on these terraces.

There are races at the southern end and on the eastern side and just a few short sections of race surviving on the northern side. The formation of the outlier postdates 1908; its northern and southern ends were being actively mined at that date (as shown on the 1908 map). The modern form of the gullies on the eastern side is similar to that extant in 1908. The races that originally went across to the surface of the outlier and out to the eastern work faces are therefore pre-1908 in age. The gradients of three races on the eastern part which we observed using the dumpy level were 1:150, 1:300 and 1:70. This is a steeper gradient than was typical for races and may reflect the need for rapid draw-down of water for a ground sluicing face. As noted previously, Gordon in the *Miners' Guide* (1894: 259) recommends a fall of no more than 16 feet per mile or about 1:300. One section of race is of more than usual interest since it lies on an embankment partly created on the north side by the upcast of race B. The embankment is not a dam.

STONY TERRACE

This is a complex of dams, ditch and bank enclosures (E41/237, incorporating E41/23, 24, 25, 30) and late nineteenth or early twentieth century poplar shelter belts (surrounding a settlement), occupying most of the area of Stony Terrace at the foot of the steep hill country (Fig. 13). In 1894 it was reported that the Davis brothers had been working the terrace "for many years" (AJHR 1894 C-3: 117). There was little gold concentration in the upper layers of the terrace and successful mining required the removal of large volumes of gravel (AJHR 1895 C-3: 142–143).

Dams A and B have banks about 1.8 m high while the linked dams C-D (not visited) appear to have lower heights. On an outlier terrace in the sluicings is one further dam, E (E41/25). Dams A and B were fed by races (E41/30) from the upper part of Stony Creek.

[3] The name is spelled Johnston in the AJHR and Johnson in the Crawford 1908 map.

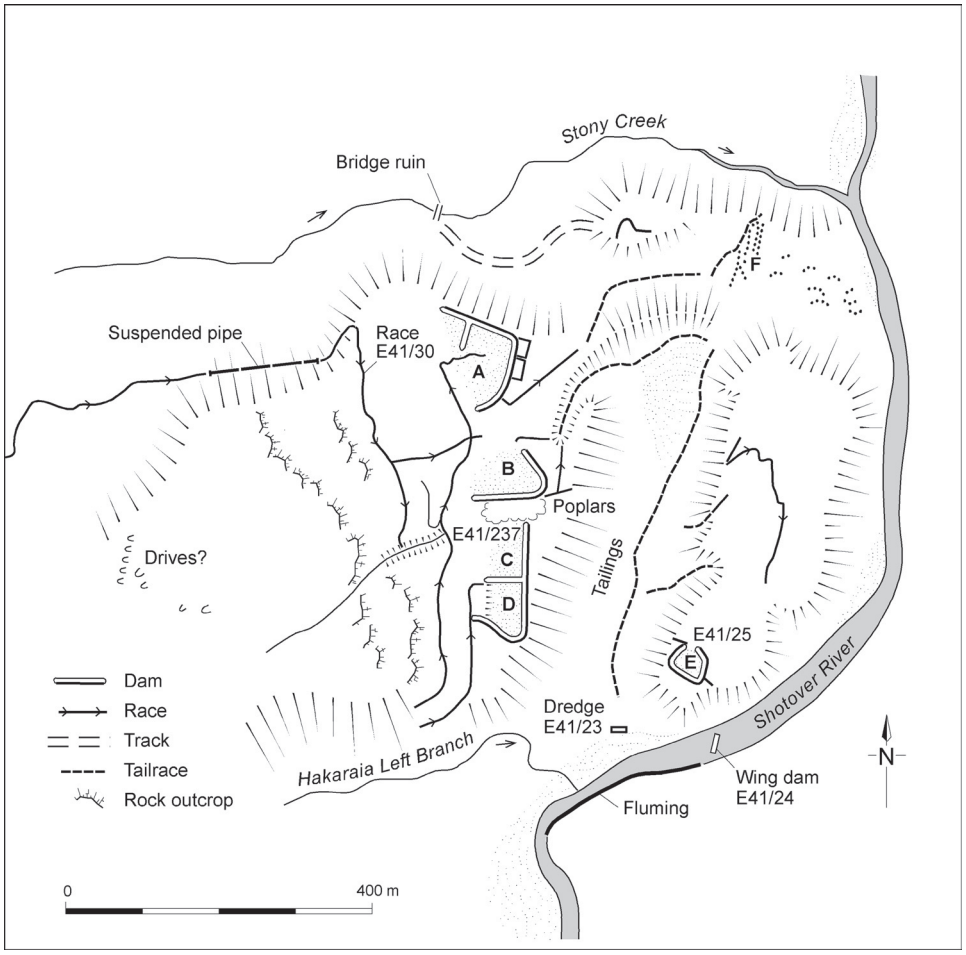

Figure 13: Stony Terrace and surrounding area.

These races include sections of lightweight pipe suspended on the cliff faces on the south of the creek. The pattern of the races indicates that at some stage all the dams were also supplied from the Hakaraia Left Branch. C-D was supplied mainly from the Hakaraia but may also have received water from Stony Creek. Outlets can be detected for dam A. There are probably huts (recorded as E41/26 but not visible on the aerial photographs) between dams B and C in the area of poplar trees. There are more rectangular ditch and bank enclosures partially buried by dam A (see figure in Jones 2007a). These are adjacent rectangular enclosures, the northernmost 9 x 12 m, the other 22 x 12 m. The former has a nineteenth century cast iron fireplace, upright and more or less *in situ*. The complex is presumably a miner's house and yard but it has been partially covered over by the dam. The enclosing ditch and bank (the ditch is exterior) of the house yard is estimated to be 2.4 m from top of bank to outer ditch and 60 cm from top of bank to bottom of ditch.

The tailings area worked from water supplied from dams A and B is immediately above the true right of the Stony Creek, extending south for some 120 m from a cliff which falls to the creek. It lies more or less on the bedrock after sluicing of the overlying 40 m depth

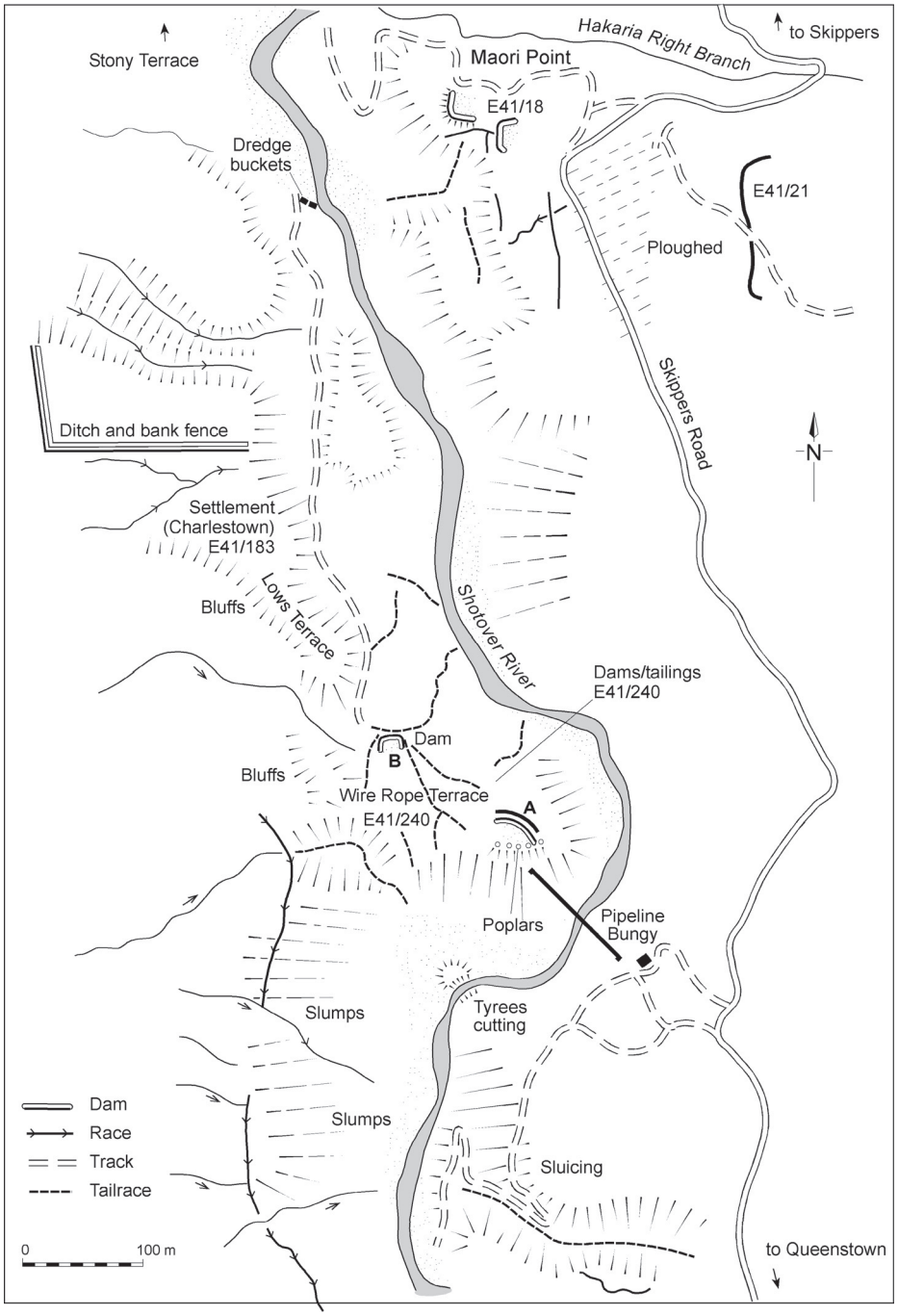

Figure 14: Maori Point, Charlestown (west bank) and Wire Rope Terrace.

of gravel. The primary focus is a deep, well formed tail race channel (F), which drained the large area of tailings to the south. There are other blocked off tail races angling in from the east from earlier phases of sluicing.

CHARLESTOWN (WEST SIDE), LOWS TERRACE

The site on and to the immediate north of Lows Terrace, true right of the Shotover, may be what is left of the Charlestown settlement (Fig. 14). Wernham and Doo (site record form E41/184) have placed it, based on historical documentation, on both banks, extending from Maori Point to Stony Creek Terrace, following the cadastral and NZMS 260 maps. On Lows Terrace there are several rows of poplars suggestive of shelter for a settlement. There is an obvious (from the Skippers Road), unusually large, ditch and bank enclosure to the north of Lows Terrace occupying the foot of the hillslope; it is formed or delimited on the north side by the steep edge of a gully. It is 260 x 100 m in plan (2.6 ha) and would appear to be a horse paddock or possibly for over wintering sheep. Chandler's map shows graves on the hillside above Lows Terrace. To the east the terrace has been reduced by an area of sluicings extending out to the Shotover River.

MAORI POINT

Two dams (E41/18) are 10–60 m south of the bulldozed road which snakes down to the river at Maori Point and about 150 m west of the Skippers Road (Fig. 14). The lower one is a partly destroyed bank with an open V plan enclosing the slope. A flood control radiotelemetry station is on one arm of the V. This dam would have been 28 x 28 m in plan with an approximate depth of a metre. The upper dam is curved like a banana in plan and is about 60 m across the slope. It also has wings about 20 m long. The pattern of races visible in the aerial suggests that both dams were used on the sluicings immediately to their south. It is possible that both were led away to the west further down Maori Point.

WIRE ROPE TERRACE

Two dams, a habitation area and tailings (E41/240) lie on the area north-west of The Pipeline Bungy suspension bridge (Fig. 14). The 'wire rope' is probably a reference to the original pipeline suspension method. Dam A is marked by a short belt of poplars on its south wall. It is D-shaped and about 24 x 24 m in plan. A race curves around the north-eastern side of the bank. About 125 m further to the north-west and low down in the tailings are a dam (B) and a stacked-stone domestic enclosure set amongst some poplars. The tailings are noted on the plan with their principal tail races. The terrace has been sluiced down to bedrock immediately east of dam A.

BOOMERANG TERRACE

There are two dams (E41/170) on Boomerang Terrace (not in figures) on the true right of the Shotover and tailings immediately to the south. The dams are fed by a race coming in from the west. One dam is on an upper part of the terrace and a blown out race leads down to a second dam. The dam on the upper terrace is semi-circular in plan and about 50 m in diameter. The lower dam is quadrangular in plan, about 55 m long and 7 to 10 m wide. It

has been excavated out leaving a downslope on the south-west side and banks to the north-east and south-east. Spidery dendritic head races lead down to the sluice face.

STAPLETONS TERRACE

Stapletons dam (E41/168) is at the northern end of Stapletons Terrace (not in figures). This is a typical terrace dam, curved in plan with a bank about 180 m in length. It is partly obscured by trees in the aerial photograph. At the far southern end of Stapletons Terrace, Scheibs dam (E41/166) appears to be a natural low-lying area with a distinct, partly natural, partly scooped-up bank to the west and a distinct bank to the south. It is about 100 m long north–south and 12 m across. It is fed by a roughly made race immediately above the dam, which took in water from blow-outs from a major race up the hill. The sluiced ground here is amorphous and prone to slipping.

BLUE JACKET TERRACE AND DEVILS ELBOW VICINITY

The Blue Jacket dam and sluicing complex (E41/163) (not in figures) is on the true right of the Shotover, 300–500 m north-west across the river from Devils Elbow on the Skippers Road. The surviving terrace is at two levels; the higher is more weathered and eroded. There is an isolated remnant of terrace with a dam which is oval in plan and about 55 x 45 m; it has been sluiced away all around. Another dam is on the upper terrace at the extreme south-west of the area. It is banana-shaped in plan and about 60 m long. Its exit is a blown out race plus another sinuous race running to the north. A third dam appears to have been carried away in part by sluicing at the edge of the terrace. It was irregular in plan, 12 m across the terrace and a minimum of 45 m long.

Two dams (E41/167), an upper and a lower (not in figures), are in a dish-shaped broad valley on the true right of Shotover, about 500 m north of the Devils Elbow. Both are banana-shaped in plan. The lower has been excavated out of the slope and the fill placed in the bank. A supply race comes in from the south-west. There is a shaft (E41/169) recorded in this vicinity.

TABLE 1

Volume of dams on the Shotover River based on tape and compass and dumpy level survey. NZMG from the site recording scheme.

NZAA no.	East	North	Name	Volume m3	Notes
F40/76	720	042	-	960	-
F40/14	714	040	-	400	-
F40/74	716	036	-	1700	-
F40/73	717	029	Sedge Tarn	3300	Modified tarn
F40/83	718	013	-	70	-
E40/61	699	007	-	1900	-
F40/66	715	000	Amphitheatre	4100	-
F40/80	700	999	Hazeels	250	Isolated dam on this complex
E40/53	699	996	Hazeels	1200	Dam A
E40/53	699	996	Hazeels	5280	Dams B, C subdivided and partly infilled

Table 1 continued.

E40/53	699	996	Hazeels	800	Dam D
F40/69	729	967	Ironstone Creek	3000	-
F40/41	727	956	Muddy Terrace	980	Upper dam
F40/41	727	956	Muddy Terrace	4200	Lower dam
F40/71	730	946	Muddy Terrace South	200	Dam G
F40/71	730	946	Muddy Terrace South	700	Dam H (lower)
F40/70	732	944	Muddy Creek	900	-
F40/68	734	936	-	750	-
F40/37	731	931	Bill Guys Terrace	1000	Dam A
F40/37	731	931	Bill Guys Terrace	500	Dam B
F40/79	735	928	Coolgardies	150	-
F40/36	734	926	Stroehles Terrace	345	No.1 dam
F40/36	734	926	Stroehles Terrace	385	No. 2 dam
F41	717	895	-	350	Monks Terrace
F41/	716	888	Peats	1400	Lower dam
F41/	716	888	Peats	1350	Upper dam
F41/20	706	879	Nugget	400	Powered Pelton wheel on battery
F41/528	734	821	Deep Creek terraces	1000	One of two dams, other not quantifiable
E41/47	685	870	Londonderry Terrace	950	Upper dam
E41/47	685	870	Londonderry Terrace	400	Lower dam
E41/41	682	862	Pleasant Terrace	5100	Johnson's dam
E41/39	682	860	Pleasant Terrace	13200	New Skippers. Multi-phase use
E41/34	682	858	Pleasant Terrace	2800	Johnson's no. 2 (infilled by gravel wash)
E41/237	681	852	Stony Terrace	9500	Dam A
E41/237	681	852	Stony Terrace	6900	Dam B
E41/237	681	852	Stony Terrace	6100	Dam C-D
E41/25	684	848	Stony Terrace	1500	In tailings area
E41/18	686	845	Maori Point	400	Two dams
E41/18	686	845	Maori Point	1200	-
E41/240	686	835	Wire Rope Terrace	300	Two dams
E41/240	686	835	Wire Rope Terrace	180	-
E41/170	686	827	Boomerang Terrace	700	Dam D
E41/170	686	827	Boomerang Terrace	700	Dam F
E41/168	688	824	Stapletons Terrace	1100	-
E41/167	684	823	Schursted	300	Dam C
E41/167	684	823	Schursted	200	Dam E
E41/163	683	818	Blue Jacket Terrace	1500	Dam A
E41/163	683	818	Blue Jacket Terrace	750	Dam B
E41/163	683	818	Blue Jacket Terrace	600	Dam G
E41/166	688	818	Scheib	1200	-
E41/152	669	785	-	400	-
E41/150	668	782	-	400	-
Total	**-**	**-**	**-**	**93950**	-

BUTCHERS POINT VICINITY

There is a pair of dams here on opposite sides of the river, about 1.6 km south of Long Gully. One dam and terrace are on the first point south of Butchers Point on the true right of the Shotover. The terrace is about 180 m (down river) and 90 m across with the dam in its southern part; the dam bank is about 60 m long. It is fed from a race coming along the rear edge of the terrace and from the north. The other dam and terrace are on the first point south of Butchers Point on the true left bank. This terrace is about 180 m long, irregular in plan and about 120 m at its widest. Here the dam bank is about 60 m long and the volume is estimated as about 400 cubic m. There are trees (poplars or willows) and huts on this terrace.

About 300 m north of Butchers Point on the true right is another small area of terrace about 60 x 60 m in plan. There are two races on the slope above: one feeds to the terrace where a small area of sluicing can be detected, another runs more or less parallel but above and disappears to the south-west into an unnamed gully.

RESULTS (2): DAMS

Dams enabled the storage of water overnight so that a full supply could be maintained in the course of a working day. They represent an important part of the capital investment in alluvial goldmining and the way individual miners or companies negotiated or attempted to control a resource critical to the success of mining. Water could be controlled by a company for its own purposes or sold to individual miners (Offer 1997: 107–110).

Most dams are constructed in the form of a curved bank on the slightly sloping surface of the terraces. The water was held on the upslope above the bank. The largest dams had a maximum depth of no more than 1.8 m. One smaller dam had a depth of 2.8 m near its outlet. Generally, smaller dams had a constant depth of between 60 cm and 1 m, depending on the height of the dam.

Table 1 lists the location and volume of the dams surveyed. Figure 15 shows that their numbers and volume are greatest on the richest terraces immediately below the Mount Aurum/Bullendale lodes. This reflects the capital-intensive nature of the operations in the late nineteenth century. The dams at Skippers itself may have been pinched for area by the presence of the town and, as has been noted, contemporary records show that water was in short supply there (AJHR 1884 C-4: 23; AJHR 1894 C-3: 117). On the Polnoon, the Sedge Tarn dam, holding 3300 m^3 of workable water, would have been a particularly efficient piece of engineering in terms of the limited work invested in its construction. The upper Shotover shows a predictable pattern of small holders with small investment capability. Even then, Hazeels Terrace and Muddy Terrace show that the later miners (*c*. 1900?), would put in large investments in supply races and dams once an area had been partly proved. Overall, however, these are small dams compared with the size of those installed by the government elsewhere in New Zealand (Offer 1997: 107–110).

RESULTS (3): SETTLEMENT AND ENCLOSURES

Enclosure may be defined as any attempt to partition off public land or ‘The Commons’ (community-held land, without title) for the benefit of an individual or corporate body: “to

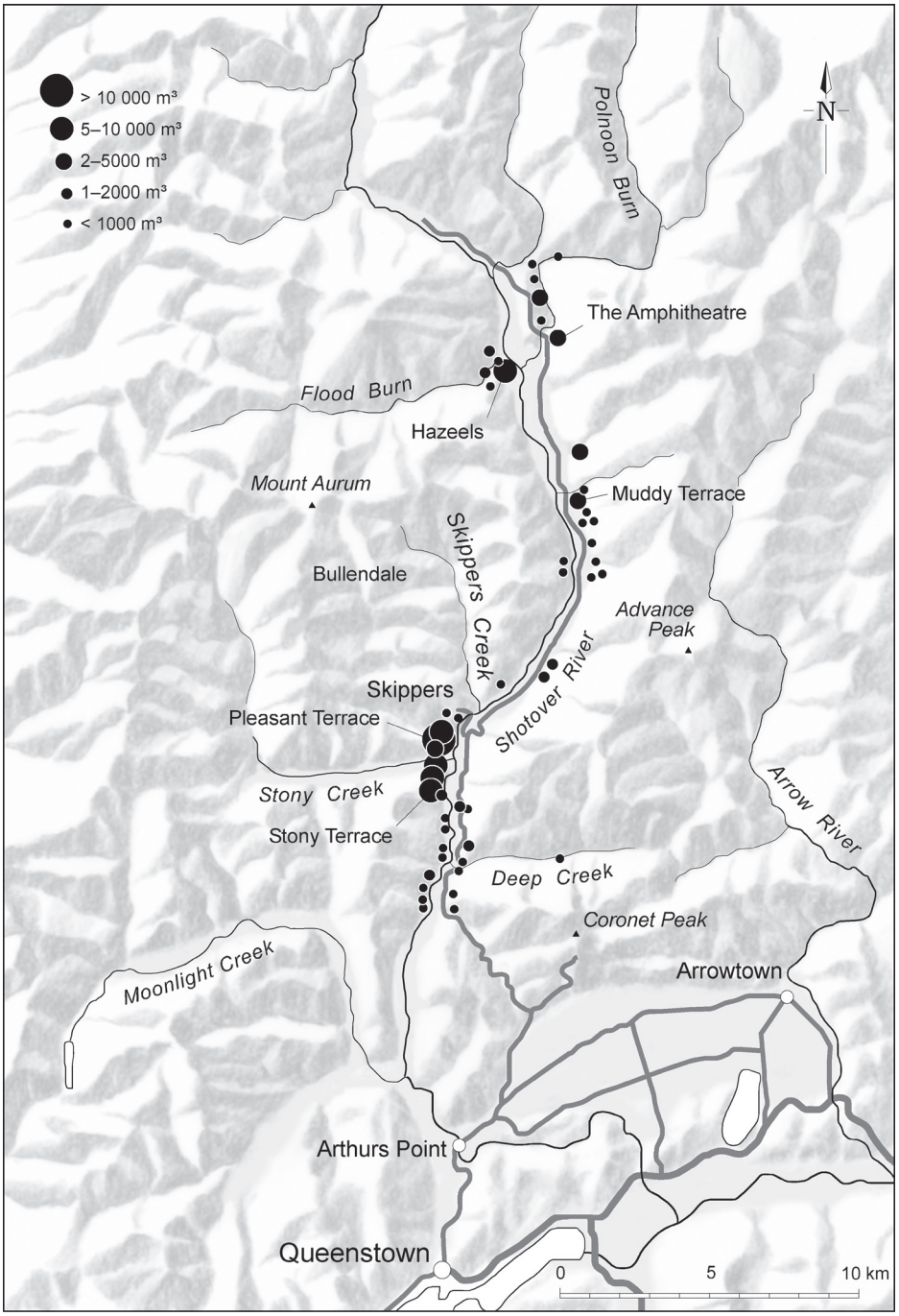

Figure 15: Volumes of dams on the middle and upper Shotover River (see also Table 1).

fence in (common land) with a view to appropriation" (*Shorter Oxford English Dictionary*). It generally included the break-up of large areas of communally farmed land into small fields farmed by individuals, the conversion of arable land to pasture and the occupation of commons by large landowners, excluding other users (Tate 1967). It is clearly enclosure against the grain of the expectation of commons or tenants' usage. It may not be so relevant to New Zealand conditions where there was no particular antecedent common use of the land in the English sense — usage by Māori being the only form of commons.

To what extent were the enclosures on the Shotover an example of exercising a right to the one acre of domestic land that came with the miner's licence and to what extent was it pastoral enclosure? If the enclosures were mainly miners', should they be credited with the introduction of stock such as sheep and horses to this remote country?

The Shotover was entirely pastoral licence or leasehold land. Because of the Otago Province's interest in the gold, Rees the owner of the pastoral licence, ever on the watch for commercial advantage, was unable to obtain freehold on any of his lease. In 1863, before the Otago Waste Land Board which kept a remarkable verbatim record of the proceedings, he was told that he could not "do anything which would stop the natural traffic of the country" (Griffiths 1971: 97–102). The miners, on the other hand, could exercise rather substantial legal rights to mine and do all the ancillary works (construct races, dispose of waste gravel) needed for mining, including setting aside small areas of land (one acre) for residences and subsistence and the introduction of stock. Early pastoral yards at Muddy Terrace and a sod house on Stony Terrace were built over by an early goldmining dam. Even in areas of intensive sluicing, miners' dwellings and cropping/horticultural areas were protected from stock (sheep or horses) by ditch and bank fences. An example is the enclosure on Hazeels Terrace. On Pleasant Terrace, an extensive area (8 ha and probably more) of ploughed land (probably for growing oats or beet) was later swept away by sluicing. It seems likely that the oats were for sale to miners or for use by the station, rather than being a miner's endeavour. In the event, the arable terrace was lost to mining.

In the course of the survey I was particularly conscious of the likely age of ditch and bank fences and the period when they went out of use with the introduction of post and wire fences. The upper Shotover today is marked by the complete absence of naturally available timber for building or posts. This absence is probably the combined result of the felling of native beech forest in the mining period (1862 to the advent of WW I), casual burning for pastoralism and the relative dryness of this country (30–40 km east of the main divide). Galvanised barbed wire did not come into general use until the 1870s (Hamel 2001: 100). The relatively late Nuggets mining settlement, with its surviving post and wire fences and the Art Nouveau (1890–) decorated coal range, perhaps makes the point. Even allowing for a lag in the take up of post and wire in this remote district, it can reasonably be concluded that the ditch and bank enclosures of all forms date to the period between 1862 and 1880. This is the main type of enclosure seen on the Shotover. Because they were co-located with mining areas and are all equal to or less than the area that could be allocated under a mining licence, it can be concluded that these were in the main miners' domestic and stock or garden enclosures. However, there is one notable example of pastoral enclosure at The Neck on the Polnoon, designed to manage the ancient transhumant practice of moving sheep to and from the snow-prone sub-alpine country.

CONCLUSIONS

Custom-flown vertical aerial photographs in medium format (6 x 6 cm) at original scales of 1: 25,000 to 1: 16,000 provided an ideal base for mapping almost all the earthworks on the middle and upper Shotover River. The principal focus of mapping has been on the remnants of the sluice faces, dams, races and small miners' settlements on the terrace lands above the flood plain, particularly those just below the principal lode areas on the western side of the valley — at Hazeels, Skippers, Pleasant and Stony Terraces. Despite substantial investments in races and dams such as those on Muddy Terrace or Stroehles Terrace, the extent of completed sluicing on the eastern side of the valley suggests that this ground was much less productive of gold.

The domestic enclosures recorded in the course of the survey ranged from the proverbial one acre (0.45 ha at Muddy Terrace) downwards. The size of the remarkable domestic enclosure at Hazeels appears to have been limited by the small width (13 m) of the terrace. It is likely that the ditch and bank yards were to exclude stock from domestic and garden areas, but some are big enough to have been folds for sheep in winter. All such enclosures and the much reduced remains of sod huts within could only have been the domestic enclosures of miners. They must have been introducing horses and livestock to what was a difficult area (especially in winter) and managing feed for the horses. The later phases of mining may have been happening in the early stages of pastoral establishment (from the 1870s?).

The Polnoon tunnel (F40/17), completed in 1934, takes water from the Polnoon Burn into the Shiel Burn. This crossing of the narrowest part of The Neck reflects the goldmining history of the Polnoon but, on the surface, the pastoral industry is reflected in a ditch and bank fence. In an early phase of the establishment of The Branches run (1870s?), it would have controlled stock movement from The Island to the summer grazing country of the mountains to the north-east on Duries Peak and Snowy Peak. To the south-east of The Neck, The Island would have been perceived as easy terrain with upwards of 150 ha of natural grassland, naturally enclosed. It is bounded by the Shiel Burn gorge to the north, the steep eastern faces of the Shotover and the entrenched course of the Polnoon to the east and south. It would have formed the focus of grazing on the eastern side of the upper Shotover. Stock must have been taken south for some 2 km through The Amphitheatre (another smaller, naturally enclosed area) for shearing in the vicinity of the station.

Supplementary survey and mapping has enabled a better appreciation of the volumes of reservoirs and the gradients of races. Mapping of some 60 goldmining dams indicates that about 96,000 m^3 of water storage was engineered in the area, with the greatest volume in the richest, most deeply sluiced landscapes on the terraced valley floor downstream of Skippers Creek (the Skippers, Londonderry, Pleasant and Stony terraces). The very largest dams were on Pleasant Terrace (now one of the foci of management in the Mount Aurum Recreation Reserve), where they also seem to have had a long sequence of varying use. The volume of stored water in any particular reservoir was more or less proportional to the volume of the gravel removed and the implied value of gold recovered from the deepest workings.

Precise levelling of head races at Muddy Terrace and Pleasant Terrace showed that they had much steeper gradients than recommended in the relevant nineteenth century miners' handbook. The best preliminary conclusion to draw is that the precise and rigorous engineering requirements applied more to investment in long supply races than to head races. The wide view of the aerial photographs shows that races were built with extreme

economy of effort. They were designed to take in sources of spring water as they traversed faces; they were let into shallow valleys and the water was taken up behind dams lower down; sometimes water was simply let out of the side of a race and flowed downslope to a suitable dam. The number of blowouts in races also indicates that maintenance must have been a constant task.

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