FRASER RIVER PLACER MINING LANDSCAPES

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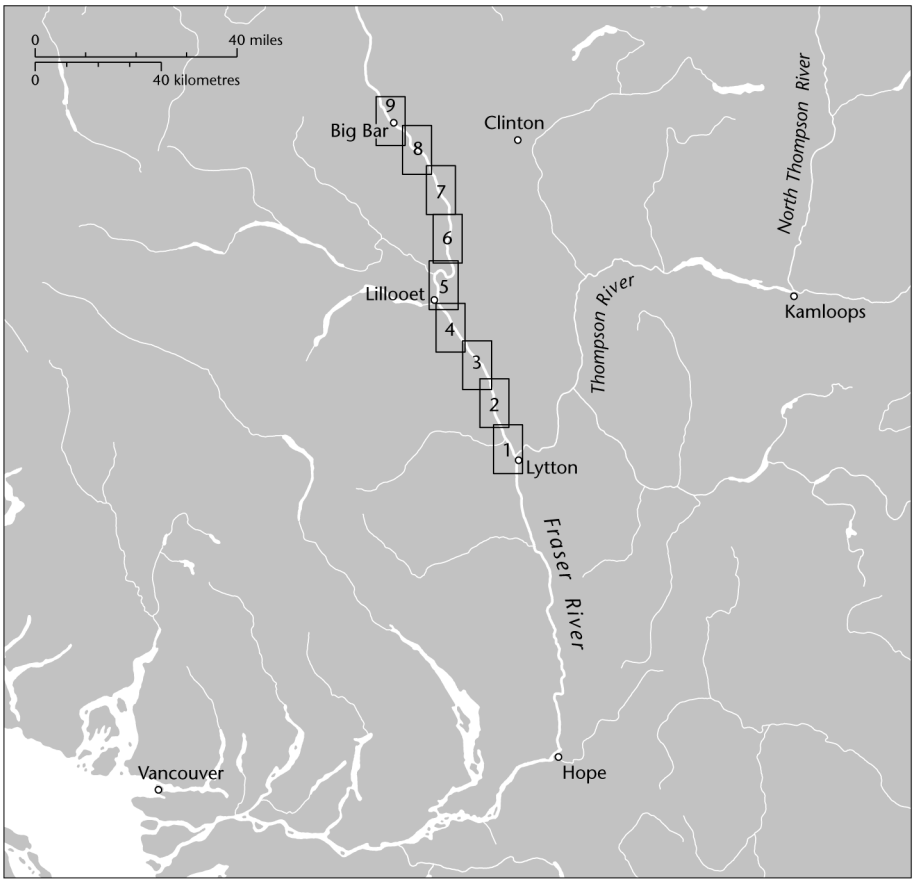
THIS ARTICLE DESCRIBES, maps, and seeks to explain surviving placer mining sites along an 80-mile section in the upper canyons of the Fraser River between Lytton and Big Bar. Although this stretch of the river has been relatively little modified by human activity since most placer mining ended some one hundred years ago, annual spring floods have obliterated virtually all sites on or immediately adjacent to the river. Most surviving sites are on terraces above the high water line. They are numerous, if not always easily recognized. It has taken five years of seasonal fieldwork (best in spring or fall, when light snow cover etches the outlines of placer sites otherwise invisible) to find and map them.[1] A collection of more than fifty contemporary images of selected sites in the study area can be accessed on the *BC Studies* website at www.bcstudies.com.

TECHNOLOGIES AND LANDSCAPE REMAINS OF PLACER MINING

The gold rushes to British Columbia – the first, according to some estimates, drawing more than thirty-five thousand miners and fellow travellers north to Vancouver Island and New Caledonia in the spring of 1858[2] – followed by as much as a decade the rushes to California and other American territories west of the Rockies. There, technologies of placer mining that had diffused to the American West from goldfields

[1] I wish to thank Cole Harris for supporting what initially was a minor later-in-life 'retirement project' and what then, through his strategic guidance, re-direction, and sustaining interest became a major endeavour in the exploration and mapping of the largely 'unseen' mining landscape of the inner canyons of the middle Fraser, and for taking a late-arriving novice through the portals and into the land of academic writing; Graeme Wynn for his enthusiasm for the project; Richard Mackie and Daniel Marshall for their warm acceptance and ongoing encouragement of my entry into the world of early British Columbian history and geography; Robert Galois for opening doors to Colonial Office records and the Cariboo gold rush; Eric Leinberger and José Aparicio, cartographers with the UBC Geography Department for their limitless patience and the finely crafted products; and Orren Lane for volunteering four seasons of unflagging and good-humoured assistance in the field.

[2] Daniel Marshall, "Claiming the Land: Indians, Goldseekers, and the Rush to British Columbia," PhD diss., University of British Columbia, 2000.



Map 1. Location of study area. Numbered parallelograms along the Fraser River indicate the locations of Mapts 2 - 10 following. Cartography by Eric Leinberger.

in the American Appalachians or in Spanish America, or that were rediscoveries or reinventions of much older strategies,[3] had been brought to their final form of development. Most of the miners coming to the Fraser River were well acquainted with these technologies; many of the "old 49ers" among them had a great deal of practical mining experience. Placer mining sites along the Fraser River reflect the technologies that created them, all of which, except dredging and draglining, were available on the Fraser River as soon as steamboats reached Hope and Yale. They and their landscape effects are briefly described below.

[3] See, for example, R.H. Limbaugh, "Making Old Tools Work Better," *California History,* Vol. LXXVII no. 4 (Winter 1998-99): 24-51; and Randall Rohe, "Origins and Diffusion of Traditional Placer Mining in the West," *Material Culture* 18, 3 (1986): 127-66.

Figure 1. Upper Fraser Canyon near Watson Bar Creek. *Source:* Government of BC, photo 1087:46.

The gold pan is a stamped metal pan eighteen inches in diameter at the top, with sides sloping down at thirty degrees to a bottom ten inches in diameter. Capable of holding one full shovel of gravel, it is worked either in-stream or at streamside with a series of rocking and swirling motions. A competent miner can average fifty-five pans in a ten-hour day, in so doing processing about a third of a cubic yard of gravel. *Landscape effects*: negligible.

The rocker separates the mechanical processes of panning in a semi-portable hand-driven device that raises the throughput to three to six yards per day (Figure 2a). The difficult-to-master skills needed to pan gold while crouching in a stream are replaced by a machine that collects

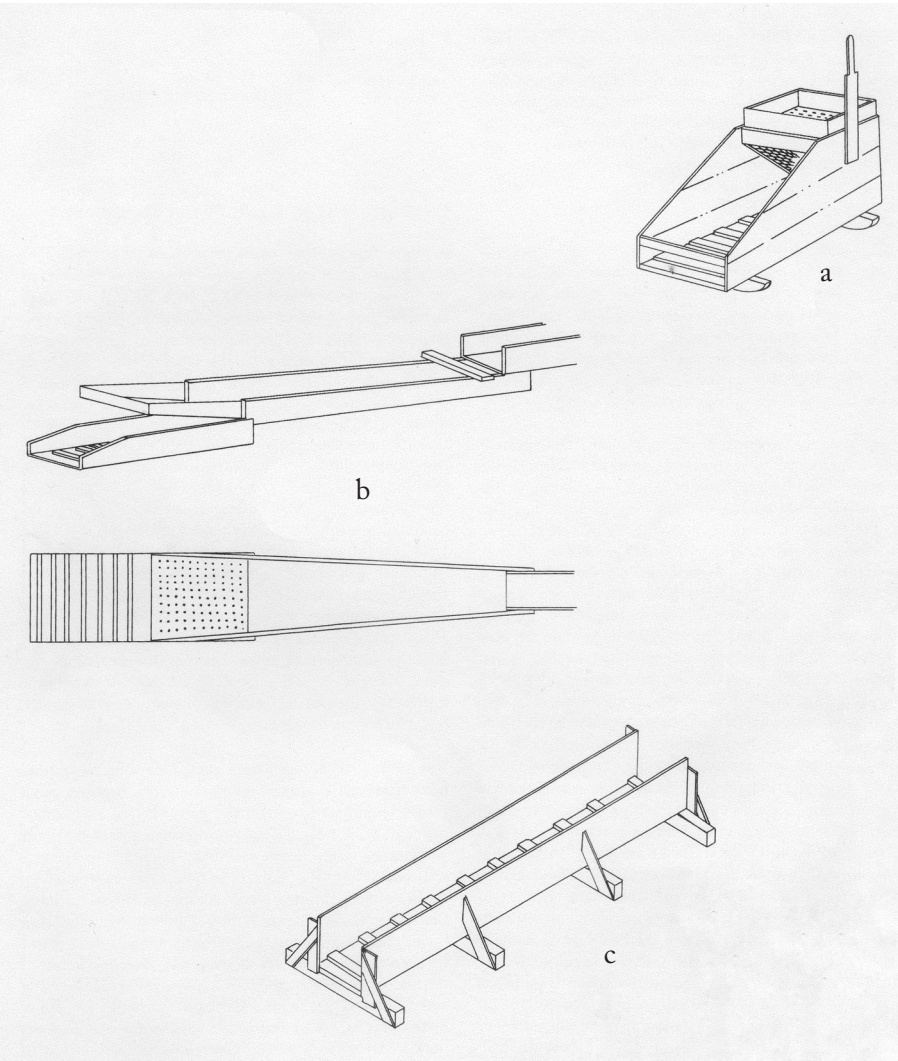


Figure 2. Basic gold recovery equipment used during placer mining period: a) the rocker, b) the long tom, c) the sluice box. *Source:* J.M. LaLande.

gold in three stages between a sieve that separates out large sediments and two sets of riffles at different gradients (perhaps charged with mercury) that catch different sizes of flakes and dust. Although one person can operate a rocker, two or three were more common. *Landscape effects*: small scattered heaps of tailings, isolated boulders on washed surfaces, no ditches. An example of a rocker landscape can be seen on both sides

of the river at Fountain Bend north of Lillooet, where the bed-bank-lower-slope interface is dominated by boulders and small cobble piles on a surface stripped of finer sediments. No ditches of any size are nearby.[4]

The long tom may be thought of as a rocker separated into its components and driven by continuously running water (Figure 2b). Unlike the rocker, it does not need to be operated in a series of short cycles but, rather, runs until a clean-up is necessary. The system consists of two troughs set at different gradients. Oversize material is sorted out by a sieve plate, or "riddle," in the upper trough, and gold is captured by riffles in the more gently sloping lower trough. Worked with less labour than a rocker, a long tom is capable of processing three to six yards of gravel in a ten-hour day. *Landscape effects*: see "sluice boxes."

Sluice boxes resemble the lower box of the long tom (Figure 2c). Typically they were ten or twelve feet long and six inches to three feet wide, had a variety of riffles and gold-saving mats, and could be fitted together. Sluice systems, often one hundred feet or more long, have accounted for most placer gold mined in western North America. Sluicing requires a large volume of water and a lot of sawn lumber.[5] With a sluicing system, two people can process twenty to thirty yards of gravel in a ten-hour day (and considerably more with a horse and scraper). *Landscape effects*: Sluice systems leave tailings in extensive heaps, sometimes in geometric rows,[6] and the remains of ditches. The most extensive array of parallel-cobble stacks and sluice trenches in the study section is on Cameron's Flat (west side of the Fraser River some 8 ½ miles above Lytton).

Ground sluicing is an efficient means of moving sediments into a line of sluice boxes or a rock-lined sluicing channel. Whereas human labour shifts gravels into long toms or sluice boxes, in ground sluicing running water is used to do so. Feeders from a main ditch bring water to a point where it begins to erode overburden and then the auriferous gravels in a terrace edge. The gravels eroded from water pouring off the terrace are channelled into sluice boxes. Two people can process from twenty to thirty yards of gravel per day. Ground sluicing is the least costly of

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[4] The only evidence for ditch construction on the north side of the river at Fountain is the eroded remnant of an early ditch drawing on a spring without surface water and incapable of serving a sluice.

[5] The sluicing action of sediments wears the wooden sides and bottom of sluice boxes, and it requires their replacement with new lumber at regular intervals.

[6] Neville Ritchie, a New Zealand historical archaeologist, has created a typology of seven major forms in which stacked tailings can be formed, defining them as "herringbone," "blow down," "parallel," "box," "fan," "amorphous," and "pothole." See Ritchie, "Archaeological Interpretation of Alluvial Gold Tailing Sites, Central Otago, New Zealand," *New Zealand Journal of Archaeology* 3 (1981): 51-69.

Figure 3. Ground sluicing above Lillooet. *Source:* Phair collection.

all methods of high-volume placer mining, but it does require suitable gradients for sediment transport and waste removal. To achieve the latter, ground sluicing operations frequently include deep, steeply sloped, cobble-walled sludge channels leading down to the river.[7] *Landscape effects*: large, irregular heaps of cobbles sometimes behind walls of steeply stacked cobbles, eroded depressions, steep scarps, level floors, steep sludge channels, ditchlines, and an absence of the head-boxes associated with hydraulic mining. The mines on Browning's Flat (west side of the Fraser between Della Creek and Intlpam Creek) with their deep, steep-sloping cobble-lined sludge chutes, almost level coalescent wash-pits, and nearly vertical interlocking scarps are the least disturbed examples in the study area.

High-head hydraulic mining used water carried in pipes or hoses and directed through a nozzle ("monitor" or "giant") to create a jet capable of

[7] Kelly, McAleer, and Tordoff, working in northern California, have done extensive work mapping and analyzing ground sluicing landscapes and, in so doing, have clarified efforts to understand similar landscapes on the Fraser River. See J.L. Kelly and H.J. McAleer, *An Archaeological Survey Assessment and Recommendations for the Ohio Flat Mining District ,Trinity County, California* (Redding, CA: US Dept. of the Interior, Bureau of Land Management, 1986); J.D. Tordoff, *The Evolution of California's Placer Mining Landscape: A View From Prairie City* (Sacramento: California Department of Transport [CALTRANS], 2004).

Figure 4. Hydraulic mining at the "Old Bridge" site. *Source*: Phair collection.

eroding large masses of sediment from hillsides and terrace edges down to lines of sluice boxes. *Landscape effects:* extremely high steep scarps and gently sloping wash pits littered with large boulders, cobbles, and perhaps iron hardware and pipe remnants. Three of the eight or nine hydraulic sites below the "Old Bridge" at Lillooet[8] survive intact to the present.

Low-head hydraulic mining is similar to *High-head hydraulic mining* except that intakes are much closer vertically to the "giants," or nozzles, which therefore produce streams of water at a much lower pressure. Consequently, lighter equipment and material can be used. *Landscape effects*: similar to ground sluicing but for the siting of ditches and the presence of head-boxes or their sites.

Wingdamming and river mining. Wingdams were wooden or cobble coffer dams used to partially block the flow of a river or stream in order to expose part of the bed for mining. They were frequently used with Chinese pumps (current-driven, bucket-equipped wheels used to lift water from streams to supply rockers and sluices). River mining, which was never employed on the Fraser (because of its size) was practised on the Bridge River and on Cayoosh Creek near Lillooet. It involved moving the stream from its bed to an artificial channel. Both systems were always vulnerable to flooding. *Landscape effects (wingdamming)*:

[8] Larger and equally well preserved but reforested examples are located on the west side of the river below the Stein River confluence.

cobble, boulder, or timber wings extending out into current. A line of cobbles and boulders heading into the current south of Texas Creek at "James" Bar may be the only remnant of wingdamming in the study section.

All these technologies arrived from California, as did ditching/irrigation technology that had originated in the Mediterranean (from where it reached Spanish America) or in south China.[9] Long toms, sluicing, and hydraulicking required running water taken from small tributary streams. Stream flows were diverted and carried in low-gradient ditches, or "races," either directly to the workings or to convenient gullies from which they were recaptured above the mine sites. Perennial streams were preferred, but ephemeral streams and tiny springs could be used. Ditches could be a few hundred feet long or run for several miles and might include reservoirs to extend their useful season. Lengthy systems entailed a division of labour between mining crews and ditch crews, and they usually cost a good deal more than did the constructions required at the mining site.

Dredging, a technology not available in 1858,[10] took every mechanical aspect of placer mining and coupled it to steam power or, later, to electricity. Shovels and ground sluicing were replaced by powered bucket-lines with a reach of as much as eighty feet; panning and sluice boxes were replaced by a perforated powered spinning drum (trunnel) washed with high-pressure jets of water; further refining was performed on gold-saving tables and related devices; and tailings were stacked by a boom-directed conveyor belt. All of this (weighing up to 250 tons) was mounted on a wooden barge moved by cables and steam winches. *Landscape effects*: dredged channels in bars, machine-stacked cobble piles, and industrial debris. Examples survive on Horsebeef Bar (east side of the river just below Cayoosh Creek), where there are machine-stacked tailings, a visible dredge-eroded channel, and a dredge hulk embedded in the north end of the bar. Seasonal erosion periodically reveals rusting iron mechanical and structural components at the surface.

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[9] LaLande (analyzing placer landscapes in southern Oregon) and Liping Zhu (working in Idaho) attribute some of the Chinese success there and elsewhere to water management skills acquired in the hydraulic culture of south China. See Jeffrey M. LaLande, "Sojourners in Search of Gold: Hydraulic Mining Techniques of the Chinese on the Oregon Frontier," *Journal of the Society for Industrial Archeology* 11, 1 (1985): 29-52; Liping Zhu, *A Chinaman's Chance: The Chinese on the Rocky Mountain Mining Frontier* (Niwot: University Press of Colorado, 1997), 104-5.

[10] An image of the Sacramento River painted in 1853 shows a steam-powered craft identified as a "dredge." However, successful application of dredging technology in western North America had to wait until the innovation reached its commercially successful level in New Zealand in the 1890s.

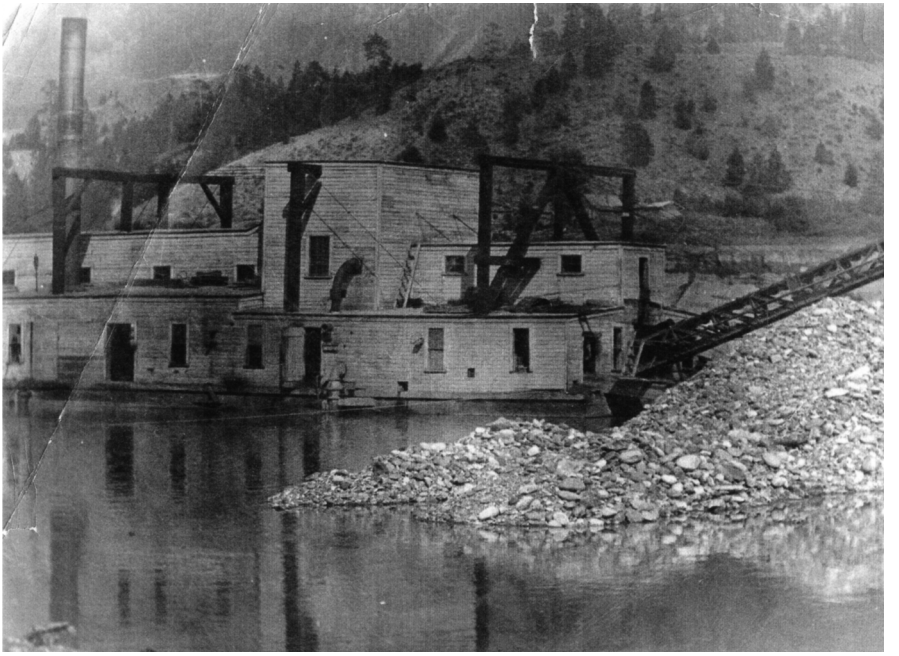

Figure 5. "Bliss" on Horsebeef Bar. *Source*: W.G.C. Manson collection.

Draglining, also not available in 1858, combined the gasoline engine (and perhaps, earlier, steam engines) with masts, booms, cables, and buckets. Shore-based draglines mimicked dredger sediment processing lines but sacrificed mobility for lower construction costs. Using mainmast, back anchor, and haulback line, it was possible to dig gravel from bed, bar, and bank in a line between two fixed points. Moving the back anchor increased access. *Landscape evidence*: conical tailings piles, industrial debris. The efforts of a local ironmonger and the development of a residential subdivision have obliterated the only known dragline site in the study section (at the south end of Canada Flat, Lillooet).

THE CHRONOLOGY OF INTRODUCTION

The first American[11] miners in the Fraser watershed, arriving in small numbers in the summer of 1857 and early in 1858, used pans and rockers. Given the high cost of ditching, sluicing was postponed until the most favourable gold sites and the behaviour of the river were better known and

[11] James Douglas, the governor of Vancouver Island and ranking British official in the goldfields, noted that "American" miners included American, British, French, German, Danish, African, and Chinese individuals. They were either veterans of the California gold rush or more recent arrivals who were moving through that state and the Pacific territories to the Fraser goldfields. See J. Douglas, Great Britain Colonial Office, 19 August 1858, CO 60 (microfilm), British Columbia, original correspondence, 1858-1871.

until relations with the Nlaka'pamux had stabilized. However, sluicing began in the lower canyon by late summer 1858, and, by late fall, water companies were constructing elaborate ditches near Hope and Yale.[12] Farther up the river, between Bridge River and Fountain Canyon, ditching and sluicing were in place before the end of the year.[13] There is some evidence of small wingdams at several sites between Lytton and Fountain before the end of 1858. Early in 1859, a thirty-foot diameter water wheel (Chinese pump) was used on the lower river to supply a sluicing system.[14] Later that year, the Gold Commissioner's ledger indicates that nearly every tributary of the river within five miles of Lillooet was taken up for placer mining – clear evidence of sluicing.[15]

Between the end of the Gold Commissioner's entries in 1860 and the first annual reports of the Minister of Mines (1874), little documentary evidence is currently available about mining along the middle Fraser. Attention had shifted to the Cariboo. However, mining along the middle Fraser had not ended; it continued to be practised by small groups of Chinese and Native miners who used pans, rockers, and sluices. In any given year some six hundred people,[16] only a few of them white, were mining between Lytton and the mouth of the Chilcotin River. Not all of this work was small scale; in 1876 and the following years the Ah Sam Company at Lillooet consolidated and extended the ditch from Fountain Creek south for eleven and one-half miles to Horsebeef Flat

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[12] Richard Hicks, corresponding with Douglas, notes the shift from pans and rockers to sluicing, which came with the initiation of ditch systems first on the lower river, then to the north. See R. Hicks to J. Douglas, in F.W. Howay, "Early History of the Fraser River Mines," British Columbia Archives (hereafter BCA), memoir 6, Victoria, 1926, 7-8.

[13] Henry de Groot, correspondent for the *Alta California* (San Francisco) and quoted in the *Victoria Gazette*, made a circuit up the new Harrison trail and toured the northern goldfields, where he over-wintered before returning through the canyons to Yale. While in the vicinity of the "Great Falls" (at Bridge River) and La Fontaine's (Fountain) in the late fall, he noted several parties engaged in sluicing. See *Victoria Gazette,* 18 December 1858.

[14] H.H. Bancroft, *History of British Columbia*, vol. 32 (San Francisco: History Company, 1887), 443.

[15] Thomas Elwyn, the Assistant Gold Commissioner at Cayoosh, later Lillooet, kept a ledger in which he recorded claims, claim transfers, mining certificate sales, water rights recorded and transferred, and land pre-empted from the fall of 1859 to 1861. His record of water rights show every stream, brook, and spring taken up for the purpose of mining. See British Columbia, Government Agent (Ass't Gold Commissioner), Lillooet, BCA, Government Records (hereafter GR) 0225, box 21 (ledger), Victoria.

[16] Native miners received little official notice in the annual *Report to the Minister of Mines* and were left out of annual tabulations of provincial mining activity. However, in occasional mentions in the accompanying mining district, anecdotal reports note Native family groups mining in numbers equal to the Chinese during a period when three hundred or more Chinese were active (or, again, that "Chinese and Indians at times reached 600"). See British Columbia, *Report to the Minister of Mines* (Victoria: Queen's Printer, 1879), 240.

and supplied water en route to every placer operation on the terraces and banks below.[17]

Hydraulic mining began in the mid-1880s. A site near the original suspension bridge at Lillooet was worked for fourteen years, and there were other hydraulic sites at the Stein River, Texas Creek, Sallus Creek, Pavilion Creek, High Bar, and Big Bar. In 1887, water from Fountain Creek was piped across the Fraser Canyon on a cable suspension bridge, an operation that continued for two years and may have been repeated at Gibbs Creek immediately upstream.[18] The population of miners increased with the discovery in 1894 of rich gravel on Cayoosh Creek near Lillooet; both wingdamming and river mining were employed there. Throughout these years, a core mining population continued to work along the river with pans, rockers, ground sluicing, and sluices.

Gold dredging began at Big Bar in 1890, and over the next two decades some eight craft of differing design operated near Big Bar, Lillooet, and Lytton. Their attractive features were efficiency and mobility, but a series of mishaps – tippings, groundings, sinkings, and mechanical difficulties – led to abandonments, break-ups, and sales. The last dredge ceased operations at Lillooet in 1909.

In the first decade of the twentieth century, to all intents and purposes the last decade of placer mining along the middle Fraser, almost the full range of placer mining technology was in play: dredging near Lytton, Lillooet, and Big Bar; hydraulic mining at Big Bar, Fountain, and Lillooet; short-lived attempts at wingdamming at the mouth of Bridge River; and small operations still dependent on pan, rocker, and sluice. By the end of the decade, however, the river was quiet; the seasonal visits by the small groups of miners that had driven the industry in the canyons for fifty-two years had come to an end.

THE DISTRIBUTION OF PLACER MINING

Along the middle Fraser, derelict ditches cross valley walls; heaps of lichen-coated cobbles, some geometrically ordered but most not, lie on the terraces and lower valley sides; conical piles of fine sorted sediment appear here and there; and gullies running down to the river are lined

[17] The activities of the Ah Sam Company are reported in three successive annual reports to the Minister of Mines, beginning in 1879. See British Columbia, *Report to the Minister of Mines* (Victoria: Queen's Printer, 1879), 240.

[18] The activities of the Fraser River Cable Company and its successor on the site, H.S. Southard, are reported in the *Report to the Minister of Mines* in 1887 and later in 1899. See British Columbia, *Report to the Minister of Mines* (Victoria: Queen's Printer, 1887), 273; and ibid., 1899, 289.

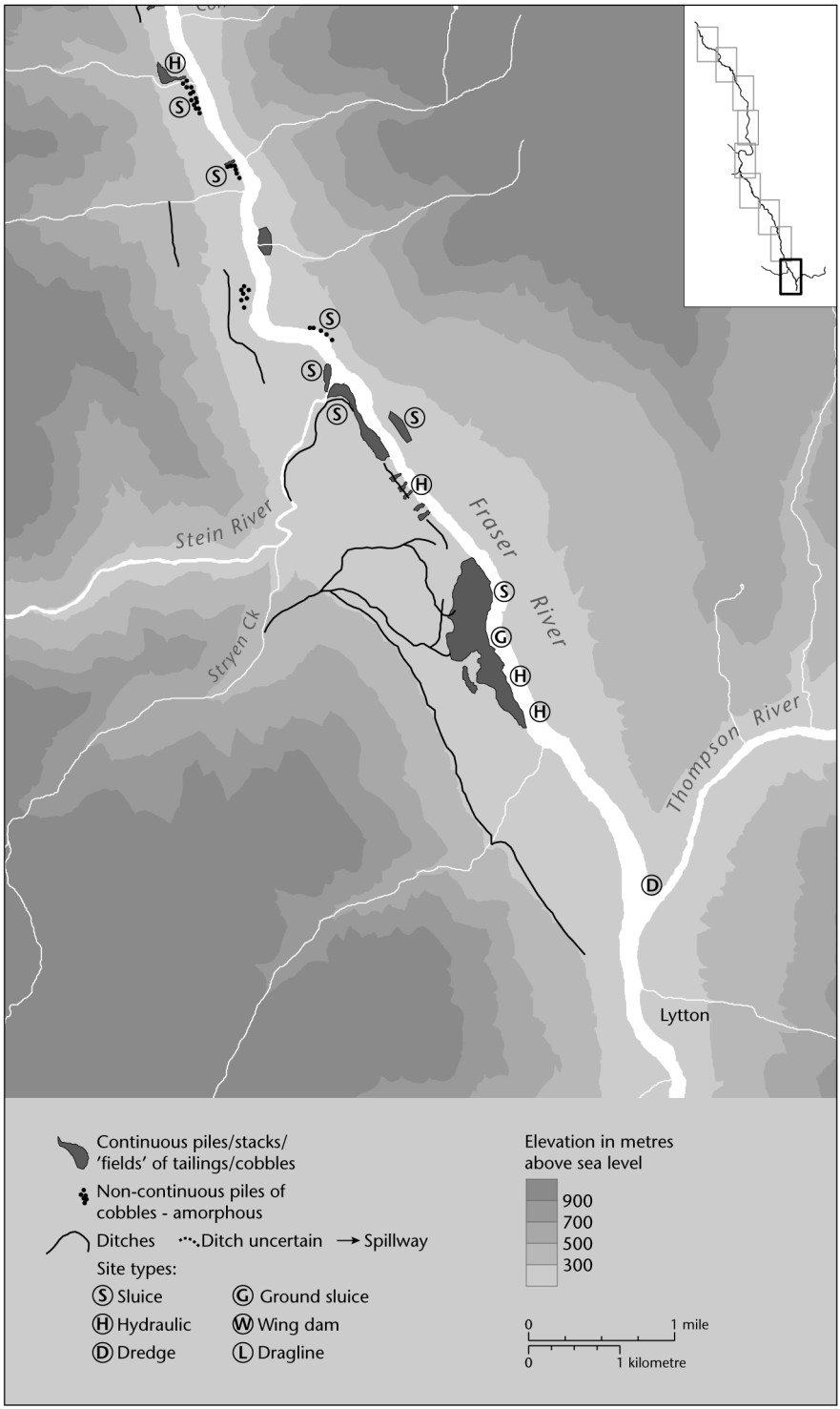
with cobbles, some piled almost vertically. Although irrigation is common, these ditches do not reach fields but, rather, end in or near cobble piles or in stone-lined gullies. All of these features are the landscape remains of placer mining. Taken together, they are perhaps the largest surviving "artefact" of early-modern British Columbia.

This study is based on the precise mapping of these placer mining sites and of the ditches that served them. That mapping (originally mylar overlays on a set of 1:13,000, black-and-white air photographs taken in 1950 and then transferred to 1:20,000 base maps) is shown here in a set of nine maps at a scale of 1:160,000 (Maps 2-10). At this scale, much detail is lost (a single dot locates many small sites), but the general patterns remain. Two 1:30,000 maps (Maps 11 and 12) reveal much more detail in and around the village of Lillooet.

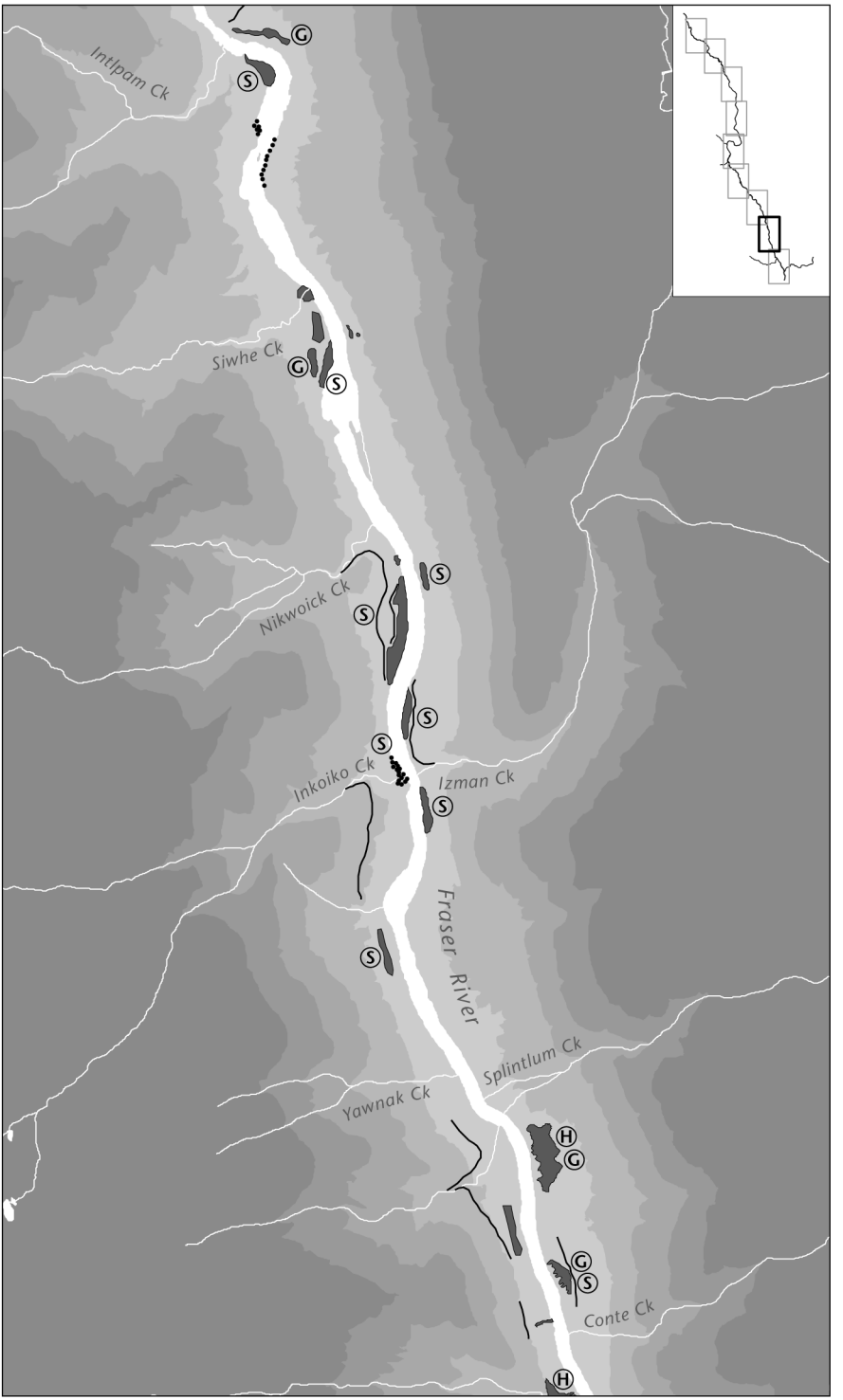
Terraces, composed of sediments deposited by the immediate post-glacial Fraser River or in ice- or debris-dammed post-glacial lakes,[19] extend from river level to 650 feet above the river; they range in area from less than 5 acres to one hundred and more. Save the river channel itself, they occupy virtually the entire valley. Terrace surfaces, once almost horizontal, are frequently sloped by layers of "slope-wash" sediments introduced from the valley walls. Old Californians and others recognized the river terraces for what they are: ancient river and lakebeds, banks, and bars. Because water from the Fraser River was not easily available to work the terraces, by the end of the placer mining era, and probably much earlier, water from virtually every perennial and ephemeral stream in the study section that drained into the Fraser had been harnessed for placer mining. With one exception (Kelly Creek) all tributary streams join the Fraser either through or adjacent to terraces. For the most part, west bank tributaries drain larger basins and higher elevations with far greater snowpacks (or, in four cases, glaciers) than those entering from the east.

The hydraulic works supporting placer mines in the study section are found above the Fraser from Lytton to Big Bar. No considerable interval in the 80-mile corridor is without remnants of ditches ranging in length from a few hundred feet to several miles. The longer ditches are almost all on the water-poor east side of the river; those on the

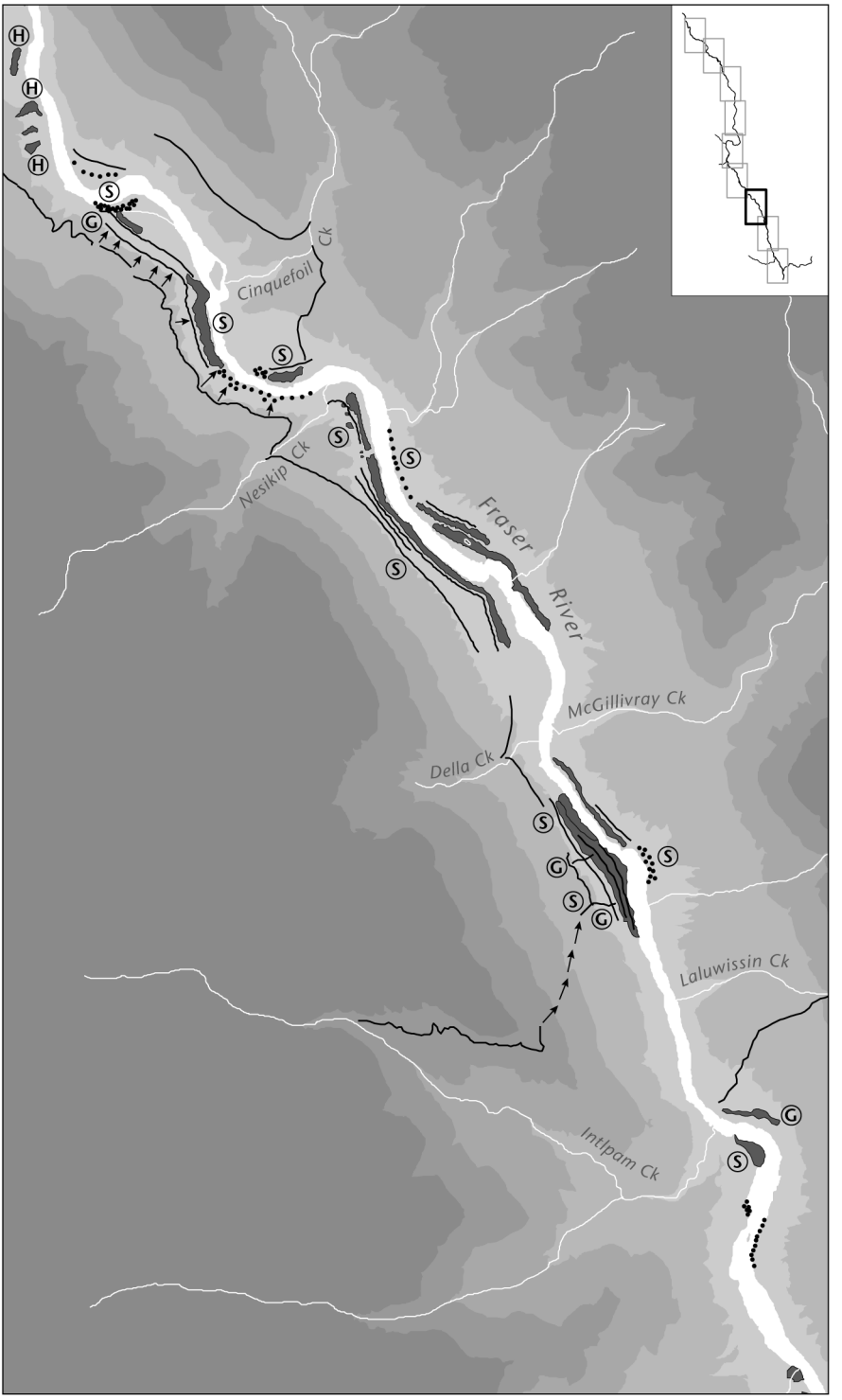
[19] Trettin and Ryder, reporting on fieldwork, mapped and reconstructed the late glacial landscapes of the Fraser River in the middle canyons. See H.P. Trettin, "Geology of the Fraser Valley between Lillooet and Big Bar," in *British Columbia Department of Mines and Petroleum Resources Bulletin* 44 (Victoria: Queen's Printer, 1961), 2-3; J.M. Ryder, "The Lillooet Terraces of the Fraser River: A Palaeoenvironmental Inquiry," *Canadian Journal of the Earth Sciences* 23 (1986): 869-84.



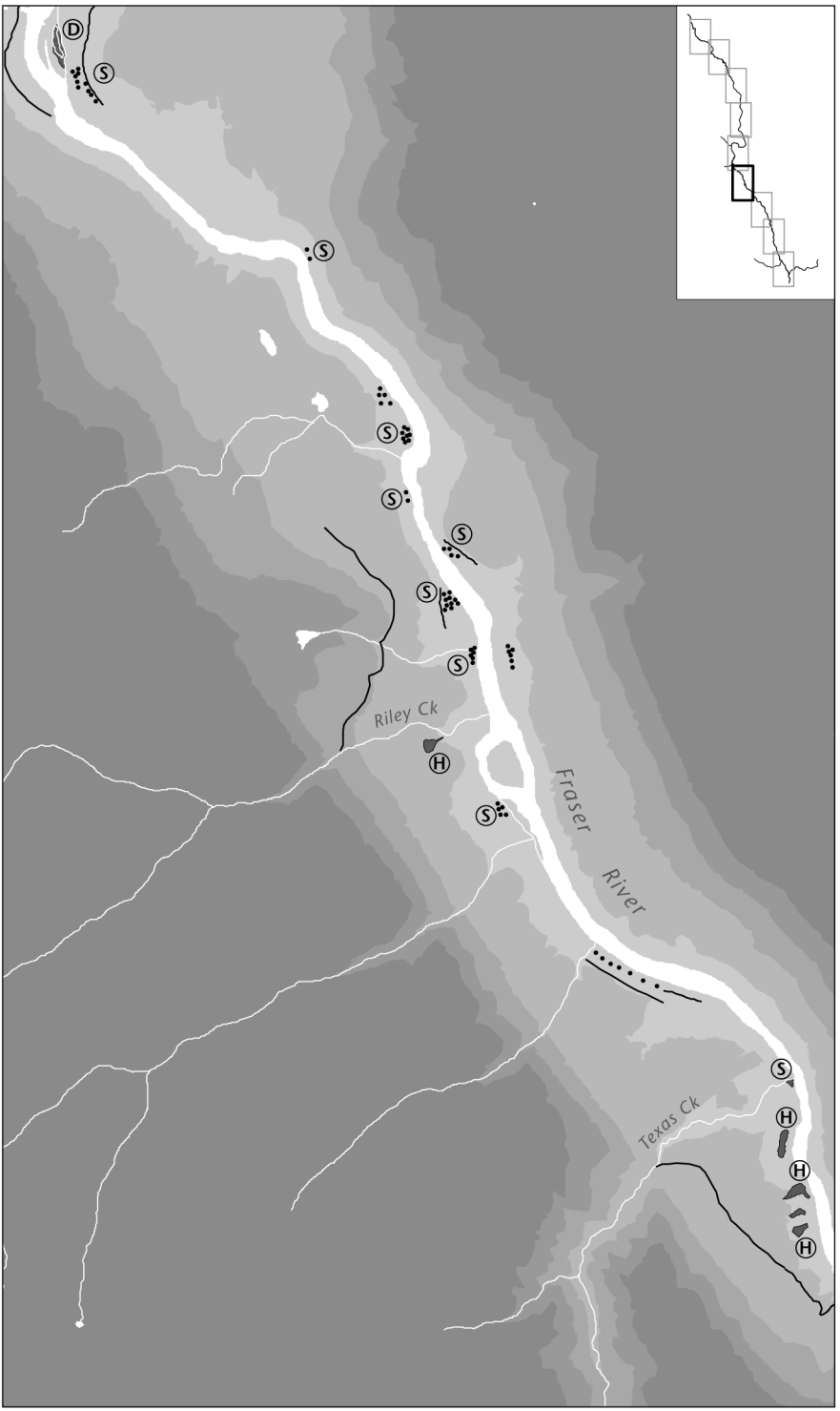
Map 2. Lytton/Stein River to Conte Creek. Cartography by Eric Leinberger.



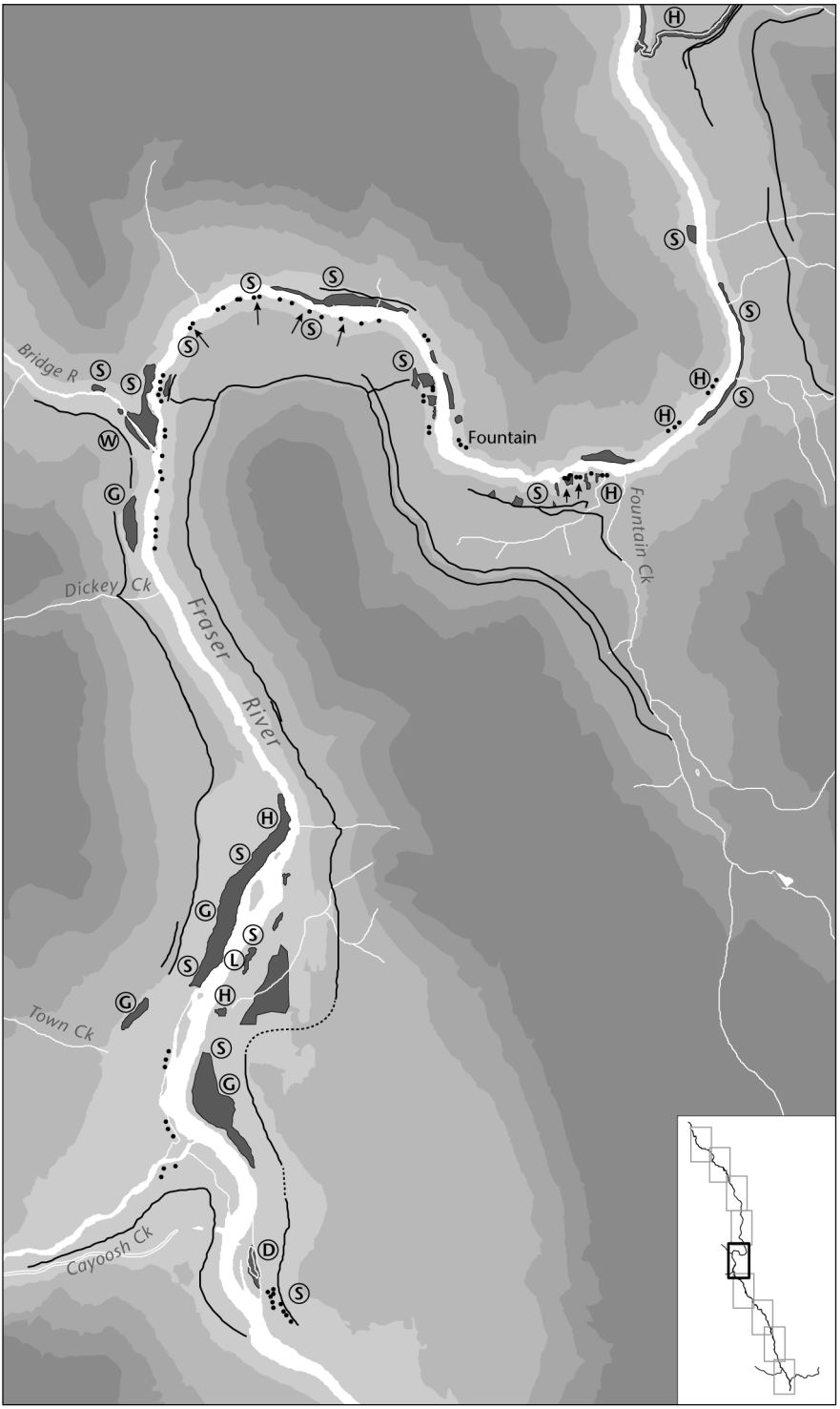
Map 3. Conte Creek to Intlpam Creek. Cartography by Eric Leinberger.



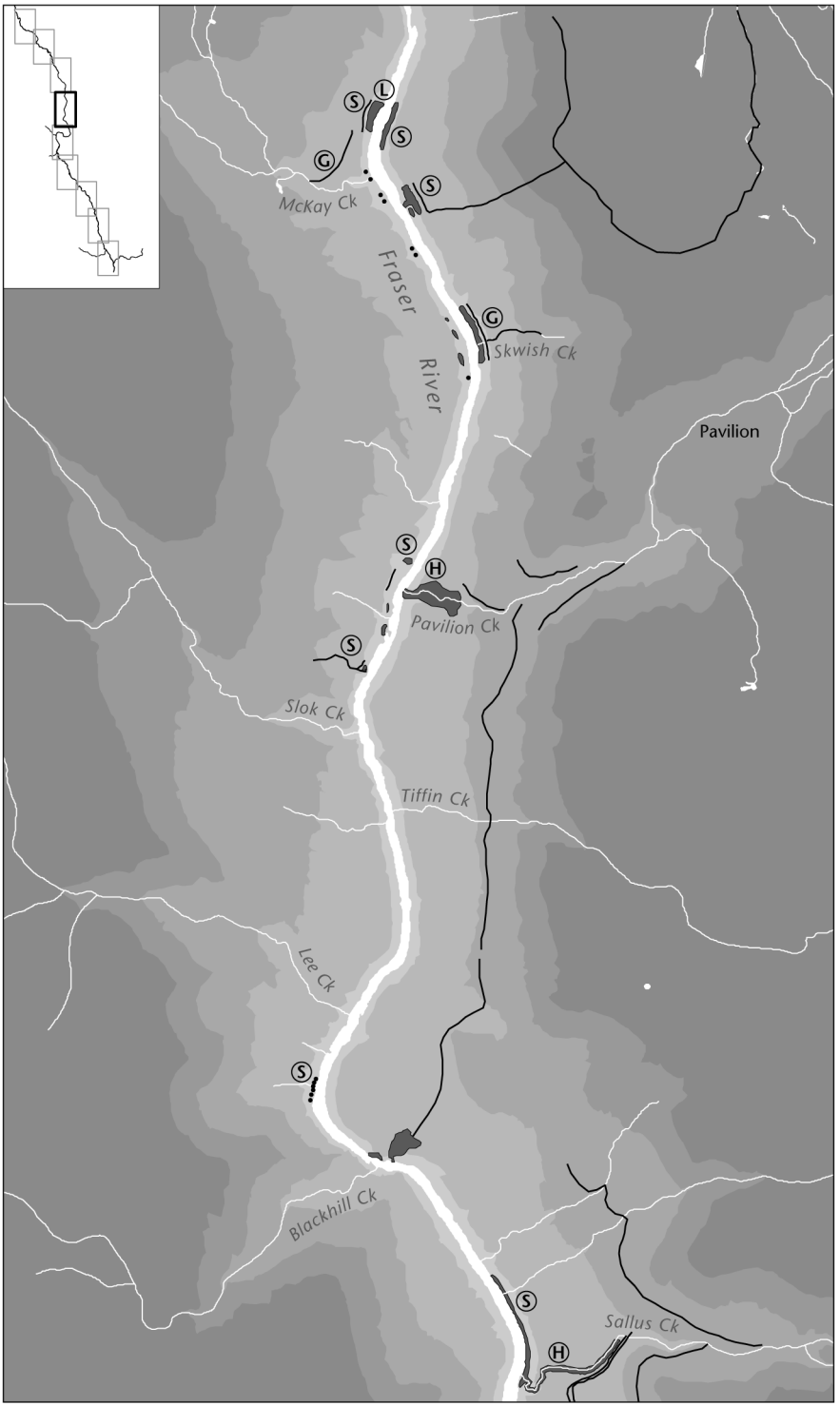
Map 4. Intlpam Creek to Cinquefoil Creek. Cartography by Eric Leinberger.



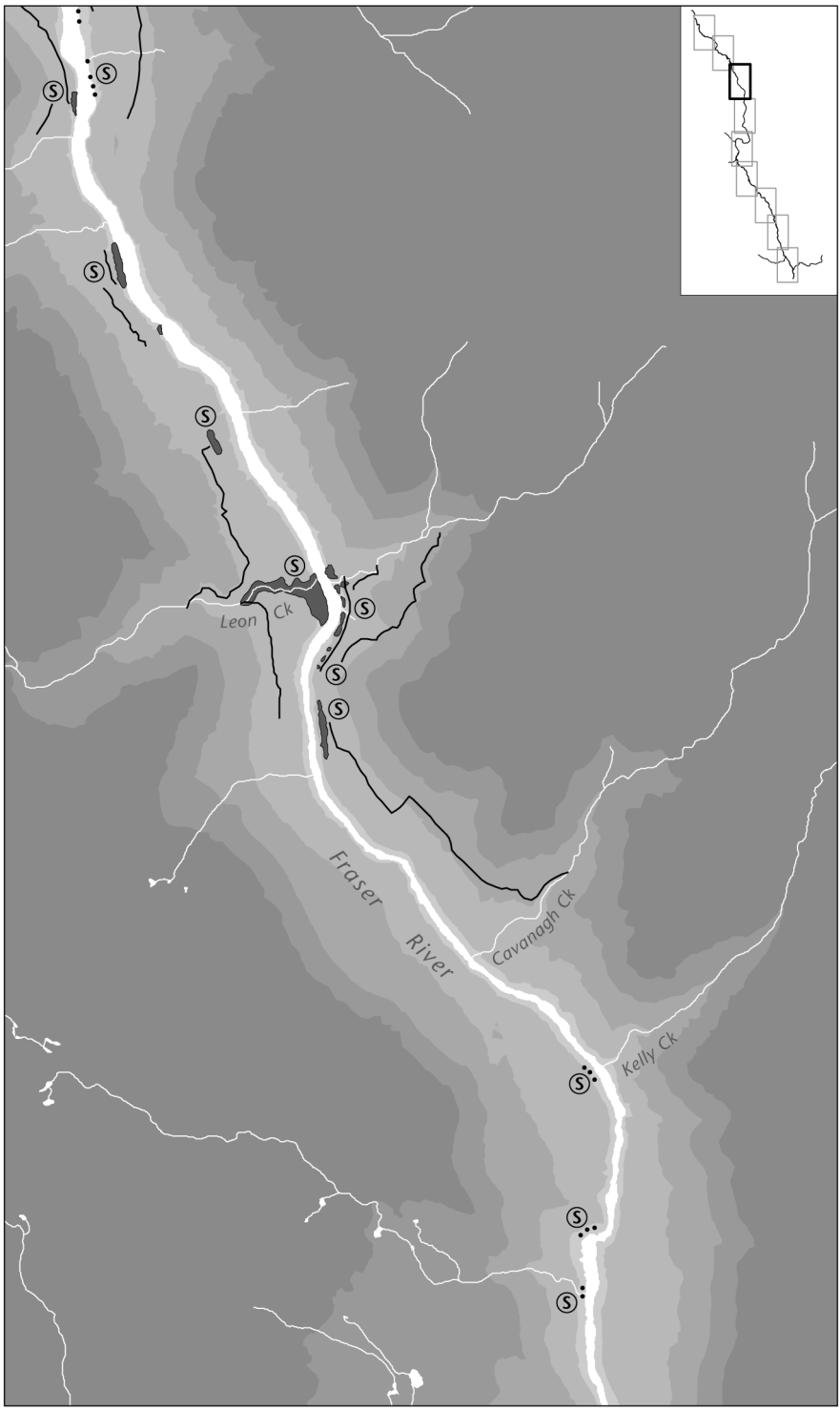
Map 5. Cinquefoil Creek to Horsebeef Bar. Cartography by Eric Leinberger.



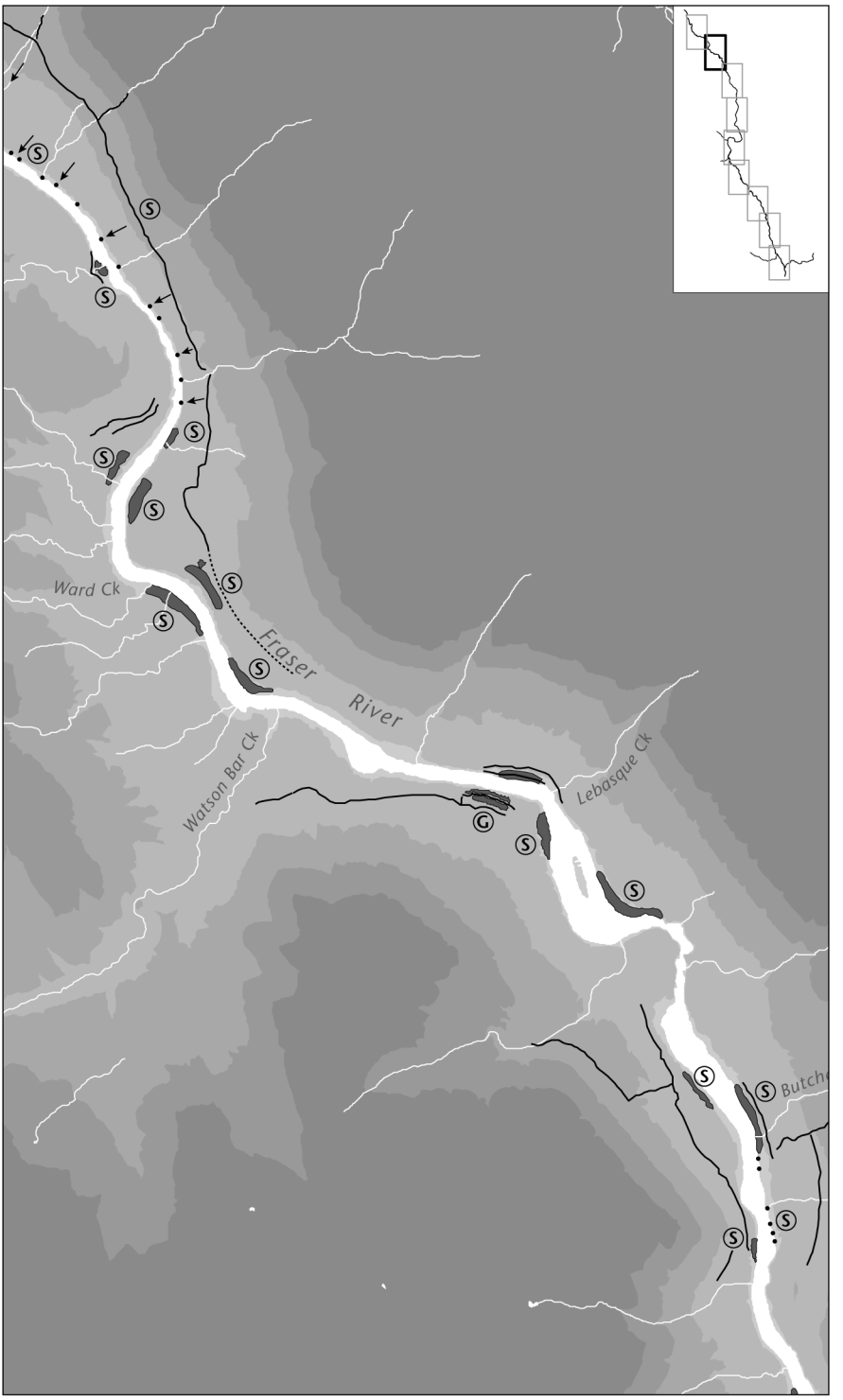
Map 6. Horsebeef Bar to Sallas Creek. Cartography by Eric Leinberger.



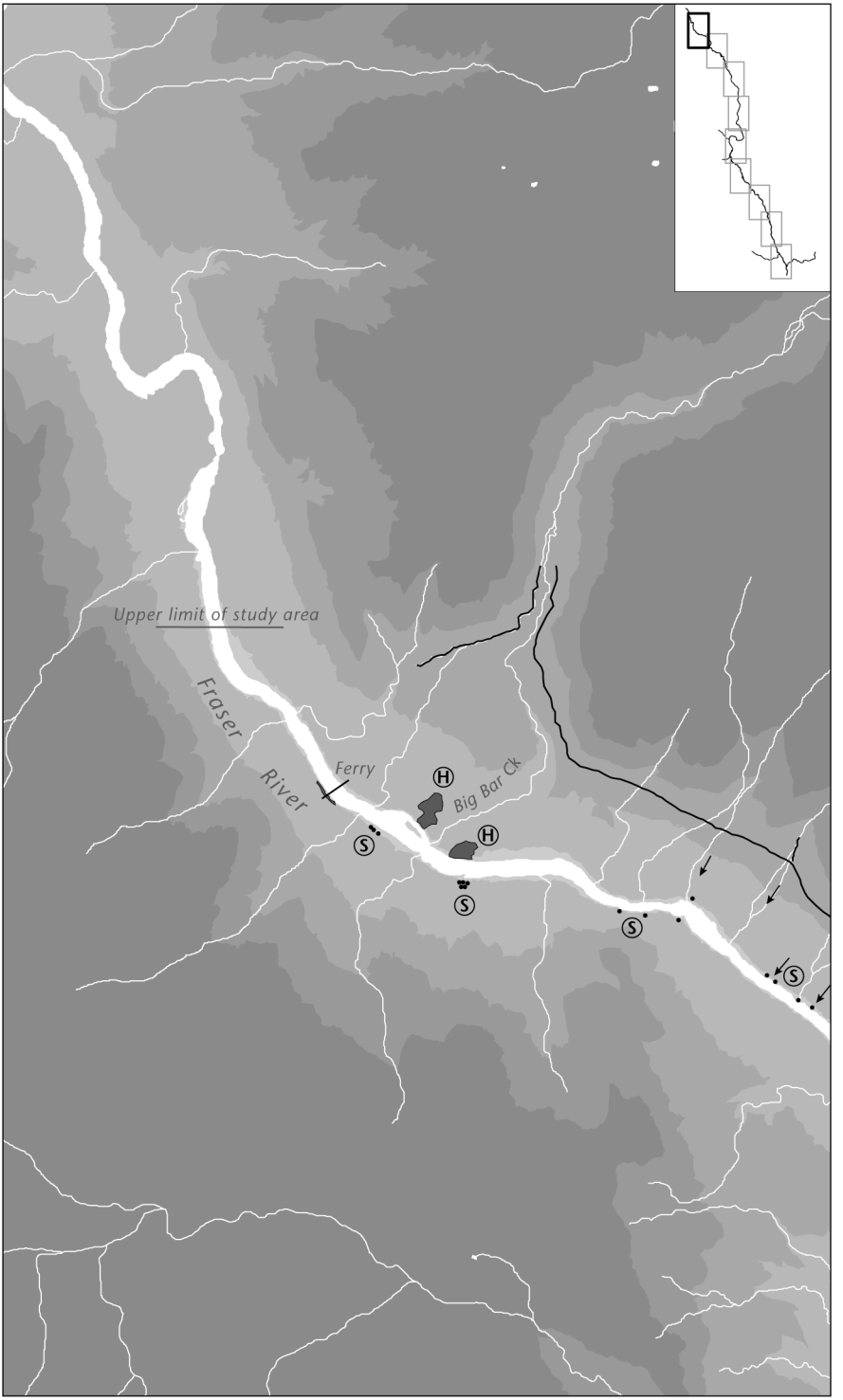
Map 7. Sallas Creek to McKay Creek. Cartography by Eric Leinberger.



Map 8. McKay Creek to Leon Creek. Cartography by Eric Leinberger.



Map 9. Leon Creek to Ward Creek. Cartography by Eric Leinberger.



Map 10. Ward Creek to Big Bar Ferry. Cartography by Eric Leinberger.

west side usually carried more water. The ditch works themselves vary in complexity from the simplest hand-dug channel to complex systems incorporating storage reservoirs. Some ditches added water from tributaries intersected en route and distributed it in many short ditches or in steep spillways that brought water, staircase fashion, down the canyon slopes to a series of prospects. Once a ditch was in place, any prospect below it, from the intake to the final destination, could be mined using sluice box technology and its variants.

The following observations can be made about the placer mining sites shown on maps 2-10. Almost all *pan* and *rocker sites*, once almost ubiquitous throughout the study section, have been effaced by high water. Except near Fountain, such sites do not appear on these maps. Although floods have also removed the *long tom* and *sluice box* sites that were situated on river bars and along the lower banks and were served by short ditches, such sites have survived on the upper banks, valley slopes, and terrace surfaces, as have their ditch systems. They are the largest and most common placer sites in the study area. Seventy-three such sites are shown on the maps. *Ground sluice sites* commonly extend back from terrace "lips." Twenty-three have been identified, most of them in the southern half of the study area. Only eighteen *hydraulic sites* are identified, again mostly in the south. The largest may be on lower Pavilion Creek,[20] but the largest cluster (9) of such sites was worked in sequence along Canada Flat below the Old Bridge at Lillooet. *Dredging sites* appear on these maps only near Lytton, Lillooet, and High Bar.

COMPOSITE/COMPLEX SITE: "LILLOOET"

Maps 11 and 12, which show the Lillooet area at a scale of 1:30,000, reveal elaborate ditch systems and the remains of all placer mining technologies except river mining and wingdamming (both practised nearby). The location and extent of placer mining features (including ditches) are indicated and briefly discussed below. The complexity of this Lillooet example is not unique, although rarely were so many different technologies associated in so compact an area. The typonomy on maps 11 and 12 dates from 1858 to 1860.

[20] The site on lower Pavilion Creek, while apparently a hydraulic mining site, awaits final confirmation as such.

Site 1: Lillooet "Old Bridge" hydraulic mine

The Lillooet Hydraulic Mining Company developed eight or nine hydraulic mines that removed much of the gravels and finer sediments that made up the northern half of Canada Flat. Activity on this site is shown in Figure 4. Beginning in 1890, the operation ran seasonally for fourteen years.[21] It employed a team of Chinese miners for much of this time and drew water in an enlarged and extended ditch (much of which is still visible) from Four Mile Creek (French Creek, more recently Dickey Creek). These mines overrode an earlier rocker and sluice box tailings landscape, some of which survived for fifty years on the southern part of the flat until lost to residential subdivisions. The two or three hydraulic mines that survive display the classic features of their type. They are characterized by a "teardrop" plan within which is a dendritic pattern of eroded gulleys and remnant ridges that define the as-mined distribution of paying and non-paying material. The steep back wall, or "scarp," drops to a gently sloping "wash-pit," which drains to a carefully graded sluice line through the narrow end of the teardrop and then deposits a fan of large cobbles at the riverbank. Of the mines converted to housing sites, landfill, or a storage yard, only the cobble fans remain.

Site 2: Lillooet west sluice site

On the south end of "Canada Flat" and the hill slope to the west, placer features were once relatively intact and comprised the largest rocker and small sluicing landscape in the area. The direct evidence for sluicing is the small ditch remnant near the top of the rear terrace "riser" (the steep hillside at the rear of the terrace) as well as stacked cobbles. The hillside is littered with scattered tailings piles and continuous small "fields" of heaped cobbles. Except along the edge of the terrace directly above the river, most of the cobble stack features on Canada Flat proper have been removed by earth-moving equipment. A cobble-walled dugout shelter survives, as does a small area of parallel stacked cobbles – visible when air photos from 1950 are greatly enlarged. The south end of Canada Flat is the site of the only documented bucket-dragline placer mining operation in the study section. The location of the site is revealed in photographs; an expanding urban footprint has removed the cobble piles once associated with it.

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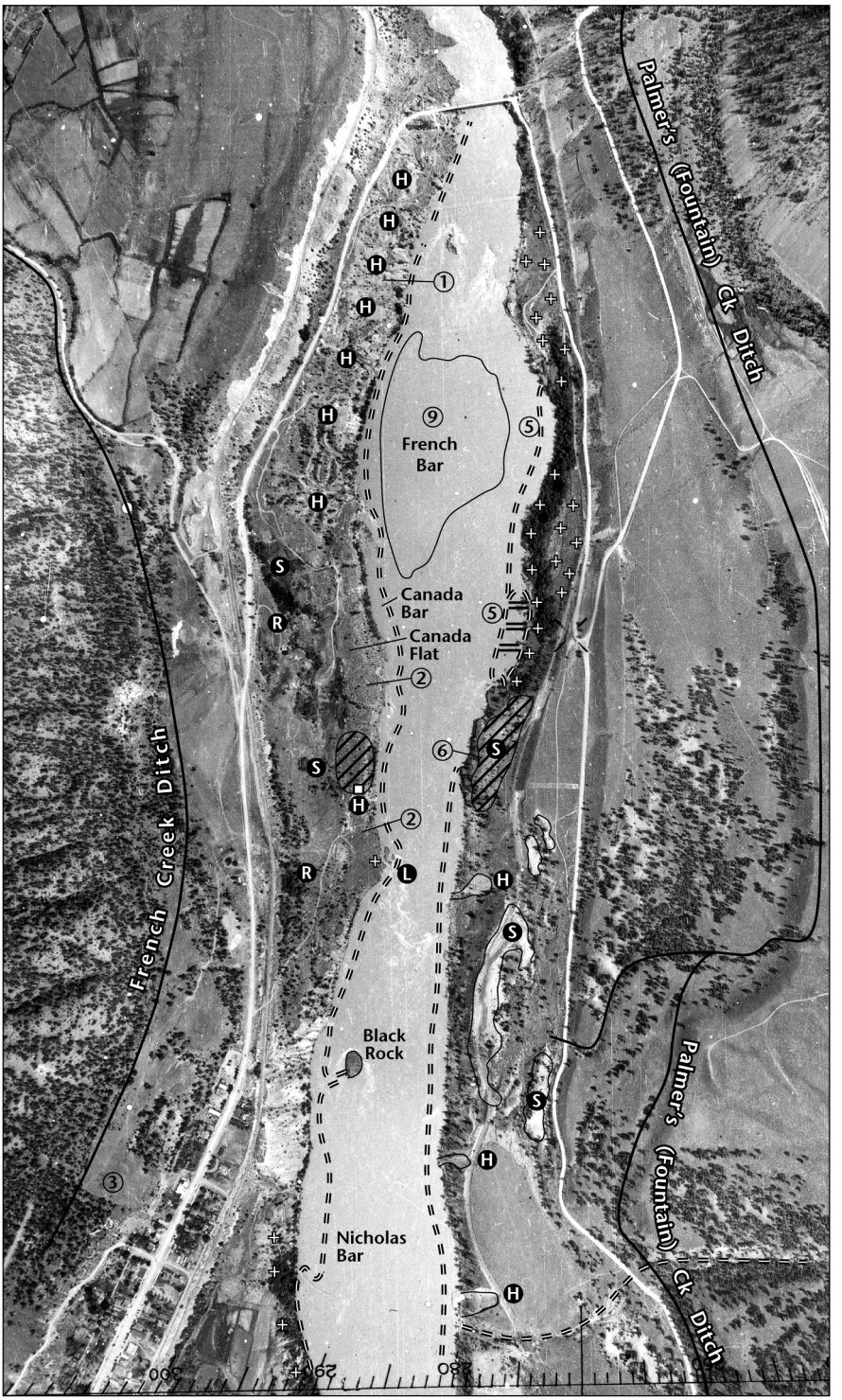
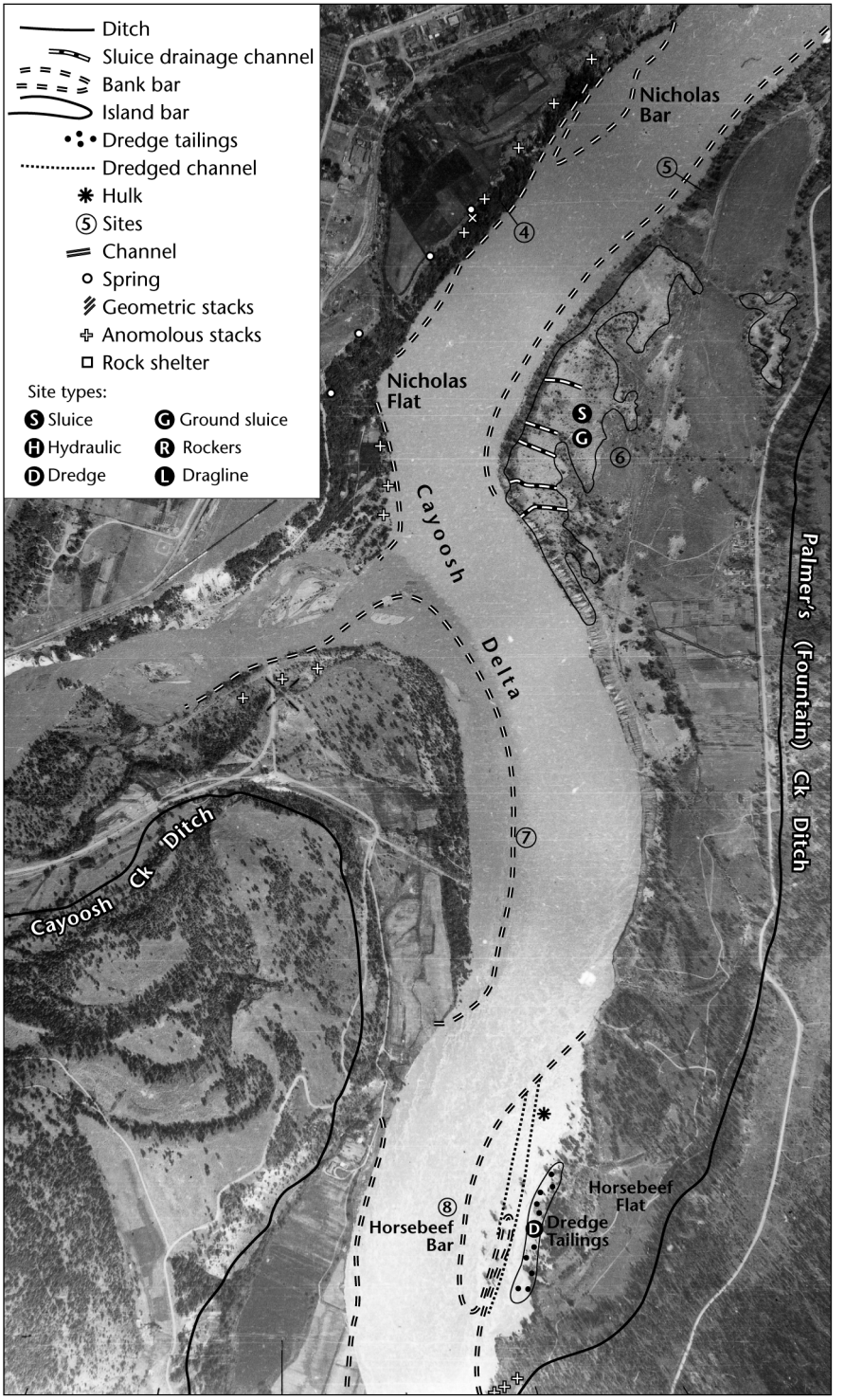
[21] The activities at the hydraulic mines below the "Old Bridge" at Lillooet are a regular feature in the annual reports to the minister of mines between 1890 and 1904. See British Columbia, *Report to the Minister of Mines*, 1890-1904 (Victoria: Queen's/King's Printer, 1890-1904).



Map 11. "Lillooet" North unit. Cartography by Eric Leinberger.



Map 12: "Lillooet" - South unit. Cartography by Eric Leinberger.

Site 3: Upper Lillooet ground sluice

Located between the village core and an adjacent residential subdivision, and occupying part of the lot of the "Miyazaki Heritage House" in the village proper, this site (shown in Map 11) is much frequented and largely unrecognized. In 1890, two local companies staked the terrace above the village and drew water from Sawmill (Town) Creek and Four Mile (Dickey) Creek to ground sluice away four feet of overburden and work the exposed auriferous sediments.[22] The surviving landscape contains most of the elements of a ground sluice placer mine: well-defined back-wall scarps, heaps of cobble tailings, drainage channels, remnants of ditches, and the absence of high ditches and head-boxes associated with hydraulic mining. Road construction through the site has probably removed the "beds" that once held the sluice boxes.

Site 4: West riverbank sites

The west side of the Fraser River from the south end of Canada Flat to the mouth of Cayoosh Creek comprises a major terrace "riser" (a steep hillside above the river), two of the lowest terraces in the area, the northern portion of the Cayoosh Creek delta, and extensive bars. Evidence of placer mining in the form of scattered piles of cobbles appears low on the terrace riser/hillside, and although no evidence of ditching survives, several of the small springs flowing out of the tread are mentioned in the Gold Commissioner's record of water rights in the 1859-1861 ledger.[23] No evidence of placer mining appears on the delta or the bars, but they are mentioned as active mining sites in reports from "our wandering correspondent" in the *Victoria Gazette* in 1858.[24]

Site 5: East riverbank sites

At low water (September to May) much of the east shore from the Old Bridge south to Horsebeef Bar is exposed as cobble bars or sand bars varying in width up to one hundred feet. Placer mining activity here dates from 1858, and the absence of ditching suggests rockers, although

[22] The operation of the ground sluice on the terrace above the village of Lillooet is initially reported in the 1890 report to the Minister of Mines. See British Columbia, *Report to the Minister of Mines* (Victoria: Queen's Printer, 1890), 376.

[23] Assistant Gold Commissioner's ledger (Lillooet) water records and transfers for 1859 and 1860. See British Columbia, Government Agent (Ass't Gold Commissioner), Lillooet, BCA, GR 0224, box 21 (ledger), Victoria.

[24] De Groot's great circuit of the upriver goldfields in the fall of 1858 took him past the mining activity around the terminus of the Harrison trail (Lillooet). And, in his usual fashion, he made careful observations and kept copious notes.

the presence of small springs in the north and an indication of water recording in the 1859 ledger suggest some sluicing at that time.[25] The completion of the Fountain Creek Ditch in the 1870s (bringing water all the way to Horsebeef Bar) does not seem to have affected work on the bars, although on the higher terraces fans of cobbles suggest hydraulic mining and sluicing.

In the northern part of this site, the lower slope of the steep bank to the river has been mined away, leaving cobble fans along the entire section. Visible channels on exposed cobble bars have been created by the removal of the large cobbles by hand labour in an attempt to reach auriferous material below and between the stones. These "channels" run from the top of the bars to the water's edge, and one of them has reached bedrock. This is the only example of this technique encountered in the area.

Site 6: East terrace sluice sites

This site extends at terrace level from the south end of Site 5 to the northern end of Horsebeef Bar (Site 8) and is an outstanding example of the scale of activity that can result from bringing water in volume to a major terrace. The terraces and adjacent river bars on the east side of the river at Lillooet were the incentive for the construction of the eleven-mile-long Fountain Creek (Palmer's Creek) ditch in 1874. The northernmost part of Site 6 is a small terrace riverward and below the abandoned Pacific Great Eastern Railway roadbed; much of its surface consists of parallel stacks of cobbles (evidence of sluicing) running across the terrace below a shallow scarp. The whole surface was once occupied by these stacks, but recently much of it has been cleared for an equipment storage site. There are scattered piles of cobbles on the slopes and lower small terraces. However, most placer mining on Site 6 was on the large southern terrace, two-thirds of which has been modified substantially. Five sluice channels run across an eroded surface to discharge into the river down the "riser" of the terrace.[26] The eroded surface is several feet lower than the original terrace surface, and although much of the site has been modified in the process of constructing a modern sawmill, the outlines of a mined surface and headward scarp are easily discerned.

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[25] Assistant Gold Commissioner's ledger water rights recorded on Derouses' Spring below the "Old Bridge" site, 1 November 1859 and 27 February 1860. See British Columbia, Government Agent (Ass't Gold Commissioner), Lillooet, BCA, GR 0225, box 21 (ledger), Victoria.

[26] Aerial photograph: X516:3 (enlarged) 1950 Moran project set, UBC Department of Geography.

A suite of linear markings below the scarp is visible on air photos.[27] Site visits located cobble fans on the lower terrace and upper bar surfaces that may be associated with now-erased sluice channels. This site was either a sluicebox or a ground sluice site. Adjacent to the main terrace and cut into the terrace riser are three hydraulic mines, one of which still has an intact cobble fan, that drained to the river.

Site 7: Southwest bar site

This site, south of Cayoosh Creek on the west side of the river, consists of several terraces, the southern portion of the Cayoosh Creek delta, and an extensive bar. Visible evidence of placer mining consists only of scattered cobble piles on the lowest terrace adjacent to the Cayoosh delta. Much of the southern half of this terrace was heavily modified when, in the 1950s, as the final stage of the Bridge River hydro development, the BC Electric Company built the Seton hydroelectric generating plant. The Gold Commissioner's ledger indicates that there was a water record and associated ditch on Cayoosh Creek in 1859-61,[28] physical evidence of which survives to the present in the form of a ditch extending from the "McDonnell farm" (now Roshard's) on the Fraser River above the southernmost west-side bar two and a half miles to Cayoosh Falls.

Site 8: Horsebeef Bar

Horsebeef Bar and Horsebeef Flat southeast of Lillooet were common subjects of newspaper correspondence and reports to the minister of mines from 1858 until 1909.[29] They have seen almost all of the placer technologies used on the river, some of them at record scale. The bar and flat were the final destination of water in the Fountain Creek ditch system (completed c. 1874), but mining began on the bar with rocker work in 1858. No evidence of rockers and sluicing remains on the large bar, but ditches and cobble stacks on the flat are remnants of sluicing. In 1897, dredges began operations on Horsebeef Bar. Three main features of dredging are present: a long shallow dredge-eroded channel that

[27] Aerial photograph: X516:4 (enlarged) 1950 Moran project set, UBC Department of Geography.

[28] Assistant Gold Commissioner's ledger recorded water rights 11 September 1860 and 1 June 1861. See British Columbia, Government Agent (Ass't Gold Commissioner), Lillooet, BCA, GR 0225, box 21 (ledger), Victoria, 269 and 277.

[29] De Groot, en route downriver from the lower French Bar December 1858, reported sluicing and rocking at Horsebeef Bar. See *Victoria Gazette,* 18 December 1858. In the 1879 and 1880 reports to the Minister of Mines, further activity is noted, and from 1896 through 1909 the reports describe dredging operations on Horsebeef Bar. See British Columbia, *Report to the Minister of Mines* (Victoria: Queen's Printer, 1879, 1880, 1896-1909).

Figure 6. Vista, Complex Site south to north, Horsebeef Bar in foreground. *Source:* the author.

divides the bar in half along its long axis and is visible at mid-flood; between the bar and the bank a long and originally steep-sided island of stacked cobbles placed by the dredge's conveyor-stacker; and, at the north end of the bar embedded in the cobbles, the timbers and ironware of the dredge "Bliss #1." Here may well be the most extensive remains in British Columbia of early dredging.

Site 9: Island Bar (French Bar) sites

Associated with Canada Flat are Canada Bar and French Bar, both repeatedly mentioned from 1859 through 1861 in newspaper correspondence and in the Gold Commissioner's ledger.[30] Correspondence in the *San Francisco Evening Bulletin* reports sluicing, and records of water rights on the several small springs at the base of the terrace at the rear of Canada Flat also attest to sluicing on the flat and adjacent bars. The associated ditches were short. Although French Bar is well positioned for wingdamming, there is no indication of it.

[30] De Groot, reporting for the *Alta California* and quoted by the *Victoria Gazette,* noted evidence of extensive activity during the summer and early fall of 1858. See *Victoria Gazette,* 18 December 1858. Entries in the Assistant Gold Commissioner's ledger for 1859 and 1860 record claims and water rights for adjacent springs. See British Columbia, Government Agent (Ass't Gold Commissioner), Lillooet, BCA, GR 0225, box 21 (ledger), Victoria, 244 and 250.

CONCLUDING OBSERVATIONS

Because the area of the larger placer operations shown on maps 2 to 10 can be calculated, and because, in many cases, scarp heights are known and the original landscape can be generally reconstructed, it is possible to calculate the volume of material removed from these sites. On the other hand, only the crudest estimates can be made of the volumes removed from small operations. Yet – and pending work on this matter that is now in process – the impression is that placer mining on the Fraser River stripped massive amounts of sediment from the bars, banks, beds, and terraces of the river valley and fed them into the active river. Placer mining must have substantially altered the behaviour of the Fraser River (probably considerably affecting, for example, the rate of growth of the Fraser delta) as well as life in and around it. It may still affect the quantity of gravel in, and the movement of gravel throughout, the whole lower Fraser system.

The thousands who came to the Fraser in 1858 during the initial gold rush and the hundreds who persevered on the river through the following half century differed enormously in their placer mining skills. Of the estimated gold rush population of some thirty-five thousand or more, only a small fraction worked the banks, bed, and bars of the river. The number of genuinely skilled "old 49ers" was even smaller, but this core group included experts in the art, craft, and, to some degree, science of placer mining. Except, perhaps, at the beginning of a rush, when there were often rich surficial deposits, placer mining in out-of-the-way places required many skills: knowledge of how to get along in isolated, improvised circumstances in the bush; social skills without which stable partnerships could not be maintained; a basic knowledge of applied geology and fluvial geomorphology; and considerable experience in the construction and profitable operation of many of the technologies of placer mining described above. A rocker, for example, was a complex device; a poorly constructed rocker would neither retain fine gold nor last for long. A sluice box had to be pitched at the correct gradient, and riffles, fabric, mud boxes, and mercury traps used in combinations (depending on the type of material being washed) that could only be suggested by experience. Time ran against both novice and experienced miners: gold had to be had or neither daily expenses nor initial costs would be met, and people would be forced to hire out their labour or quit the goldfields. Most did leave within weeks or months.[31] The more

[31] A benefit of these departures for those who stayed was the acquisition of "outfits" at fire-sale prices.

skilled were the more likely to stay, and the landscapes they left behind and the many fine calculations embodied therein only heighten one's appreciation of their skills.

Whether miners of different ethnicity brought different skills, emphasized different technologies, and left behind different landscapes are matters that cannot now be fully resolved. The influx of miners in 1858 was ethnically diverse. Their successors along the middle Fraser were largely Chinese or First Nations. A question, then, is whether the remains of placer mining at particular sites can be used to infer the ethnicity of the miners. The evidence from other goldfields is equivocal. Working in New Zealand, historical archaeologist Neville Ritchie[32] once concluded that the landforms at placer mining sites could not be tied to ethnicity;[33] but later, noting strong correlation between sites types and archival evidence of ethnicity, he became convinced that geometrically stacked cobbles (associated with sluice boxes) were created by Chinese miners.[34] On the other hand, and after intensive study of Chinese mining sites in southern Oregon, historical archaeologist Jeffrey LaLande[35] has concluded that, without other evidence, it is not possible to attribute stacked, geometrically arranged tailings to any particular ethnic group. In LaLande's view, technological diffusion was very active throughout the goldfields of western North America.[36] In the canyons of the Fraser River, there is no doubt that many of the large, geometrically arranged cobble fields were left by Chinese miners, but it is not clear that they all were. If Native miners tended to rely on rockers, they did so, presumably, because of limited access to capital.

Much of the fieldwork for this study took place on and around cattle ranches and farms that now occupy most of the terraces in the canyons of the Fraser River. Ranchers and farmers were drawn not only by the markets the gold rushes provided but also by the hydraulic landscape of placer mining – the ditches, flumes, spillways, dammed reservoirs, and controlled tributary drainages. The irrigation works vital to agriculture on the semi-arid canyon terraces were almost completely adopted from

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[32] Neville Ritchie, a historical archaeologist with the Government of New Zealand, has done extensive work on the mining landscapes of New Zealand and the Chinese presence.

[33] Neville Ritchie, "Archaeological Interpretation of Alluvial Gold Tailing Sites, Central Otago, New Zealand," *New Zealand Journal of Archaeology* 3 (1981): 54-62.

[34] Neville Ritchie, personal communication, 2006.

[35] Jeffrey LaLande is an archaeologist and historian, recently retired from the United States Forest Service in Oregon, who has done extensive work on Chinese mining in southern Oregon.

[36] J.M. LaLande, "Sojourners in Search of Gold: Hydraulic Mining Techniques of the Chinese on the Oregon Frontier," *Journal of the Society for Industrial Archaeology* 11, 1 (1985): 29-52.

abandoned placer mining ditches and associated hydraulic works. In some notable cases, these ditch works still serve today. In this part of British Columbia, two stages of early settlement locked into each other, and it is certainly debatable whether agriculture could have taken hold in the upper canyons in the 1860s and 1870s without the "gift" of a very costly hydraulic infrastructure.

In the United States, Australia, and New Zealand, legislation protects placer mining sites from being erased by urban and industrial development. It is perhaps time that British Columbia attended to the conservation of these historic sites in the Fraser River canyons.