Hydraulic Power and Coal Loading at Newcastle Harbour, New South Wales

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The Hunter River Valley north of Sydney contains one of the richest known and first discovered coalfields in Australia. A series of sandstone escarpments to the south virtually isolated the Hunter from Sydney in the nineteenth century. Exploitation of the Hunter coal reserves necessitated the establishment of a port at Newcastle, at the mouth of the Hunter River. This paper traces the development of Newcastle's coal wharves on what were originally mud flats and sandbanks in the estuary and, simultaneously, the construction of the first of Australia's hydraulic power-houses built to provide power for the cranes. The author is a consultant archaeologist who has worked in Sydney and Newcastle.

The east coast of Australia is not endowed with natural harbours. In the nineteenth and early twentieth century, river estuaries were used for local shipping but, for the main part, the river mouths were shallow. Navigation was hazardous. Furthermore, the eastern rivers are short, being confined to a narrow coastal plain which is cut off from the interior by the Great Dividing Range. Gaps in the Divide are few and far between. Few, therefore, of the river ports had much by way of hinterland to supply or receive trade goods.

One exception to this rule is the Hunter–Goulburn river system, which, alone in New South Wales, penetrates the Eastern Highlands and provides access to the interior. The Hunter Valley contains also one of the richest coalfields in the continent. Coal was a major reason for the establishment, at the mouth of the river, of the first penal settlement on mainland Australia outside the County of Cumberland (Sydney). That settlement was to develop into the city of Newcastle (Fig. 1).

Newcastle, as a harbour, had much the same problems as other river ports. A treacherous sandbank stretched from the north across much of the entrance. Low, sandy islands dotted the estuary. Mudbanks built up near the shores. The harbour as seen today was made not by nature but by man. Indeed, much was the creation of one man, Edward Moriarty.

Early coal loading in Newcastle was concentrated on the south side of the harbour. The south side was protected from prevailing storm winds. The south side was where the mines were. By the 1860s, however, coal exploitation was spreading west as more and more coal companies entered the field. Production increased. Expansion of wharfage on the south side of the harbour was limited by the depth of water. Congestion grew, as did delays in loading.

As early as 1857, Moriarty advocated that wharves be built on Bullock Island, now Carrington, a narrow mudflat partially submerged at high tide, which ran approximately north to south some 3km west of the harbour mouth. The land required would be reclaimed using ships' ballast. In August 1861, Moriarty propounded his views to the Philosophical Society in Sydney. A transcript of his paper was published in the *Newcastle Chronicle* on 21 and 24 August in that year. At that time, a sandbank of some 650ha ran north to south on the east of the island. Moriarty proposed depositing a cordon of ballast along the margin of this bank, which would both prevent it flooding at high tide and also divert the flow to scour a channel east of the ballast. Ultimately, this dyke would be widened and faced with a line of wharves which would be connected with Bullock Island by an area of reclaimed land, leaving some 360ha of water to form an eventual shipping basin to the south.[1]

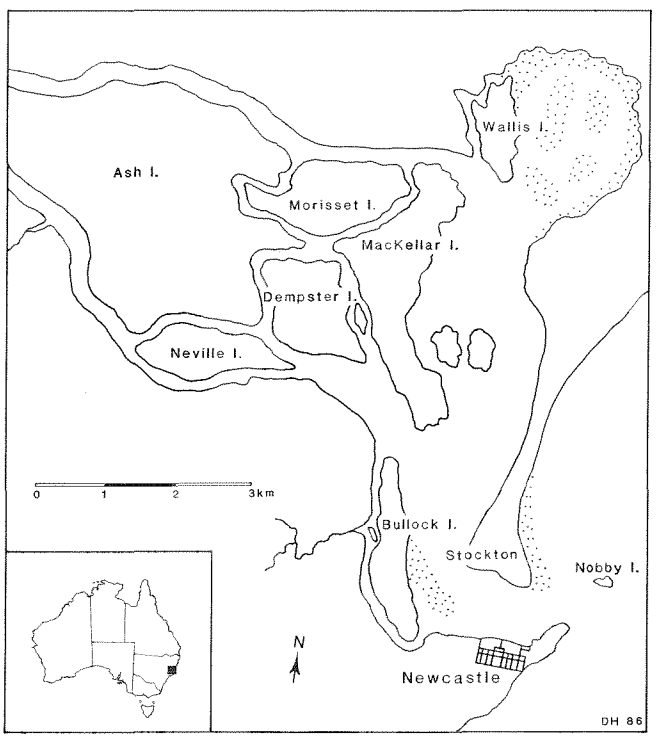
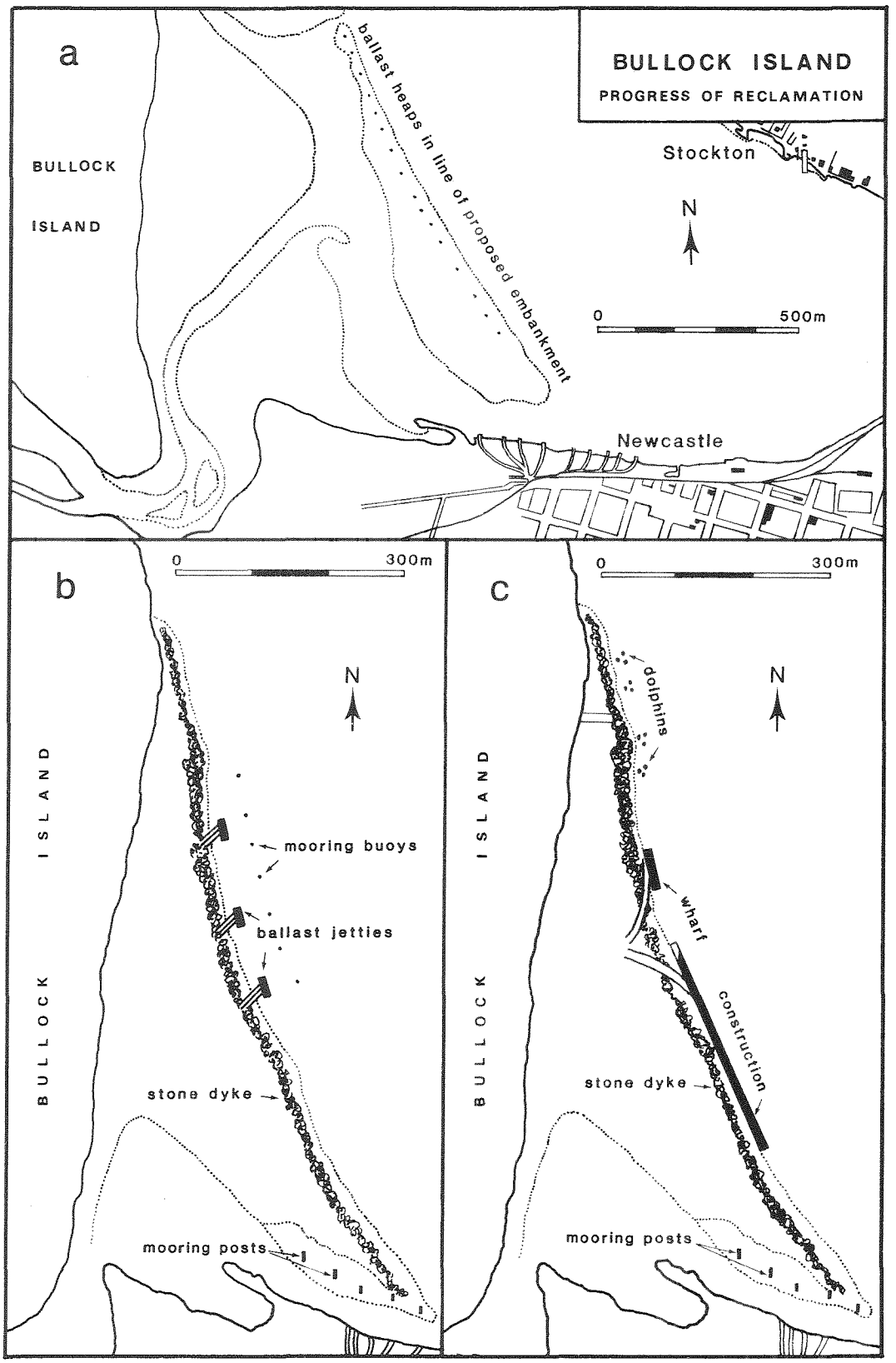


Fig. 1: Hunter River Estuary (c.1824), adapted from Public Records Office (London) Map CO. 201/194.

The concept was grandiose, possibly the biggest harbour construction proposal in the southern hemisphere. It took some time to gain government acceptance and many years were to pass before the project was completed, though it was never intended that the whole be built immediately. From the beginning, however, construction was geared to the eventual creation of the total complex comprising both the dyke and the basin, as dotted lines on harbour charts from this time on indicate. In the maps included here, those lines have been



omitted so that the actual construction over time is made clearer (Fig. 2).

Work began in 1862, if somewhat haphazardly. The *Newcastle Chronicle* in 1863 used the words 'as rapidly as the quantity of ballast arriving . . . will admit'.[2] Gowlland's chart of 1866[3] (Fig. 2a) shows only 'Ballast Heaps in line of Proposed Embankment' but in September of that year a contract was let for the construction of two ballast jetties[4] which, by 1868, were being used to discharge stone. By 1874, the stone dyke

Fig. 2: Reclamation and wharf construction at Bullock Island in (a) 1866, (b) 1874, (c) 1876. Adapted from: (a) J.T. Gowlland: Newcastle Harbour, Newcastle Region Public Library (NRPL) LHM A623.894/28. (b) D.T. Allan: Chart of Newcastle Harbour and Port Waratah, Mitchell Library (ML) M2 811.252/1874/1. (c) D.T. Allan: Chart of Newcastle Harbour and Port Waratah, ML M2 811.252/1875/1.

ran the length of the sandbank (Figs 2b & 3) while the channel was being dredged. That year contracts were let for the construction of wharves, 50,000 pounds were voted for a branch railway to connect them to the Great Northern Railway at Hamilton, a distance of about 2km,[5] and the first plans for hydraulic machinery were received from Sir William (later Lord) Armstrong's factory.

Along the Bullock Island Dyke, wharves were built in 30m (100 feet) sections, 60m (200 feet) apart, starting about 230m from the southern end. Seventeen were built in 1875, the same year as the branch railway crossed Throsby's Creek on the west of the island.[6] By 1876, including all sidings, some 11km of single track had been laid, all in steel, designed to last six times as long as the iron rails normally used. In 1876–7, concrete foundations for the first four hydraulic cranes were laid at Berths 4, 5, 6 and 7, 90m (300 feet) apart. In the course of the latter year, the first ten wharves were connected to form a continuous timber-built wharf 838m (2750 feet) long.[7]

Despite the eulogies of the *Newcastle Morning Herald* of Armstrong as a builder of cannon,[8] which is also true, his greater claim to remembrance is as an hydraulic engineer. In 1840 he produced an improved hydraulic engine and in 1845, the hydraulic crane. Soon afterwards he started the Elswick Engine-works, in Newcastle-on-Tyne in England. It was from these works that the New South Wales Government sought to equip the Bullock Island Dyke with the latest in loading equipment, hydraulic cranes powered from a central power-house. The advance of this scheme over anything hitherto known in Australia must be seen in context. Instead of a series of noisy steam cranes, each belching its own smoke and dust, the whole of the motive power was concentrated at one point. Cornish boilers activated, at first, a single 100-horse-power pumping engine which maintained a constant water pressure in vast accumulators, located in towers at each end of the power-house. Each accumulator comprised a vertical cylinder, a massive casting 13.7m (45 feet) high and almost 130mm (5 inches) thick, in which a piston 500mm (20 inches) in diameter with a 7m (23 feet 6 inches) stroke was capped with a weight of 122 tonnes (120 tons). As water was pumped against this weight, the piston rose producing a pressure of 800 pounds per square inch. From here, a series of cast iron pipes 25mm (1 inch) thick carried the water to each crane where it was held in reserve, still under pressure, until needed.[9] The pressure in the pipes was, according to the *Newcastle Morning Herald's* leader of 7 November 1877, 'equal to a column of water of 1,848 feet [563m].' Should the cranes be idle and not take off this pressure, the piston in the accumulator rose to touch a chain which opened a valve in the accumulator itself, letting high pressure water back into the return pipe. Should this fail, a throttle valve cut off the steam to the hydraulic pumps.[10] There was a final safety measure. A slim pipe still runs up the back of the engine-room wall. A further valve allowed steam to pour up this pipe to a steam whistle which shrieked its warning across the Dyke. The drivers could then lower their cranes before the power failed. The cranes they operated were capable of lifting noiselessly 15 tonnes with slow purchase, 10 tonnes quickly, 800 tonnes of coal a day at speeds some 30 per cent faster than steam cranes.[11] To supply water, a 91,000 litre (20,000 gallon) iron tank was built at the Hamilton railway junction, to which water was pumped through sand filters from nearby swamps, four hectares of which were proclaimed for the purpose. Pipes with a diameter of 76mm (3 inches) connected the reservoir to a tank in the power-house engine-room.[12]

The pride in this technology is reflected in the power-house structure. On heavy concrete foundations, then thought essential for any major building on reclaimed land, this Classic Revival edifice is of yellow, compressed brick, with Sydney sandstone quoins, architrave, frieze and pediment (Figs 4 & 5). The roof was boarded and slated. The overall length was 43.9m (144 feet), the depth 26.9m (88 feet). The engine-room measured 21.3 by 12.3m (70 feet by 40 feet 6 inches). The

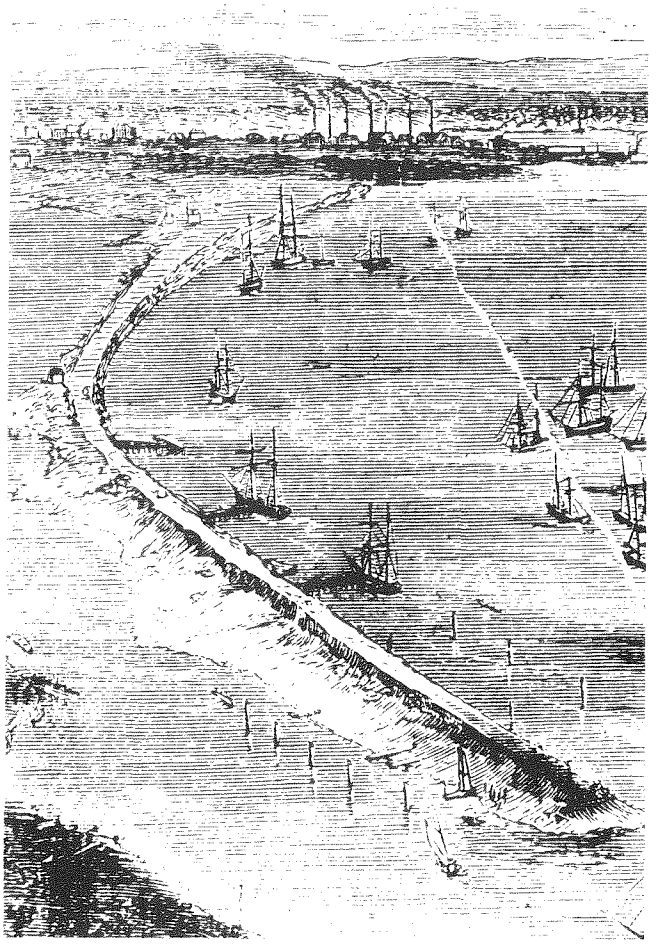


Fig. 3: Bullock Island Dyke, 1873. This illustration was published in the Illustrated Sydney News *on 27 September 1873.*

Newcastle Morning Herald in 1876 gave the dimensions of the boiler-room as 11.9 by 10.2m (39 feet by 33 feet 6 inches)[13] but this seems an error, perhaps typographical. The present dimensions are about 11.9 by 13m (39 by 43 feet) and there is no record nor indication in the building of any extension. The accumulator towers stood 17m (56 feet) high. To the west of the boiler-room was a 22m (72 feet) chimney stack. The *Newcastle Morning Herald* proclaimed:

> 'Where once only the boom of the bittern was heard for ages, the stroke of the busy hammer will resound; and the spot on which the idle aboriginal reclined, as he watched the snipe or red-bill pursue its flight above his head, will be trodden by the restless feet of the white man, or traversed by the Iron Horse.'[14]

Although the power-house was not then completed, the *Town and Country Journal* of 22 July 1876, showed it as it was to be when finished in 1877 (Fig. 4).

In February 1878, Moriarty, by then Engineer-in-Chief, saw the culmination of his plans of twenty years earlier. A crane was tested and 'nearly 18 tons was lifted with apparent ease'.[15] The following month, a locomotive was hoisted from the *Araby Maid* as she lay at No. 6 wharf.[16] On 19 March 1878, the first shipment of coal loaded by hydraulic crane left aboard the *Downiemount* which, on her last voyage to Newcastle, had brought the cranes from Britain.[17] The following year, the *Town and Country Journal* described the cranes as 'the chief glory of Newcastle' and continued:

> 'These beautiful pieces of mechanism . . . represent the last achievments of mechanical science in hydraulic

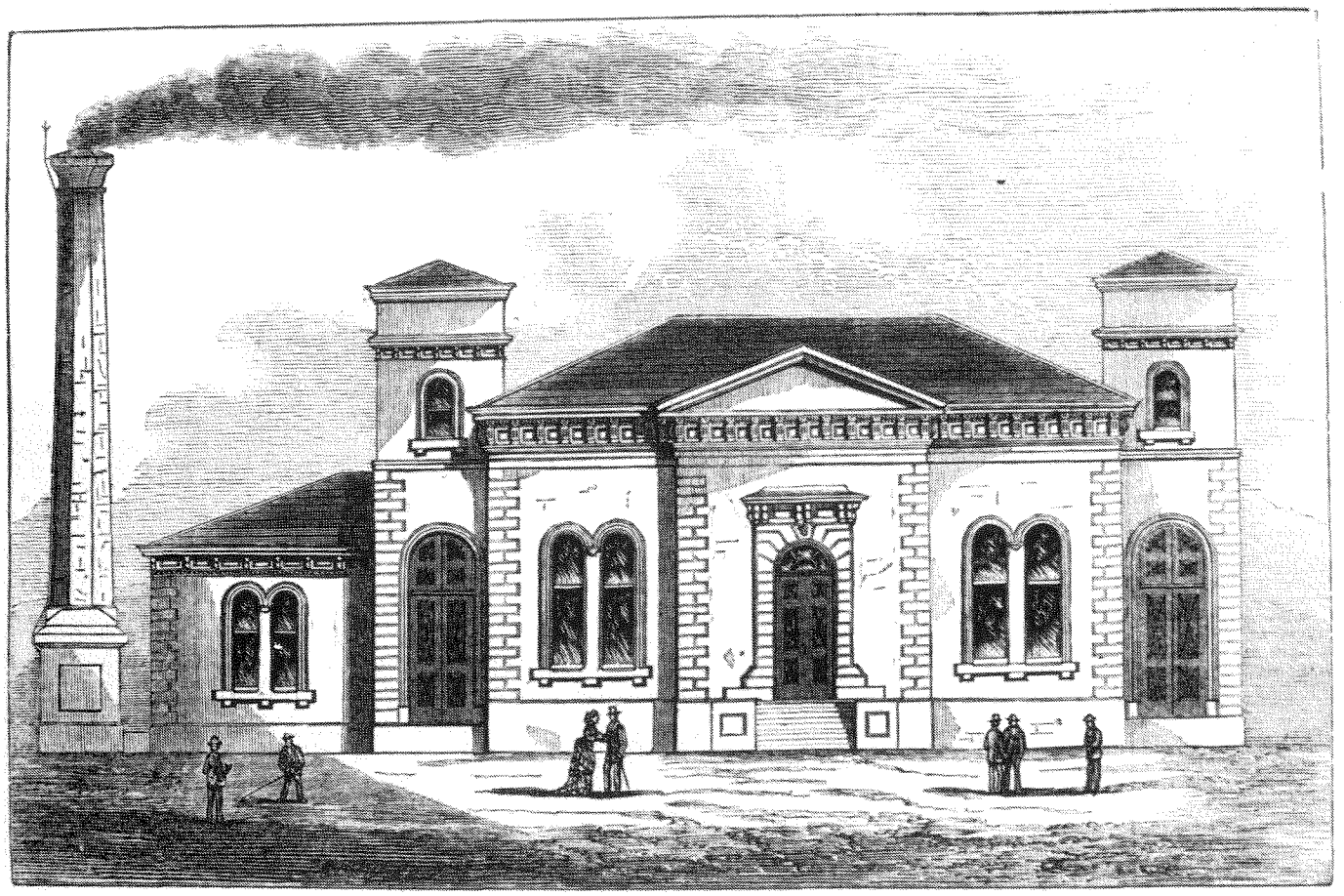


Fig. 4: Bullock Island Hydraulic Power-House. This was how the Town and Country Journal *of 22 July 1876 thought that it would look when finished in 1877.*

machinery. They . . . could be manipulated by a child. The waggons of coal are brought into position by a rope worked by an hydraulic windlass. The man in charge has simply to press his foot on the treadle, while he draws in the rope, and the irresistible water pressure does the rest. The waggon being in position, the hooks of the chains are fastened on it, and the man standing on the platform of the hydraulic crane moves a lever, and the giant lifts the top of the truck as easily as a mother would lift her child, without a sound swings it over the ship's hatchway, where the lumpers knock out the pins which fasten the bottom of the truck, and then the coal disappears into the hold of the vessel. The whole process only takes a minute and a half . . .'[18] (Fig. 6)

This was only the beginning. Foundations were laid for a second boiler-room and for three more engines, the first of which was ordered by late 1877. In the same year, four more cranes, two of 15 tons, two of 25 tons, were also ordered, as were additional boilers. In February 1879, two boilers and the engine arrived, foundations for a new crane were being laid and a second accumulator was under construction. By the end of the year, the foundations for another crane were in progress [19] (Fig. 7a). In 1880, the first of the 25-ton cranes arrived and was installed north of the existing cranes. On 11 June, it loaded for the first time. A reporter from the *Town and Country Journal* watched it 'hoisting the foremast of a ship just as if it were a walking-stick.'[20] The following year the wharf was equipped with gaslight to allow loading at night.[21]

Neither these extensions nor the installation of three more cranes could keep up with the coalmining boom of the early Eighties, as complaints of delays and congestion in 1883 reveal. The railway was extended from the power-house to the cranes and, in 1884, facilities were erected in the Dyke

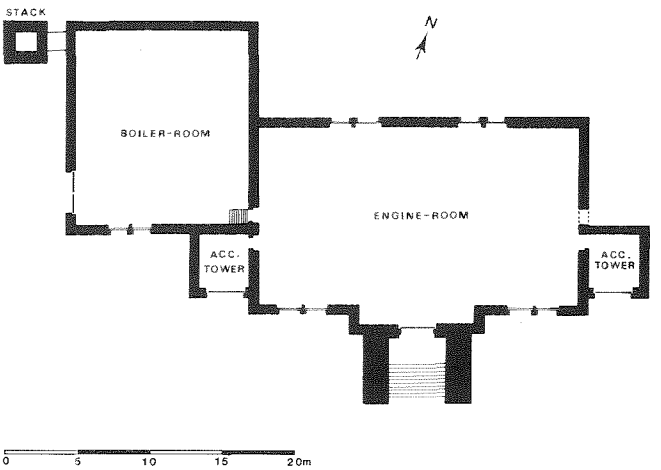


Fig. 5: Plan of Bullock Island Hydraulic Power-House, 1877, adapted from later plans.

yard to allow shunting engines to take on water and coal without returning to Hamilton.[22] In 1884–5, contracts were let for a northern extension to the wharf.[23] By 1886, the Dyke was almost 3km long and growing. Four 9-ton cranes were ordered. Though shown on an 1886 chart,[24] these cranes were not erected until early in 1888. About 5.5km of railway were built to serve them.[25]

Coal shipment was then concentrated on Bullock Island. All government coal-loading facilities on the south side of the harbour were closed down, prematurely it would seem, since the *Newcastle Morning Herald*, in December 1888, reported that ships were lying four abreast at the upper Dyke. To ease the situation, three of the five steam cranes from the Newcastle wharf were installed on the Dyke south of the hydraulic cranes[26] but the work was not completed until late in 1889, because of problems with piles and foundations.

The east side of the Dyke had been completed but there was still insufficient wharf space to meet the demand of ships. Work now began on the mammoth task of constructing the Basin. The east side of the Basin was planned to provide an additional 40ha (100 acres) on the Dyke and over 1200m (4000 feet) more wharf space. As with the Dyke, reclamation started with the dumping of ballast. Sand, dredged from the Basin, was to be built up behind the ballast. To achieve this, a sand-pump dredge, *Juno*, the first of its kind in the colonies, was brought out from Britain.[27] Dredging started in February 1890. By November, 6ha (15 acres), formerly covered by a metre of water, had been reclaimed. (Fig. 7b shows the situation by 1894.) An additional seven 10-ton hydraulic cranes were ordered, as was a new steam pumping engine to run them. This necessitated additional boilers. In 1890, work began on the second boiler-room, erected on the foundations laid in 1877. This room, 11.9 by 13m (39 by 43 feet) and 7m (23 feet) high, duplicated the original west boiler-room. The stack beside it stood 27.4m (Fig. 8).[28] Four tubular Babcock and Wilcox boilers were installed and the new 250-horse-power compound steam pumping engine, built by Sir W. G. Armstrong, Mitchell & Co., was more powerful than the other two together. The flywheel was 4m (13 feet) in diameter. It was a condensing engine, as distinct from the earlier high-pressure engines, though the latter were converted to low-pressure condensing engines early in 1892.[29]

By the end of 1890, 250m (800 feet) had been added to the wharf, a total length now of 2365m (7760 feet), and four ballast jetties had been constructed.[30] The new boilers were installed by May 1891, but the new engine had not then arrived.[31] When it became operational in February 1892, the *Newcastle Morning Herald* found 'the whole . . . by far the finest of its kind in the hemisphere.'[32]

On 22 November 1890, the *Newcastle Morning Herald* announced that Mr E. J. King, the contractor for the boiler-room, had secured the contract for a condensing-room behind the main building.[33] This suggests plans to build condensers to treat the steam from the compound engine. It would seem that condensers were not installed. An auxiliary engine-house behind the main engine-room is shown on an apparently contemporary plan held by the New South Wales Railways Department (Fig. 9), but in later plans this is shown as the dynamo-room (Fig. 10). The dynamo must have related to the production of electricity. Electric light was available by September 1891, with three Westinghouse engines driving the plant.[34] The room which housed the dynamo must be that built by King in 1890–1. It bears every indication of having been built in a hurry. While the same yellow brick has been used in this extension as in the first, the construction is much lighter and less finished than in the boiler-room.

By the end of 1891, about 11ha (27 acres) had been reclaimed; new water pipes were laid to the cranes but the activity of the opening years of the decade was curbed as the economic depression worsened. However, dredging and reclamation continued. By the end of 1895, *Juno* had pumped over two million tonnes of sand and 24ha (60 acres) had been filled. A more powerful pump-dredge, *Jupiter*, started in the Basin in 1896.[35] The size of ships had increased, with the result that the 6.7m (22 feet) depth considered adequate when the Dyke was built was no longer enough. For the Basin a depth of 9m (30 feet) was thought appropriate and this, over an area of 36–38ha (90–95 acres), meant the removal of over 300,000 cubic metres of silt.[36] In addition, submerged rocks at the entrance gave only 3m (11 feet) clearance. These had to

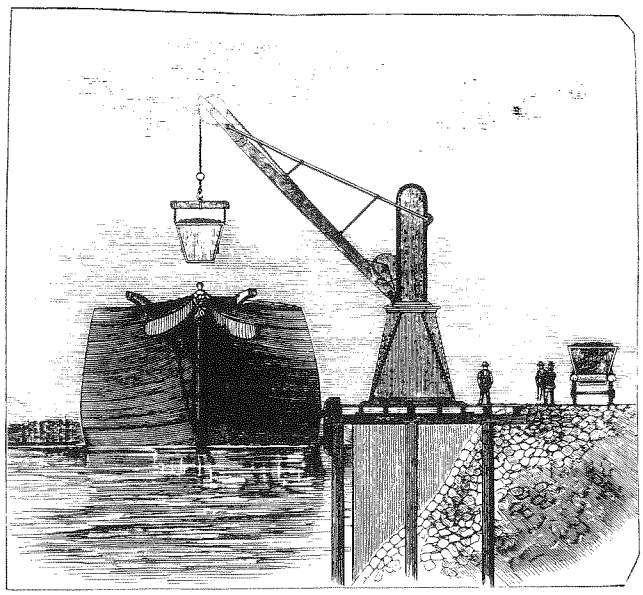


Fig. 6: One of the hydraulic cranes at Newcastle, Town and Country Journal, *22 July 1876.*

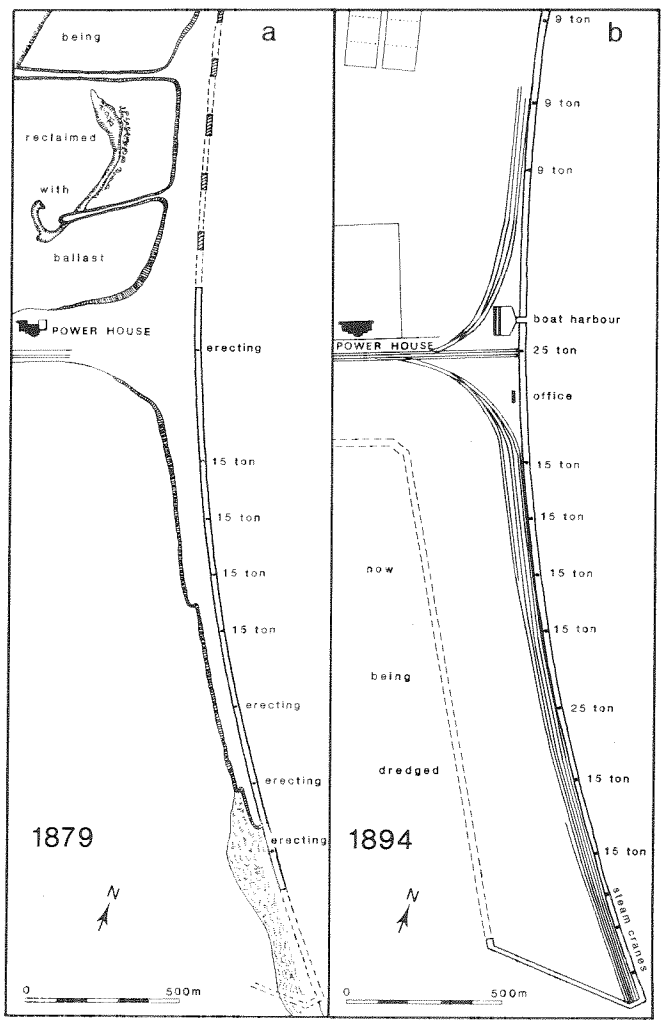


Fig. 7: Progress in the development of the Bullock Island Dyke in (a) 1879, (b) 1894. Adapted from: (a) Harbour Administration Department: Port of Newcastle, NRPL LHM C623.894/18. (b) Harbour Administration Department: Port of Newcastle, NRPL LHM C623.894/16.

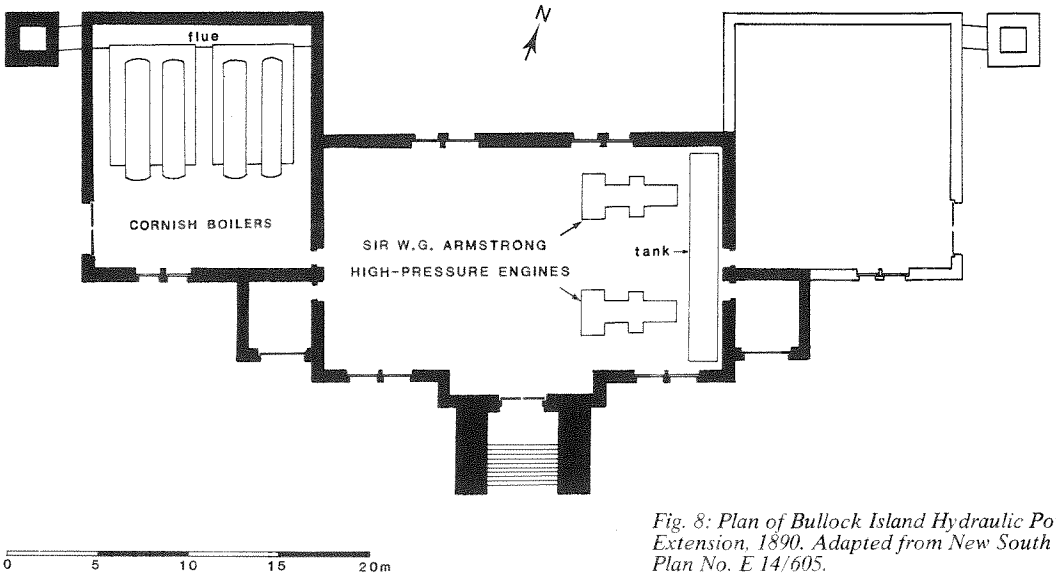


Fig. 8: Plan of Bullock Island Hydraulic Power-House, 1st Extension, 1890. Adapted from New South Wales Railways Archives Plan No. E 14/605.

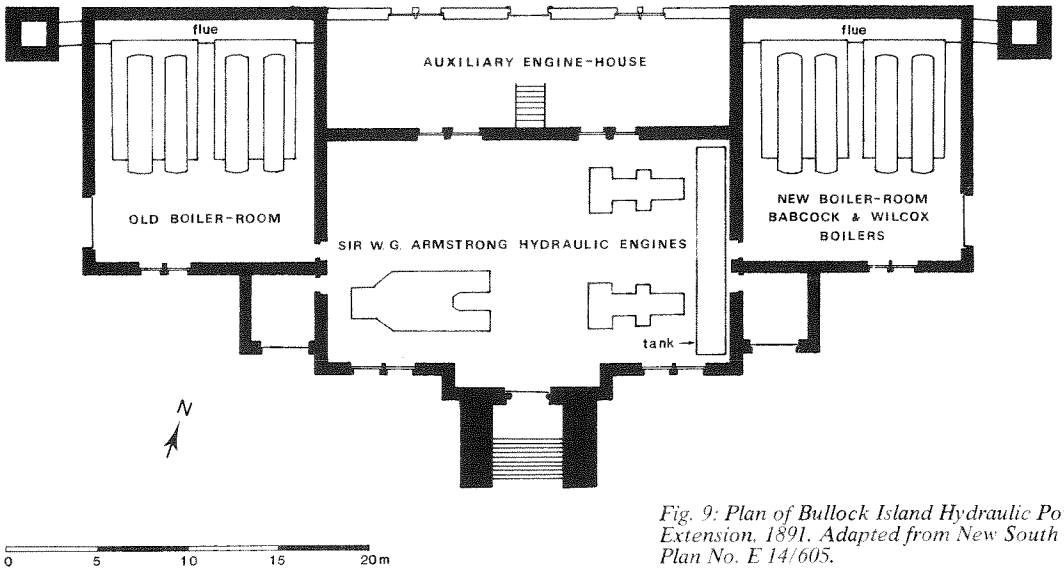


Fig. 9: Plan of Bullock Island Hydraulic Power-House, 2nd Extension, 1891. Adapted from New South Wales Railways Archives Plan No. E 14/605.

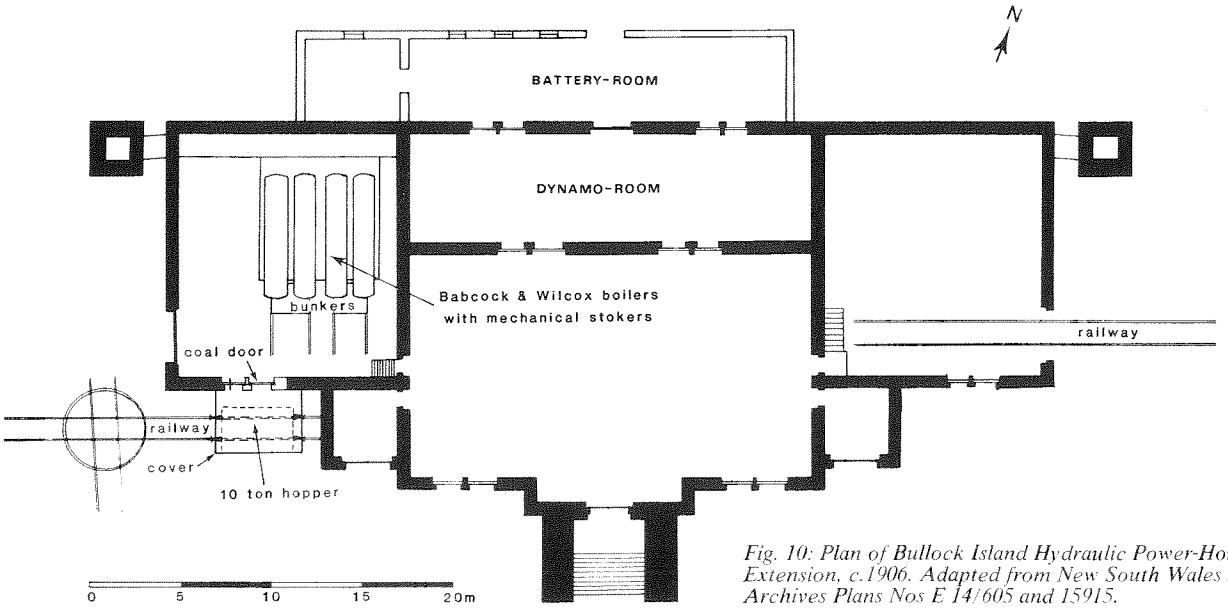


Fig. 10: Plan of Bullock Island Hydraulic Power-House, 3rd Extension, c.1906. Adapted from New South Wales Railways Archives Plans Nos E 14/605 and 15915.

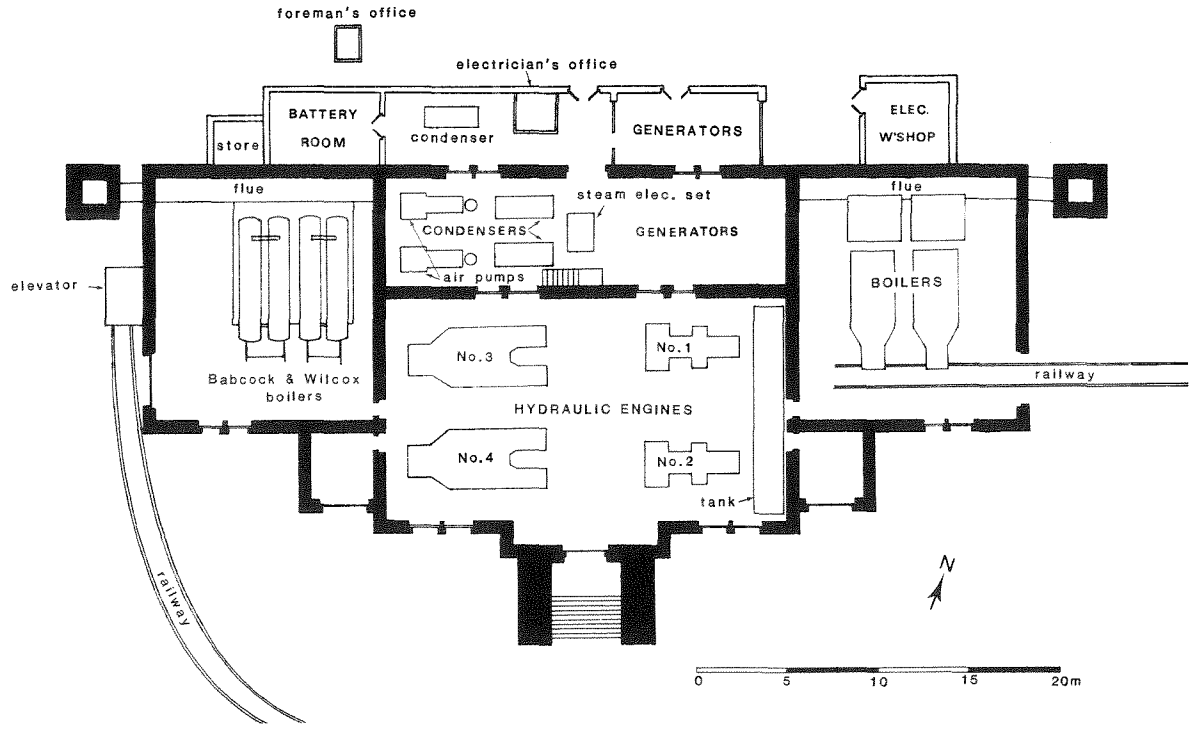


Fig. 11: Plan of Bullock Island Hydraulic Power-House, 4th Extension, 1914. Adapted from New South Wales Railways Archives Plan No. 15915.

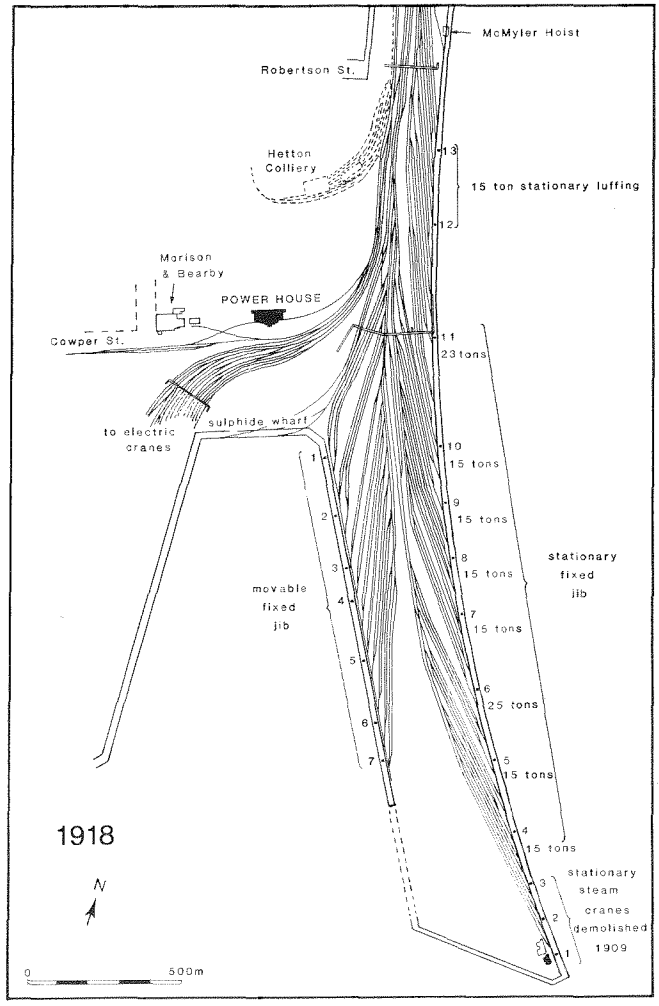
Fig. 12: Bullock Island Wharves, 1918. Adapted from New South Wales Railways Archives Plan No. 18608.

be cut away. The rock-cutter, *Poseidon*, was used but by 1898 nothing had been done about the wharves.[37] Towards the end of that year, the biggest sand-pump in the colony, the *Castor*, was brought to Newcastle.[38] In 1899, wharf construction started at last but it was only a start. As with the Dyke, the wharves were built in sections as reclamation allowed. The first 182m (600 feet) were built in 1899[39] but the next 213m (700 feet) were not completed until 1901. According to the *Newcastle Morning Herald*, this section was the strongest wharf in Australia:

> 'two rows of piles pitched five feet [1.5m] apart, and two rows pitched ten feet [3m] apart, with caps 16 x 14 inches [406 x 356mm], and girders 17 inches [432mm] in diameter.'[40]

By that time, six movable hydraulic cranes, which were designed to operate in pairs on three berths inside the Dyke, had been ordered. On 3 August 1899, the *Newcastle Morning Herald* had fondly anticipated the arrival of the cranes before Christmas and the start of operations by the middle of the following year. By November 1901, only one crane had been installed.[41] The remainder were erected over the next few years, during which the number of berths was increased to four, so that only cranes 1 and 2, 5 and 6 worked in tandem.

Meanwhile the power-house was re-equipped to meet the increased demand for hydraulic power. In 1900, plans were received from Sir W. G. Armstrong, Whitworth & Co. Limited, for a second compound steam pumping engine, the No. 4. The *Newcastle Morning Herald*, in 1906, recorded plans to replace the 1877 Cornish boilers with Babcock and Wilcox boilers fitted with chain grate stokers.[42] A copy plan marked 'detached from E 14/$\frac{605}{58}$ 23.3.14' but with an illegible original date, shows boilers fitted with mechanical stokers in the 1877 boiler-room, which seem to be those referred to (Fig. 10). A branch railway with turntable led to the front of the boiler-room, where a 10-ton coal hopper had been erected with direct access into the boiler-room. Regrettably, the site of the hopper has been cemented, concealing any remains which may survive. A second branch line entered the east boiler-room. Presumably this, too, was to allow coal to be discharged directly in front of the boilers. The plan also shows a further extension described as a battery-room. Batteries to store



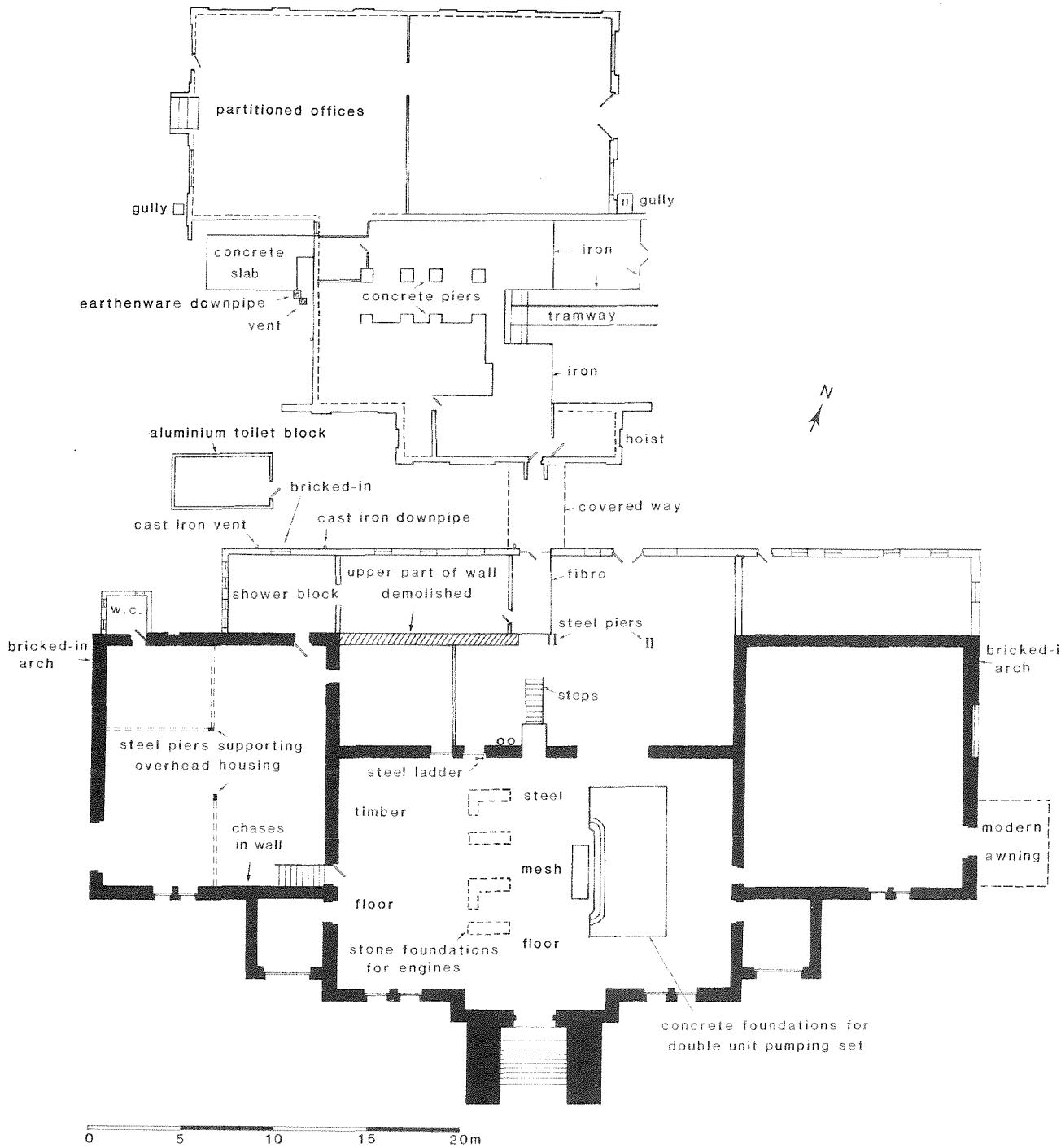


Fig. 13: Plan of Bullock Island Hydraulic Power-House, 1979.

electric power were later to be installed in part of this room.

The old stationary cranes still worked the east side of the Dyke but were considered obsolete. McMyler hoists were acquired to supplement them. The decision proved a disaster. Three hoists were bought in 1908, only one was erected and it necessitated the removal of the No. 15 crane and the eventual removal of the No. 14, which was too close to the hoist to allow berthing. The steam cranes were also removed.[43] The result was to strain coal-loading facilities. In 1911, cranes Nos 12 and 13 were replaced by 15-ton cranes, while Nos 7, 8, 9 and 10 were raised 3m (10 feet) so as to bunker larger ships. A seventh movable crane came into commission in 1915.[44]

In 1914, plans were produced for larger Babcock and Wilcox boilers to replace those in the east boiler-room. According to contemporary plans, these were erected but there is no written evidence for this. Alterations to the floor of the room have obliterated any visible evidence. Two air pumps and the condensers first considered in 1890 may also have been installed. The electrical plant was certainly extended (Fig. 11). In 1914 also, two hydraulic capstans were fitted on the Dyke.[45] Although plans for hydraulic capstans to shift coal wagons were among the first batch supplied by Armstrong forty years earlier, these seem to have been the only ones erected. Despite their reported success, hydraulic power was being superseded. In 1916, the first of the electric capstans arrived.

A programme to widen the Dyke wharf, with a view to deepening the water at its face, was begun in February 1915. A greater depth had not been practicable along the Dyke previously because the piles were too shallow. By May 1916, the depth of the first section of 165m (540 feet) had been increased to 12m (41 feet). By July, this depth was reached as far as the McMyler hoist.[46]

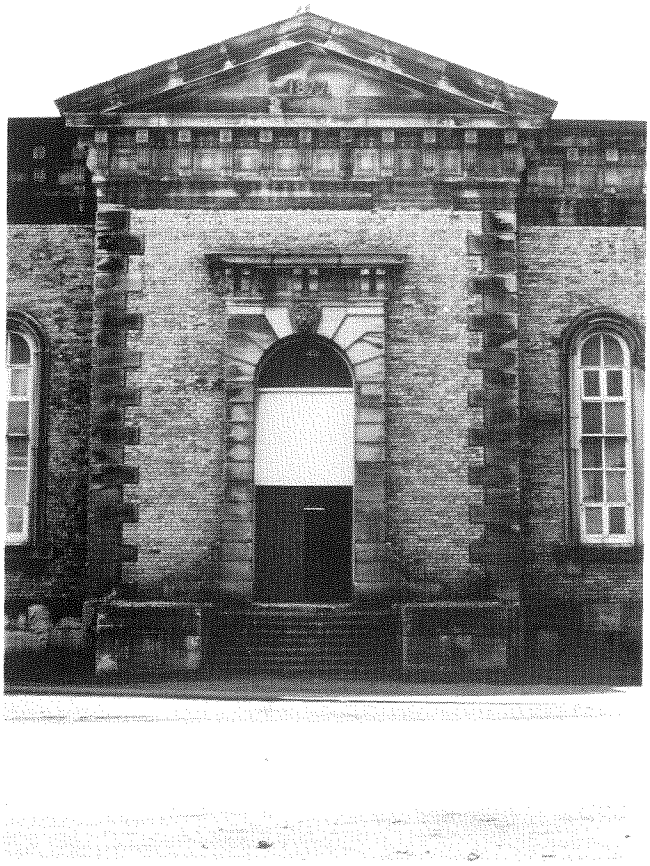


Fig. 14: Front entrance of Bullock Island Hydraulic Power-House, 1979.

Reclamation of the south-west and west of the Basin meant the demolition of the Bullock Island Bridge, which carried part of Denison Street, and, in 1916, the bridge which crossed from Wickham to Darvell Street.[47] The railway branch line was removed from the Cowper Street Viaduct to come in from the north, a proposal made by the *Newcastle Morning Herald* as early as 1902[48] (Fig. 12).

The hydraulic cranes were not without problems. The first recorded breakdown occurred in 1881, when a ruptured pipe threw all the cranes out of action.[49] Similar events were reported over the years and the *Newcastle Morning Herald* complained of 'hap-hazard . . . search of the seat of leakage'.[50] In 1895, a burst pipe caused stoppage but the cranes above the leak were able to resume 'after some little time'.[51] This implies that a system of pressure valves had been installed, possibly with the new pipes in 1891–2. The movable hydraulic cranes were supplied with an independent set of pipes. Plans drawn in 1915 show three circular pressure systems in operation at that time.[52] Eventually, pressure valves above and below each crane reduced some of the effects of leakage to the area of a single crane. If the leak occurred between the main hydraulic line and any one crane, the others could be reactivated by bringing the pressure in from the opposite direction. However, should the main line break, there was no way of maintaining pressure. All cranes were put out of action.

As wharves on the west side of the Basin approached completion, the question was with what to equip them. The old power-house was fully loaded by the existing cranes, as was the pumping station supplying it. Electric cranes were operating overseas. In 1916, the first travelling electric crane on the Basin came into use.[53] The old hydraulic cranes were being overshadowed.

With the Depression of the 1930s, cranes Nos 4–9 went out of commission, not to be used again except for a period in 1938, when Nos 8 and 9 loaded while repairs were being effected at the Basin. Nos 4 and 5 were demolished in 1936.[54] The great boilers and steam engines were replaced by electric motors and electrically operated pumps. Plans for a new pumping engine, to be installed on the sites of the Nos 1 and 2 engines, arrived in 1940. The first pumping set was lost at sea, so that the change did not take place until after the War. It necessitated considerable alterations to the engine foundations. The extant foundations and indented floor in the eastern half of the engine-room outline this structure (Fig. 13). By then only the movable cranes were controlled from the power-house. Cranes 6–10 on the Dyke, idle for over twenty years, were demolished in 1956 to make way for a belt loader.[55] In the following years the movable cranes gradually went out of service. The last was demolished in 1964 and the wharf was left to rot.

Piece by piece, the power-house machinery has gone. The last to be removed were the great accumulators, which had to be cut into sections to be taken from their towers. Only the shell of the building remains (Fig. 14). The lion above the great arched door stares with unseeing eyes over the bulk coal carriers of the modern port.

NOTES

1. *N.C.* 21/8/1861, 24/8/1861.
2. *N.C.* 27/6/1863.
3. Gowlland 1866.
4. *S.M.H.* 22/9/1866.
5. *M.A.* 20/6/1874.
6. *M.A.* 13/10/1875; McMullen n.d.: 4.
7. *N.M.H.* 25/11/1876, 7/11/1877; *T.& C.J.* 22/7/1876.
8. *N.M.H.* 10/8/1877.
9. *N.M.H.* 25/11/1876.
10. *N.M.H.* 7/11/1877.
11. *T.& C.J.* 22/7/1876.
12. *N.M.H.* 25/11/1876.
13. ibid.
14. *N.M.H.* 8/11/1876.
15. *N.M.H.* 22/2/1878.
16. *N.M.H.* 16/3/1878.
17. *N.M.H.* 20/3/1878.
18. *T. & C.J.* 29/3/1879.
19. *N.M.H.* 12/2/1879, 17/10/1879, 2/12/1879.
20. *N.M.H.* 12/6/1880; *T. & C.J.* 4/6/1881.
21. *N.M.H.* 2/7/1881.
22. *N.M.H.* 4/1/1884.
23. *N.M.H.* 15/8/1885.
24. Harbour Administration Department 1886.
25. N.M.H. 17/4/1888.
26. *N.M.H.* 5/12/1888.
27. *N.M.H.* 30/7/1890, 14/11/1890.
28. *N.M.H.* 14/11/1890, 22/11/1890.
29. *N.M.H.* 28/5/1891, 19/2/1892.
30. *N.M.H.* 1/1/1891.
31. *N.M.H.* 28/5/1891.
32. *N.M.H.* 19/2/1892.
33. *N.M.H.* 22/11/1890.
34. *N.M.H.* 19/2/1892.
35. *N.M.H.* 6/2/1896.

36. *N.M.H.* 14/1/1897.
37. *N.M.H.* 28/6/1898.
38. *N.M.H.* 12/1/1899.
39. *N.M.H.* 3/8/1899.
40. *N.M.H.* 5/8/1901.
41. *N.M.H.* 26/11/1901.
42. *N.M.H.* 4/6/1906.
43. *N.M.H.* 13/10/1909.
44. Coulin 1959: 162.
45. *N.M.H.* 1/10/1915.
46. *N.M.H.* 24/5/1916, 22/7/1916.
47. McMullen n.d.: 11.
48. *N.M.H.* 30/6/1902.
49. *N.M.H.* 19/3/1881.
50. *N.M.H.* 1/7/1886.
51. *N.M.H.* 13/2/1895.
52. New South Wales Railways Archives 1915.
53. Allan 1968: 23; Coulin 1959: 162.
54. Coulin 1959: 162.
55. ibid.

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