

IMPROVEMENT.

It will be seen from an inspection of the above table that the river may be divided into three sections, according to the descent per mile, which must determine the character of the improvement.

I. From Wilkesborough to the head of Bean Shoal the distance is 53 miles, and the descent is at the average rate of 3.15 feet per mile.

II. Bean Shoal, which may be subdivided into two divisions, the upper having a descent of 14.04 feet per mile, the lower 6.91 feet per mile; the total length of the shoal being 4.12 miles to Sycamore Ford.

III. From Sycamore Ford to the railroad bridge, near Salisbury, where the survey terminated, the distance is 64.56 miles, and the rate of fall 2.02 feet per mile.

Assuming that a grade of 1.3 feet per 1,000 feet may be taken as the limit of ordinary steamboat navigation, it is evident from the above description and the profile that the river can be improved to a navigable depth of 2½ to 3 feet at low-water from Wilkesborough as far as Bean Shoal, by excavating the bars and constructing wing-dams and four locks and dams. At the head of Bean Shoal it will be necessary to abandon the river and make a canal about 1½ miles in length, with three locks, having an aggregate lift of 21 feet. The remaining distance of about 3 miles to Sycamore Ford can be overcome by excavation and the construction of perhaps one wing-dam.

From Sycamore Ford to the railroad bridge the average fall of 2.02 feet per mile is within the assumed limit, but the actual descent at special localities is so great that excavation will need to be supplemented by the construction of wing-dams. The excavation, locks and dams, and wing dams which are necessary for light-draft steam navigation between Wilkesborough and Salisbury are included in the following estimate, given in a tabular form. The canal around Bean Shoal will have a width of 40 feet at the bottom and 60 feet at the water surface and a depth of 5 feet. The dam will be of stone and the lock of crib-work, with a chamber 100 by 20 feet.

Summary of estimate for improvement of the Yadkin River for steam navigation.

SECTION I.—WILKESBOROUGH TO HEAD OF BEAN SHOAL.

Locality.	Dredg- ing.	Rock ex- cavation.	Dams.	Amounts.	Total.
Blair's Island, Sta. 77 + 66.....	<i>Cub. yds.</i>	<i>Cub. yds.</i>	Masonry dam, 10 feet high, 1,000 cubic yards. Lock, with 7 feet lift.....	\$8,000 15,000	\$23,000 00
Sta. 84 + 64 to Sta. 266 + 24.....	1,319	2,032	2 wing-dams..... 791 cubic yards.....	1,319 6,096 2,373	9,788 00
Reynolds' Island and Staylor's Ford, Sta. 291 + 22 to 365 + 64.	1,347	167	4 wing-dams, 1,055 cu. yds	1,347 501 3,165	5,013 00
Above Sta. 377 + 20.....	33			33	33 00
Sta. 389 + 34.....	222			222	222 00
Sta. 404 + 83.....	194			194	194 00
Parkes Ford and Ledge.....		46		138	138 00
Sta. 433 + 37.....			2 wing-dams, 800. cu. yds..	2,400	2,400 00
Fish-Trap Shoal.....		*10		30	30 00
Sta. 464 + 9.....		93		279	279 00
					309 00

Summary of estimate—Section I—Continued.

Locality.	Dredg- ing.	Rock ex- cavation.	Dams.	Amount.	Total.
Sta. 475 + 41.....	<i>Cub. yds.</i>	<i>Cub. yds.</i>			\$111 00
4,000 feet above Roaring River.....	111				30 00
Foot & Reeve's Fish-Trap Shoal, Sta. 568 + 74.....	65	*10	3 wing-dams, and 3 dikes, 1,200 cubic yards.	\$30 3,600	65 00
Sta. 599 + 63.....		*10			3,630 00
Sta. 635 + 10.....	46				30 00
Below Sta. 641 + 64.....	39				46 00
Adams Island.....	46			46	39 00
Sta. 694 + 28.....			2 wing-dams, 806 cu. yds..	2,418	2,464 00
Harrill's Island.....		*10		30	3,648 00
Sta. 781 + 31.....			3 wing-dams, 1,206 cu. yds.	3,618	239 00
Hickerson's Island No. 2, Sta. 824 + 75.....	239				185 00
Gwynn's Island, Sta. 906 + 59.....	185				18 00
Sta. 978 + 17.....		*6 37		111	129 00
Sayle's Ford, Sta. 1036 + 45.....	74				74 00
Swan Creek Shoal.....			Masonry dam, 8 feet high, 687 cubic yards. Lock, with 4.2 feet lift....	5,496 9,500	14,996 00
Sta. 1068 + 83.....				555	6,576 00
Little Elkin Shoal.....		185	9 wing-dams, 2,007 cu. yds.	6,021	148 00
Sta. 1132 + 10.....					19 00
Wilcox's Ford, Sta. 1147.....	148				57 00
Above Sta. 1191 + 10.....	19				370 00
Sta. 1225, Elkin Bridge Shoal, Sta. 1249 + 23.....	370	*10	1 wing-dam, 660 cu. yds....	30 1,980	2,380 00
Town Creek Shoal, Sta. 1310 + 97. Greenwood's Creek Shoal, Sta. 1359 + 2.....	185	70	4 wing-dams, 1,256 cubic yards.	210 3,768	185 00
Tumbling Falls and Shoal, Sta. 1419 + 40.....		74	11 wing-dams, 4,279 cubic yards.	222 12,837	3,978 00
Sta. 1509 + 88.....		*10			13,059 00
Hurt's Ledge, Sta. 1570 + 56.....		156			30 00
Mitchel's Island.....	851			851	468 00
Sta. 1607 + 50.....		31	5 wing-dams, 1,030 cubic yards.	93 3,090	4,034 00
Woodruff's Fish-Trap Shoal, Sta. 1695 + 42.....		191	6 wing-dams, 2,442 cubic yards.	573 7,326	7,899 00
Devil's Staircase.....			2 wing-dams, 450 cubic yards.	1,350	1,626 00
Sta. 1763 + 88.....		92		276	5,037 00
Long Shoal, Sta. 1822 + 91.....		1,679	4 wing-dams, 972 cubic yards.	2,916	7,953 00
Sta. 1863 + 63.....		*10			30 00
Fish River Shoal, Sta. 1920 + 60.....		28			84 00
Sta. 1920 + 50.....		93			279 00
Sta. 1955 + 32.....		*10 278		30 834	864 00
Seven Islands, Sta. 2048 + 70.....		2,233			6,699 00
Bohannon's Island, Sta. 2107 + 28.....		3,037			9,111 00
Sta. 2123 + 17.....		70			210 00
Sta. 2156 + 77.....			Masonry dam 11 feet high, 1,748 cubic yards. Lock with 7.2 feet lift....	13,984 15,000	28,984 00

\*Removing dams.

Summary of estimate—Section I—Continued.

Locality.	Dredg- ing.	Rock ex- cavation.	Dams.	Amounts.	Total.
	<i>Cub. yds.</i>	<i>Cub. yds.</i>			
Foster's Upper Shoal, Sta. 2278 + 4	93			\$279 00	
Foster's Lower Shoal, Sta. 2346 + 79	56			168 00	
Sta. 2372 + 60	174			522 00	
Lime-Rock Shoal			Masonry dam 10 feet high, 1,593 cubic yards. Lock with 7 feet lift.	\$12,744	
Sta. 2463 + 31				15,000	
Below Sta. 2478 + 7	139			417	
Sta. 2505 + 49	46			138	
				28,299 00	
Reeve's Fish-Trap Shoal, Sta. 2540 + 30		556		1,668	
		*10		30	
				1,698 00	
Sta. 2586 + 19		111		333 00	
Below Sta. 2617 + 31		44		132 00	
Below Sta. 2772 + 13		222		666 00	
Removing overhanging trees				570 00	
				194,093 00	
Contingencies, 15 per cent				29,113 95	
Total				223,206 95	

SECTION II.—BEAN SHOAL.

Canal extending from the head of the shoals 8,070 feet to a point 800 feet above the foot of Island No. 9.

Earth excavation in canal, 144,600 cubic yards, at 15 cents	\$21,690 00
Rock excavation in canal, 4,259 cubic yards, at \$3	12,777 00
3 locks, lift of each 7 feet, at \$15,000	45,000 00
Guard lock at head	10,000 00
Rock excavation, Island No. 9 to Sycamore Ford, 10,692 cubic yards, at \$3.	32,076 00
	121,543 00
Contingencies, 15 per cent	18,231 45
Total	139,774 45

SECTION III.—SYCAMORE FORD TO THE WESTERN NORTH CAROLINA RAILROAD BRIDGE, NEAR SALISBURY.

Locality.	Dredg- ing.	Rock ex- cavation.	Locks and dams.	Amounts.	Total.
	<i>Cub. yds.</i>	<i>Cub. yds.</i>			
Sycamore Ford Shoal, Sta. 2998 + 3	333			\$333	
		*10		30	
				363 00	
Hauser's Island, Sta. 3107 + 15	278			278	
		*10		30	
				308 00	
Shoal above Shore's Island, Sta. 3199 + 82	619			619	
		*20		60	
		148		444	
				1,123 00	
Shore's Island Sta. 3297 + 60			Dam at head 259 cub. yds. Dam at foot 223 cub. yds.	777 669	
				1,446 00	
3,000 feet above Glenn's Dam	741			741	
Glenn's Dam, Sta. 3407 + 6		*20		60	
		1,377		4,131	
			6 dams, 4,638 cubic yards.	13,914	
				18,105 00	
Meadow Branch Shoal, Sta. 3484 + 48		*10		30	
		194		582	
				612 00	

\* Removing dams.

Summary of estimate—Section III—Continued.

Locality.	Dredg- ing.	Rock ex- cavation.	Locks and dams.	Amounts.	Total.
	<i>Cub. yds.</i>	<i>Cub. yds.</i>			
Sta. 3544 + 46		*10		\$30	
		65		195	
				\$225 00	
Below Sta. 3627 + 9	63			63 00	
1,400 feet below Jones's Dam		207		621 00	
Jones's Dam Sta. 3723 + 66	332			332	
		*40		120	
				452 00	
2,000 feet below Jones's Dam	30			30 00	
Shallow Ford Shoal, Sta. 3810 + 1	2,467			2,467	
		583		1,749	
			3 dams, 1,980 cubic yards.	5,940	
				10,156 00	
Sheek's Shoal Sta. 4004 + 19	281			281 00	
Langenhour and Neason's Dam, Sta. 4176 + 44		602		1,806	
		*50		150	
			3 dams, 1,980 cubic yards.	5,940	
				7,896 00	
3,000 feet below Langenhour and Neason's Dam.	74			74	
		74		222	
				296 00	
Sta. 4261 + 27		*10		30 00	
Sta. 4303 + 47		17		51 00	
Hall's Ferry Shoal, Sta. 4349 + 8		250		750 00	
Clouse's Upper Shoal, Sta. 4398 + 30		277		831 00	
Clouse's Lower Shoal, Sta. 4452 + 46		326		978 00	
Eckel's Shoal, Sta. 4551 + 6		1,712		5,136 00	
Sta. 4603 + 33		56		168 00	
Muddy Creek Sta. 4762 + 3	167			167	
			Jetty, 330 cubic yards	990	
				1,157 00	
Grimes's Mill, Sta. 4785 + 71		174		522 00	
Sta. 4836 + 22		56		168 00	
1,400 feet above Hartley's Mill				918 00	
Hartley's Mill Sta. 4928 + 88		*10		30	
		741		2,223	
				2,253 00	
2,000 feet above Peeble's Ferry		166		498 00	
Peeble's Ferry, below Sta. 4966 + 6	800			800 00	
1,100 feet above Peeble's Mill	92			92 00	
Peeble's Mill, Sta. 5021 + 1		412		1,236 00	
Sta. 5110 + 36		11		33 00	
Swicegood's Mill, Sta. 5279 + 16		788		2,364	
			2 dams, 1,760 cubic yards.	5,280	
				7,644 00	
4,400 feet below Swicegood's Mill		22		66 00	
Big Rock Shoal, Sta. 5532 + 64		1,111		3,333 00	
Barnes's Fish-Trap Shoal, Sta. 5569 + 76		*10		30	
		278		834	
				864 00	
Dutchman's Island, Sta. 5463 + 64		4		12 00	
Motley's Shoal, Sta. 5971 + 5		46		138 00	
Sta. 6118 + 31		23		23 00	
Removing snags and overhanging trees				600 00	
				71,019 00	
Contingencies and superintendence, 15 per cent				10,652 85	
Total				81,671 85	

\* Removing dams.

The aggregate cost of the three sections from Wilkesborough to the railroad bridge will be as follows:

Section I, from Wilkesborough to head of Bean Shoal	\$223,206 95
Section II, Bean Shoal	139,774 45
Section III, foot of Bean Shoal to railroad bridge	81,671 85
Total	444,653 25

BATEAU NAVIGATION.

The improvement of the river for steam navigation above the foot of Bean Shoal will not only entail the expenditure of \$362,981.40, but will

also make government liable for the annual future cost of repair and superintendence. I have, therefore, thought proper to submit another estimate for improving the natural channel of the river in order to make it suitable for bateau navigation. This can be done by means of riprap dams and the excavation of rock and gravel bars.

Bean Shoal will be reduced to a grade of 1.3 feet in 1,000 feet, from Sycamore Ford to a point 7,360 feet below the head of the shoal. For the remaining distance the grade will be 2.6 feet per 1,000, which can be overcome by towing with a cable or poling and combining the crews of the bateaux.

Summary of estimates for improvement of the Yadkin River for bateau navigation.

SECTION I.—FROM WILKESBOROUGH TO HEAD OF BEAN SHOAL.

Locality.	Dredging	Rock excavation.	Dams.	Amounts.	Total.
	<i>Cub. yds.</i>	<i>Cub. yds.</i>			
Gordon's Ford Shoal, Sta. 24 + 20	187		1 dam, 142 cubic yards	\$187 426	\$613 00
Finley's Ford Shoal, Sta. 30 + 91	237		1 dam, 159 cubic yards	237 477	714 00
Blair's Island Shoal, Sta. 60 + 72	165		1 dam across right channel, 122 cubic yards	165 366	
Above Sta. 77 + 56	93	*7	1 dam, 130 cubic yards	93 21 390	1,035 00
Sta. 84 + 60		187		561 00	
High Rock Shoal, Sta. 103 + 2		27		81 00	
Buckeye Shoal, Sta. 130 + 30		139		417 00	
Bar at Mulberry Creek, Sta. 203 + 87	90		Jetty, 133 cubic yards	399 90	489 00
Hunt's Island Shoal, Sta. 212 + 80 to Sta. 216 + 3	53	78		53 234	287 00
Reynolds's Island Shoal, Sta. 294 + 90 to Sta. 306 + 90	230	*7		230 21	251 00
Staylor's Ford, Sta. 355 + 20		126	1 dam, 167 cubic yards	501 378	879 00
600 feet above Sta. 377 + 20	22			22 00	
Sta. 389 + 34	93			93 00	
Sta. 404 + 83	204			204 00	
Parke's Ford, Sta. 432 + 87		30		90 00	
Fish-Trap Shoal, Sta. 464 + 9 and Sta. 475 + 11		*7 129		81 387	408 00
Foote and Reeves's Fish-Dam, Sta. 558 + 75		3		9	
Sta. 565 + 30		*7 17		21 51	81 00
Sta. 599 + 63		*7		21 00	
Greenwood's Island, Sta. 635 + 10		33		99 00	
Harrill's Island, Sta. 778 + 51		*7		21 00	
Hickerson's Island No. 2, Sta. 824 + 75		*7		21	
Below Sta. 834 + 73	130			130	151 00
Below Sta. 964 + 69		*7		21 00	
Sayle's Ford Sta. 1036 + 45	30			30 00	
Swan Creek Shoal, Sta. 1058		73 *5		219 15	234 00
Little Elkin Shoal, Sta. 1127 + 25		*10 76		30 228	258 00
Wilcox's Ford, Sta. 1144 + 60	44			44 00	
Sta. 1227 + 50		*5		15 00	
Elkin Bridge Shoal, Sta. 1249 + 23		*7		21	
	554			554	575 00

\*Removing dams.

Summary of estimates—Section I—Continued.

Locality.	Dredging.	Rock excavation.	Dams.	Amount.	Total.
	<i>Cub. yds.</i>	<i>Cub. yds.</i>			
Greenwood's Creek Shoal, Sta. 1361 + 80		*8 36		\$24 108	\$132 00
Tumbling Falls, Sta. 1404 + 70		78		234 00	
Tumbling Shoal, below Sta. 1412 + 42		14		42 00	
Sta. 1509 + 58		*3		9 00	
Hurt's Ledge, Sta. 1570 + 56		53		159 00	
Mitchell's Island Shoal, Sta. 1600 + 28 to Sta. 1614 + 10	1,191	*6		1,191 18	1,209 00
Woodruff's Fish-Trap Shoal, Sta. 1695 + 42		684 *4		2,052 12	2,064 00
Devil's Staircase, Sta. 1763 + 88		*4 9		12 27	39 00
Long Shoal, Sta. 1806 + 70		1,628 *4		4,884 12	5,037 00
Sta. 1829 + 40		47		141	15 00
Below Sta. 1862 + 53		*5		12	
Below 1941 + 30		*4 44		12 132	144 00
Below Fish River, Sta. 1955 + 32		*4 87		12 261	273 00
Seven Islands, Sta. 2046 + 99		177		531 00	
Bohannon's Mill and Island, Sta. 2107 + 28		1,425		4,275 00	
Rockford, Sta. 2140 + 61		741		2,223	
Sta. 2150 + 77	356			356	2,579 00
Foster's Upper Shoal, Sta. 2278 + 4		*4 5		12 15	27 00
Lime Rock Shoal, above Sta. 2380 + 91		160		480	
Sta. 2417 + 99		*4		12	492 00
Sta. 2463 + 31		1,944		5,832	
Below Sta. 2478 + 7		237		711	
Above Sta. 2505 + 49		7		21	6,554 00
Reeves's Fish Dam, Sta. 2540 + 3		*6		18 00	
Sta. 2632 + 77		*4		12 00	
Removing snags and overhanging trees, 53 miles, at \$20					1,060 00
Contingencies, 20 per cent					32,609 00
Total					6,521 80

\*Removing dams.

SECTION II.—BEAN SHOALS.

Locality.	Dredging.		Dams.	Amounts.	Total.
	Cub. yds.	Rock excavation. Cub. yds.			
Bean Shoals, above Island No. 9.			Wall 2,111 cubic yards.....	\$6,333	
Sta. 2752 + 73 to Sta. 2813 + 56.		2,856		8,568	
Sta. 2854 + 52.		176		528	
Sta. 2898 + 76.		746		2,238	
Below Sta. 2931 + 8.		22		66	
Above Sycamore Ford, below Sta. 2971 + 28.		6		18	
		*296	Cable anchorage, 15 cubic yards.	45	
			5,800 feet of 3/8 inch diameter cable, iron center, at 20.9 cents.	1,212	
Removing snags and overhanging trees for four miles, at \$20					\$19,896 00
					80 00
Contingencies 20 per cent.					19,976 00
					3,995 20
Total					23,971 20

SECTION III.—SYCAMORE FORD TO WESTERN NORTH CAROLINA RAILROAD BRIDGE.

Locality.	Dredging.		Dams.	Amounts.
	Cub. yds.	Rock excavation. Cub. yds.		
Sta. 3072 + 61		10		\$30 00
Sta. 3107 + 15		6		24 00
Sta. 3199 + 62		10	Dam, 300 feet long	1,252 00
Below Sta. 3212 + 8		322		338 00
500 feet above Sta. 3264 + 94		20		60 00
Sta. 3297 + 60			Dam, 259 cubic yards	777 00
Below Sta. 3326 + 52		230		230 00
Glenn's Dam, Sta. 3407 + 61		53	Two dams, 1,033 cubic yards..	3,258 00
Glenn's Fish-Trap Shoal, Sta. 3422 + 2		*6		18 00
Meadow Branch Shoal, Sta. 3484 + 48		44		
		*7	Dam, 463 cubic yards.	1,539 00
Sta. 3544 + 46		*10		30 00
1,000 feet below Sta. 3627 + 9		60		60 00
2,600 feet below Sta. 3627 + 9		231		231 00
Jones's Mill-Dam, Sta. 3723 + 66		116	Dam, 556 cubic yards.	1,874 00
Above Sta. 3787 + 17		74		74 00
Shallow Ford Shoal, Sta. 3787 + 17 to Sta. 3835 + 13.		168	Dam, 1,980 cubic yards.	6,168 00
Langenhour and Neason's Dam, Sta. 4176 + 44.			Two dams, 1,556 cubic yards..	5,268 00
3,400 feet below Sta. 4176 + 44		33		99 00
Sta. 4346 + 61, below Hall's Ferry		6		
		*6		36 00
Sta. 4406 + 4, Clouse's old dam		*6		18 00
Douthet's Dam, Eckel's Shoal, Sta. 4551 + 6.		1,712		5,136 00
Sta. 4603 + 33		17		51 00
Muddy Creek, 1,500 feet below Sta. 4736			Jetty, 330 cubic yards.	990 00
Sta. 4836 + 22		4		12 00
Hartley's Mill-Dam		*6		
Sta. 4928 + 88		84		270 00
2,600 feet below Sta. 4928 + 88		70		70 00
Peeble's Ferry, 1,700 feet above Sta. 4995 + 98.		129		129 00
Sta. 4995 + 98		19		19 00
Peeble's Mill, Sta. 5015 + 34		360		360 00
Swicegood's Mill-Dam, Sta. 5279 + 16, 200 feet above Sta. 5525 + 64.			Two dams, 972 cubic yards.	2,982 00
Big Rock Shoal		44		44 00
Sta. 5532 + 64		159		477 00
Barnes's Fish-Trap Shoal, Sta. 5569 + 76		*6		18 00
Sta. 5756 + 8		*6		18 00
Sta. 5976 + 15		81		243 00
Removing snags and overhanging trees				600 00
Contingencies, 20 per cent.				32,743 00
				6,548 60
Total				39,291 60

\* Removing dams.

The aggregate estimate of the cost of bateau navigation will be as follows:

Section I. Wilkesborough to head of Bean Shoal.....	\$39,130 80
Section II. Bean Shoal .....	23,971 20
Section III. Foot of Bean Shoal to railroad bridge.....	39,291 60
Total .....	102,393 60

I have submitted two estimates for two distinct plans of improvement. That by means of locks and dams will cost \$444,653.25, and will be suited for light-draft steamers. That by means of wing-dams and excavation will afford a bateau navigation for bateaux of 6 to 7 tons, and will cost \$102,393.60.

The river, however, can be made navigable for steamboats as far as Bean Shoal without employing locks and dams, and will cost \$81,671.85.

But this part of the river is obstructed by mill-dams which must be removed, at a cost which can only be determined by consulting with the owners or by submitting the question to the judgment of the arbitrators.

The following list gives the localities and character of the dams and mills:

MEMORANDA OF MILLS AND DAMS ON THE YADKIN RIVER BETWEEN SYCAMORE FORD AND THE WESTERN NORTH CAROLINA RAILROAD BRIDGE.

*Glenn's Grist-Mill*, 7.6 miles below Sycamore Ford. The mill is in ruins. The dam, which was built of timber and formerly extended the full width of the river, is broken down.

*Jones's Grist and Saw Mill*, 13.5 miles below Sycamore Ford. The mill is a very good one, chiefly for grinding; a little sawing is done. The dam is composed of stone, logs, and brush, and extends the full width of the river. The proposed improvement will destroy the dam.

*Bitting and Carver's Grist-Mill*, 15.5 miles below Sycamore Ford. Very fair mill with wing-dam built of stone. The proposed improvement will not affect the dam.

*Langenhour and Neason's Grist-Mill*, 22.3 miles below Sycamore Ford. This is an excellent mill, the best on the river. The dam, constructed of timber filled in with stone, extends the full width of the river. The proposed improvement will destroy the dam.

*Clouse's Mill-Dam*, 26.1 miles below Sycamore Ford. The mill was destroyed by fire several years ago. The low wing-dam, built of stone, extends nearly across the river. The proposed improvements will destroy the dam.

*Douthet's Saw-Mill*, 29.3 miles below Sycamore Ford. The mill is a small, unimportant affair, and was not in operation at the time of the survey. The dam, constructed of timber, extends about one-third the width of the river. The water-power is considered valuable. The proposed improvement will destroy the dam.

*Grimes's Saw and Grist Mill*, 33.8 miles below Sycamore Ford. A very good mill. Low wing-dam of stone, extending three-fourths the width of the river. The proposed improvement will not affect the dam.

*Hartley's Grist-Mill*, 36.4 miles below Sycamore Ford. Ordinary country mill. Low wing-dam, built of stone, extending nearly across the river. The proposed improvement will destroy the dam.

*Peeble's Grist-Mill*, 38.3 miles below Sycamore Ford. An inferior mill doing little work. Low wing-dam built of stone. The proposed improvement will not affect the dam.

*Swicegood's Grist-Mill*, 43 miles below Sycamore Ford. Ordinary country mill. Low wing-dam built of stone, extending the full width of the river. The proposed improvement will destroy the dam.

GENERAL CONCLUSIONS.

1. Cost of improving the Yadkin River for 3-foot navigation from Wilkesborough to the railroad bridge near Salisbury:

(A) By means of locks and dams and a short section of canal around Bean Shoals for steam navigation, the cost will be \$444,653.25.

(B) By means of wing-dams and rock excavation for bateaux, ranging from 6 to 7 tons capacity, the cost will be \$102,393.60.

2. I would recommend that the river from Salisbury to the foot of Bean Shoal be improved for light-draft steamers, since this improvement can be made with a navigation of  $2\frac{1}{2}$  to 3 feet at low-water without the aid of locks and dams. Until this part of the river is improved, it would not be advisable to begin the improvement at or above Bean Shoal.

3. Before the improvement is begun, the claims of owners of mill property for the destruction of the mills and dams should be ascertained. The total amount of these claims, if settled now, would be small, but if left until the completion of the improvement would increase with the needs and expectations of the proprietors.

The following maps accompany this report:

General map of Yadkin River from Wilkesborough to Western North Carolina Railroad bridge. Scale, 1 inch=6,000 feet.

Profile of Yadkin River from Wilkesborough to Western North Carolina Railroad bridge.

Special map and profile of Bean Shoal. Scale, 1 inch=500 feet.

I am greatly indebted to Mr. S. W. Evans, assistant engineer in charge, and to Mr. Burr and Mr. Fisher, assistants, and to the other members of the party, for the skillful conduct of the operations of the survey.

Very respectfully, your obedient servant,

S. T. ABERT,  
*United States Civil Engineer.*

The CHIEF OF ENGINEERS, U. S. A.

#### G 17.

##### IMPROVEMENT OF FRENCH BROAD RIVER, NORTH CAROLINA.

A survey of this river between Brevard and the termination of the present improvement at Big Buck Shoals was made in 1877, and a report with estimate of cost and a detailed description of the river is contained in the Report of the Chief of Engineers for 1878, Part I, page 525, to which I would respectfully refer.

The obstruction to navigation consisted of rock and gravel shoals, over which it was proposed to secure the proper slope and dimensions of channel, by dredging, rock excavation, and building wing-dams. The depth proposed is  $2\frac{1}{2}$  feet at low-water, and the estimated cost of the improvement by this plan was \$45,500. The first appropriation was made August 14, 1876, amounting to \$10,000.

After the survey was finished the improvement was commenced by hired labor, in the fall of 1877. The snags and overhanging trees were removed and rock quarried for the wing-dams at Davidson's River. An appropriation of \$15,000 was made June 18, 1878.

During the last fiscal year the following work has been done:

The improvement of Davidson's River Shoal was commenced July 17, 1878. The gravel was excavated with scrapers and 16 wing-dams were built, some of stone and others of crib-work filled with stone. The latter were found to be cheaper and more satisfactory. In some cases the openings between the dams were paved. The excavation of gravel at Patton's Shoal was commenced September 3, 1878, and completed October 10, 1878. The banks were then protected from wash by brush and stone. The improvement of Cherokee Shoal by the excavation of rock was commenced August 10, 1878, but it became necessary to suspend October 19, as the water had become too cold for work.

On February 3, 1879, a stone quarry was opened near Patton's Shoal, and on February 24 a second one was opened at Lydia's Bluff, to obtain the rock for building wing-dams. Quarrying was continued at these points until the season had sufficiently advanced for the water work, and on May 5, 1879, the excavation of rock and gravel at the shoals and the construction of wing-dams was resumed. The wing-dams at Patton's Shoals, and the dredging Allison's Shoal have been finished. The rock excavation at Cherokee Shoal, the wing-dams at the same shoal, and dredging at other points is in active progress, and the improvement of Little Buck Shoal will be commenced in July.

The following appropriations have been made for this work:

August 14, 1876 .....	\$10,000
June 18, 1878 .....	15,000
March 3, 1879 .....	5,000

For the completion of the work according to the original estimate \$25,000 will be required. The work has so far advanced and its success is so assured that movement has already been made for the introduction of steamers upon this mountain stream, 2,100 feet above the level of the sea.

The estimated shipments of produce per year are 1,900 tons, and the receipts of merchandise about one-third this amount. The lack of cheap transportation has been a great drawback to the prosperity of the French Broad Valley, the cost of hauling produce and grain to market consuming all the profits. The Spartanburg and Asheville Railroad is, however, now completed to Hendersonville, and in connection with the river improvement will give largely increased facilities for the shipment of the abundant products of this fertile valley.

There is a large amount of timber, such as poplar, oak, walnut, ash, locust, white pine, cherry, hickory, &c., which would be very valuable if cheap transportation could be secured. There are also some limestone quarries near Davidson's River, which are worked largely for agricultural purposes and from which lime could be shipped by boats on the French Broad to the farms below. A mine of hematite ore found near this place has been worked and a very good quality of iron produced.

##### Money statement.

July 1, 1878, amount available .....	\$17,837 92
Amount appropriated by act approved March 3, 1879 .....	5,000 00
July 1, 1879, amount expended during fiscal year .....	\$22,837 92
July 1, 1879, amount available .....	10,251 84
July 1, 1879, amount available .....	12,586 08
Amount (estimated) required for completion of existing project .....	25,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1881 .....	20,000 00

#### G 18.

##### IMPROVEMENT OF PAMLICO RIVER, NORTH CAROLINA.

##### HISTORY OF OPERATIONS.

The act of Congress making appropriations for rivers and harbors, approved March 3, 1875, provided for an examination or survey of Pamlico River, North Carolina. In accordance therewith an examination of

the river was made by direction of the Chief of Engineers, and a report with an estimate of the cost of the improvement submitted December 14, 1875. (Report of Chief of Engineers for 1876, Part I, p. 361.) Surveys of the river had previously been made by the officers of the United States Coast Survey, and an examination had also been made in 1872 under the direction of Maj. William P. Craighill, Corps of Engineers. These afforded the data necessary for an examination and approximate estimate.

Pamlico River lies entirely in Beaufort County, North Carolina. It is formed by the union of the Tar (or Tau) River and Bear Creek, which flow together a few miles above Washington, N. C. It flows in a southeasterly direction, is nearly straight, and empties into Pamlico Sound at its southwestern end about 37 miles below Washington. The width of the river gradually increases from one-half a mile at Washington to 4 miles at its mouth. The depth gradually decreases from 21 feet at the mouth to about 8 feet near Washington below the bar.

Washington is the county seat of Beaufort County, has 2,000 inhabitants, and is the center of trade for a large section of country. It is connected by railroad with Jamesville, on the Roanoke River, and by lines of steamers with Tarborough, and with Norfolk, Va. Large shipments of cotton and naval stores are made each year.

The obstructions to navigation consisted in a blockade of piles at Hill's Point and shoal water near the town of Washington.

#### PILE OBSTRUCTIONS.

At Hill's Point, 6 miles below Washington, the width of the river is about 1 mile, being somewhat less than the adjacent portions above and below. It was therefore chosen as a favorable locality for placing obstructions during the late war. Rows of piles were driven at short intervals across the river and cut off about 3 feet below low-water, forming a dangerous obstruction to the navigation of the river. Some of the piles in the main channel had already been removed, so as to afford a pass, which was marked by buoys.

The bar near Washington commenced at a short distance below the lower wharf of the town, and extended about 1,200 feet down the river. The least depth was found by a survey made just before commencing the improvement to be 6.2 feet, the material being sand. The water at a point 1 mile below the town was found to be shoal, requiring some dredging. The estimate of the cost of the improvement was \$28,050.

#### IMPROVEMENT.

An appropriation of \$15,000 was made by the river and harbor act, approved August 14, 1876, for the improvement, which became available May 1, 1877. The project submitted for this work May 2, 1877, proposed—

1. The removal of the obstructions in the river near Hill's Point, consisting of rows of piles running across the channel.
2. Dredging a channel 8 feet deep and of such width as the funds would permit through the bar near the town of Washington.

The proposed plan of operations having been approved by the Chief of Engineers, specifications were prepared and the work advertised for contract. An abstract of the bids received and opened June 27, 1877, will be found in the Report of the Chief of Engineers for 1877, Part I, page 366.

The contract for the removal of the piles was awarded to Messrs. Swindell and Sparrow, of Washington, N. C., at \$1.90 each. The con-

tract for dredging was awarded to Mr. G. H. Ferris, of Baltimore, Md., at 15 cents per cubic yard.

Work under the former contract was commenced August 1, 1877, and completed September 19, 1877. The piles were drawn by a Spanish windlass, rigged on a scow, and snag-hooks. The piles were grasped by the hooks near the top and drawn by a steady pull. They were of cypress, gum, and pine, averaging from 10 to 14 inches in diameter, with a penetration of from 3 to 20 feet, ranging generally from 8 to 12 feet. The piles were sound, although thickly covered with barnacles. They were taken to the shore and securely piled at Hill's Point and Swan Point opposite—895 piles. All that could be found were removed.

Dredging, under the contract with Mr. Ferris, was commenced October 1, 1877, on the bar just below Washington. With the exception of a few stumps and logs on the east side, the material of which the bar was composed was found to be sand, readily excavated. The material was deposited in 7 feet of water on the east side of the river 1 mile below the bar. A channel 175 feet wide was completed January 1, 1878, affording decided relief to navigation. The depth was made 9 feet below ordinary low-water to give 8 feet when the northwest winds caused extreme low-water.

Upon the completion of this channel vessels and steamers very naturally began to load to a greater draught, and soon found that the shoal part of the river, about a mile below the town, caused some delay during low-water. A survey of the locality was made in February, 1878, and it was found that the navigation of the river could be improved by dredging.

Work was therefore resumed March 29; soon after the dredging of the lower channel was commenced it was found that underneath a layer of about 1 foot of sand and mud there was a mass of roots and stumps which could be removed only with the greatest difficulty.

The contract was intended to cover ordinary dredging, and the contractor therefore requested that he be paid for the removal of stumps, or be allowed to withdraw from the work. Upon an examination of the channel it was evident that the contractor was justly entitled to payment for the unexpected class of work which he had encountered, and recommendation was made to the Chief of Engineers that the contract be modified to cover the removal of the stumps. This recommendation having been approved the work proceeded, although not without serious delays and great expense to the contractor. The dipper dredge used was not adapted to this kind of work, and broke down constantly. It was found necessary to use giant powder for blasting many of the stumps before they could be removed.

The cypress stumps were perfectly sound and in their natural position; the gum stumps were partly decayed. The greatest diameter was 8.9 feet, and the roots were about 9 feet long. Two hundred and eighty-seven stumps and knees were removed without giant powder, and 25 by the use of the powder and the aid of a diver.

On June 22 the lower channel had been completed to a width of 70 feet, and work under Mr. Ferris's contract was suspended.

Operations at Washington were brought to a close during the early part of the present fiscal year.

The work remaining to be done is widening the lower channel. The lines adopted for this channel were those usually followed by vessels, to avoid the large number of stumps found in a straight course from Buoy 12 to Washington. The amount of dredging will be small, the principal work being the removal of stumps.