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Bridging the Gap: Canadian Engineer Operations at Canal du Nord–Bourlon Wood, 1918

Brian Pascas

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Abstract: During the last hundred days of the Great War, the Allied armies swept eastward past the Hindenburg Line with hammer-blow offensive warfare. Performing their work under intense machine gun and shell fire, engineers erected bridges and constructed roads, allowing infantry and artillery units to pursue the retreating enemy. These combat engineers played a vital role in battle tactics and logistical services of open warfare. Their versatile formations contributed to the Canadian Corps' rapid victories, which included the successful Canal du Nord crossing leading to the capture of Bourlon Wood in September 1918.

> The battle of Bourlon Wood was an engineers' battle. The success of the whole operation depended on the speed with which the necessary crossings of the Canal du Nord were provided, and the way they were maintained and improved during the day, so as to enable the guns and infantry to be maintained in the positions which they had reached in their advance.[1]

Was the Battle of Canal du Nord—also referred to as Bourlon Wood (BW) in official documents—an engineers' battle? Most battle narratives concentrate on infantry and artillery tactics; some analyse the war's operational and strategic levels.

[1] J.F.B. Livesay, "Canadian Engineers' Marvellous Feats at Canal du Nord Scrap," *The Montreal Daily Star*, 5 November 1918, RG9, III-C-1, Volume 3964, Folder 29, File 5, Library and Archives Canada [hereafter LAC]. See also J. Castell Hopkins, *Canada at War: A Record of Heroism and Achievement 1914-1918* (Toronto: The Canadian Annual Review, 1919), 192. Lloyd George declared: "This is an engineers' war, … we need arms more than men…." See William Philpott, *Attrition: Fighting the First World War* (London: Little, Brown, 2014), 166.

Ancillary services receive less recognition. To refute or confirm this "engineers' battle" assertion, one must understand the Canadian engineers' logistical battlefield work in the last one hundred days of the Great War.

"Engineers were considered, first and foremost, as fighting troops. Each one went through the normal course of infantry training and were individually armed and equipped as such."[2] The military engineer (the sapper) frequently came under enemy fire while performing engineer services in the front line. The sapper operated as both soldier and technician.[3]

The Great War engineer's numerous duties included constructing and repairing roads, assembling portable and permanent bridges, tunnelling and mining, laying tramway tracks, establishing water points, and disarming booby traps. This article examines the Canadian engineer's role in the last months of the war, beginning with the engineer battalions created in the spring of 1918 from field companies and pioneer battalions. In September, these new battalions faced an immense challenge constructing crossings and bridges while under enemy shell and machine gun fire. Infantry, tank, artillery, and tramways units depended on the engineers for unobstructed passage across mine-cratered roads and the Canal du Nord, littered with destroyed bridges, near Bourlon Wood. The engineering work, with a focus on bridge building, is assessed during the opening day's assault at the Canal du Nord on 27 September.

The military engineer's mission in the Great War was straightforward:

> The purpose of engineers is to apply engineering science to the emergencies of modern warfare, in order to protect and assist the troops[,] to ameliorate the conditions under which they are serving and to facilitate locomotion and communication.[4]

[2] David Love, *A Nation In Making Volume 2: The Organization and Administration of the Canadian Military During the First World War* (Ottawa, Service Publications, 2012), 271.

[3] Bill Rawling, *Technicians of Battle*: *Canadian Field Engineering From Pre-Confederation To The Post-Cold War Era* (Toronto: Military Engineering Institute of Canada, 2001), xiii.

[4] James L. Melville, "The Canadian Engineers," *Canada in the Great World War* (Toronto: United Publishers of Canada, 1921), 38.

REORGANISATION

All divisional engineers were pooled under the direct executive command of the Canadian Corps' Chief Engineer who became the General Officer Commanding (GOC) Canadian engineers.[5] Under Army orders, British Royal Engineer (RE) field companies and pioneer battalions were attached under the Canadian Corps' Chief Engineer when the work required additional units.[6] The GOC was also responsible for training, promotions, transfers, and postings. Thirty-eight-year-old Brig.-Gen. W. Bethune Lindsay became the Canadian Corps' Chief Engineer in March 1916. His promotion to major general in December 1919 was retroactive to 1 August 1918. Lindsay was technical adviser to Canadian Corps commander Lieut.-Gen. Sir Arthur Currie for all engineer services. The four infantry divisions each retained a pioneer battalion and three field companies. Three tunnelling companies were categorised as army troops and the corps troops included entrenching battalions and four labour battalions.[7]

In November 1917, Lindsay proposed engineer units with integral labour—merging skilled and unskilled men—thereby freeing the infantry from manual labour tasks. Before the reorganisation, Canadian engineers planned and supervised daily infantry working parties. This led to the motto: "engineers responsible for quality and infantry for quantity."[8] The infantry despised these working parties, especially the digging, and did as little as possible. The engineer who arrived late and forgot the tools intensified the loathing. "[U] nder these conditions the average man does not do 25% of the work he might fairly be expected to accomplish."[9] Currie remarked that the infantry would fight a battle one day and perform engineering

[5] Halfdan F.H. Hertzberg, "The Re-organization of the Engineering Troops of a Canadian Division-Great War 1914-18," *Canadian Defence Quarterly* (July 1924): 46.

[6] Love, *A Nation In Making Volume 2,* 275.

[7] The four entrenching battalions were disbanded in August 1917 and replaced by the Canadian Corps Reinforcement Camp. Two of the four labour battalions became railway troop battalions and the other two became the 1st and 2nd Infantry Works battalions. In mid-September, these Works battalions were disbanded to create four infantry works companies under the authority of the Canadian Labour Group.

[8] Hertzberg, "Re-organization of the Engineering Troops," 41.

[9] Secret Memorandum on Engineer Services, MG30, E100, Volume 37, File 166, LAC.

work the next.[10] A reorganisation was needed to supervise and carry out all the engineering work itself.[11] Currie realised the engineer and machine gun units were drawing heavily on the infantry for additional personnel and he had to stop the drain on the infantry. He recommended expanding each engineer field company to an engineer battalion, lumping in the pioneer battalion.[12] On 27 February 1918, Currie wrote: "...I consider this reorganization to be so necessary that I would prefer to go without Infantry rather than without Engineers."[13] The War Office granted authority for the changes on 24 March. On 24 May, Currie ordered the engineering reorganisation, which was finalized in late July.[14] In the meantime, personnel, animals, vehicles, and inventory stores were transferred to the new battalions.

Under the reorganisation, the engineer divisional headquarters, field companies, pioneer battalions, base reinforcements, 5th Canadian Division Engineers' field companies, and two tunnelling companies were regrouped into engineer brigades. The four infantry divisions were each allotted a brigade. A headquarters, three battalions, and a seventy-member pontoon bridging transport unit (PBTU) defined the engineer brigade staffed by 3,249 officers and other ranks (OR). A field company became an engineer battalion comprising a headquarters and four companies, with twenty-four 3-ton lorries and over 500 horses. On 4 June, the 2nd Brigade's three battalions were the last of the twelve new battalions to be established.

These four brigades reported to the Chief Engineer who maintained a staff including field engineers for tramways, bridges, and roads. In the war's last months, the corps area was divided into four parts with an engineer brigade made responsible for each part. The same engineers remained on the same job until its completion ensuring continuity.[15] Corps troops, signals service, detached units, and the CE Motor Transport Company also reported to the Chief Engineer. Five army troops companies, two tramways companies,

[10] A.M.J. Hyatt, *General Sir Arthur Currie: A Military Biography* (Toronto: University of Toronto, 1987), 111.
[11] Hertzberg, "Re-organization of the Engineering Troops," 40.
[12] Arthur Currie to Mr. McGillicuddy, MG30, E100, Volume 27, File 7, LAC.
[13] A. Kerry and William McDill, *The History of the Corps of Royal Canadian Engineers, Volume 1 1749-1939* (Ottawa: The Military Association of Canada, 1962), 162.
[14] Melville, "Canadian Engineers," 69.
[15] Hertzberg, "Re-organization of the Engineering Troops," 46.

the Canadian Corps Survey Section and one "artizan" company were amalgamated as corps troops. Detached units included the No. 3 Tunnelling Company and an anti-aircraft searchlight company. The Canadian Engineers Reinforcement Depot (CERD) retained fifty officers and 1,600 OR.[16] The battalion ranks were augmented throughout 1918. In September, the 8th Battalion, CE received 144 reinforcements from the CERD; 31 percent were draftees.[17]

Currie wrote "that much of the success of the Canadian Corps in the final 100 days was due to the fact that they had sufficient engineers to do the engineering work and that in those closing battles we did not employ the infantry in that kind of work."[18] However, the poor bloody infantry could not escape the pick and shovel burden. On the evening of 29 August 1918, 100 OR from the 2nd Battalion, CE were ordered to consolidate newly captured enemy territory. The men, transporting 500 picks and 500 shovels, finally arrived at 3 a.m. With sufficient infantry to do the work, the sappers were dismissed from the overcrowded outpost line. The infantry dug themselves in and secured the line.[19]

Currie noted after the war that a British expert "committee found that the Canadian infantry organization and the Canadian Engineer organization and the Canadian Machine Gun organization was the most effective possible and therefore should be adopted for the British."[20]

CANAL DU NORD – BOURLON WOOD OPERATION

On 15 September 1918, Field Marshal Sir Douglas Haig held a strategic conference with the First, Third, and Fourth Army commanders. He ordered a joint operation towards Cambrai by General Sir Henry Horne's First Army and General Sir Julian Byng's Third Army with the capture of Bourlon Wood by First Army. On 23 September,

[16] Administration of Engineer Services Canadian Army Corps, RG9, III-D-2, Volume 4811, LAC; Canadian Engineers Reorganization, RG9, III-D-2, Volume 4811, LAC.
[17] Patrick Dennis, *Reluctant Warriors: Canadian Conscripts and the Great War* (Vancouver: UBC Press, 2017), 263.
[18] Currie to Mr. McGillicuddy, MG30, E100, Volume 27, File 7, LAC.
[19] Appendix H, Report by 1st Brigade, CE, Drocourt-Quéant Operations, MG30, E100, Folder 37, File 168, LAC.
[20] Currie to Mr. McGillicuddy, MG30, E100, Volume 27, File 7, LAC.

Allied generalissimo Marshal Foch sanctioned four sequential hammer-blow offensives from the River Meuse to the North Sea: a Franco-American attack on 26 September in the Meuse-Argonne, the British First and Third Armies attack on 27 September, a Flanders Group (British Second Army, Belgian, and French) attack on 28 September between the sea and the River Lys, and a British Fourth Army and French First Army attack on 29 September at the Canal de St. Quentin.[21] The Canadian Corps attached to the First Army had to protect the Third Army's left flank during their advance. After Currie submitted his plans to General Horne, First Army issued instructions on 18 September to the Canadian Corps and Lieut.-Gen. Alexander Godley's British XXII Corps.

The Canadian Corps with the 11th British Division and 7th Tank Battalion under its command planned an ambitious two-phase operation. The corps' first phase objective: capturing Bourlon Wood (about 2 miles east of the Canal du Nord) and the high ground about Pilgrim's Rest (north of Bourlon Wood), La Maison Neuve (north of Pilgrim's Rest) with the left flank thrown back across the plateau via Sauchicourt Farm to the canal, and the Fontaine-Notre-Dame Line east of Bourlon Wood. The Canadians had to capture three strongly wired trench systems after crossing the Canal du Nord: the partially-dug Canal du Nord Line (200-500 yards east of the canal) with its two wired trench lines and deep dugouts, the Marquion Line (a mile farther east), and the Marcoing Line defending Bourlon village and Bourlon Wood. Numerous fortified shell holes, concealed dugouts, sunken roads, and pits populated the area between the canal and the enemy's first defence line. The second phase entailed seizing bridges over the Canal de l'Escaut northeast of Cambrai, establishing the necessary bridgeheads, and capturing the high ground overlooking the Sensée Valley between the Canal de l'Escaut and the Canal du Nord.

Previously, the Canadian Corps had received orders to attack the Drocourt-Quéant Line on 2 September and exploit rapidly forwards, seizing crossings over the Canal du Nord on a 5-mile front from Sains-Lez-Marquion to Palluel. The 7th Battalion, CE with the 4th and 5th Army Troops Companies, CE prepared materiel for heavy bridges at Sains-Lez-Marquion, Marquion, and 2,700 yards further north at

[21] Ferdinand Foch, *The Memoirs of Marshal Foch* (London: Heinemann, 1931), 473-74.

Sauchy-Cauchy.[22] The 3rd Battalion, CE would be responsible for light transport bridges and cork raft infantry footbridges over the canal and the River Agache, for crossings selected on 31 August.[23] However, the canal crossings were not captured on 2 September, forcing the postponement of the bridging operations. This delay would turn out to be a godsend.

Two days later, Currie personally reconnoitred the Canal du Nord after the Germans had retreated east of the canal destroying bridges and roads as they withdrew. He concluded a frontal attack on the German positions east of the canal would be formidable stating:

> 1. The canal itself is a serious obstacle,
>
> 2. The marshes on the eastern side made difficult going,
>
> 3. It is strongly defended by machine guns from the trench system running parallel to the canal,
>
> 4. The high ground on the east gives a perfect command of the approaches,
>
> 5. The more we advance to the eastward the more violent becomes the enfilade fire.[24]

The Canal du Nord was indeed a daunting hurdle. It had been under construction until the outbreak of war and not all was excavated and water-filled. The canal was dry, except for shallow pools, for nearly 7.5 miles from Hermies in the south to 500 yards northeast of Inchy-en-Artois at Lock 3.[25] The ground rose from north to south along the canal's course from Arleux to Noyon connecting the Canal de la

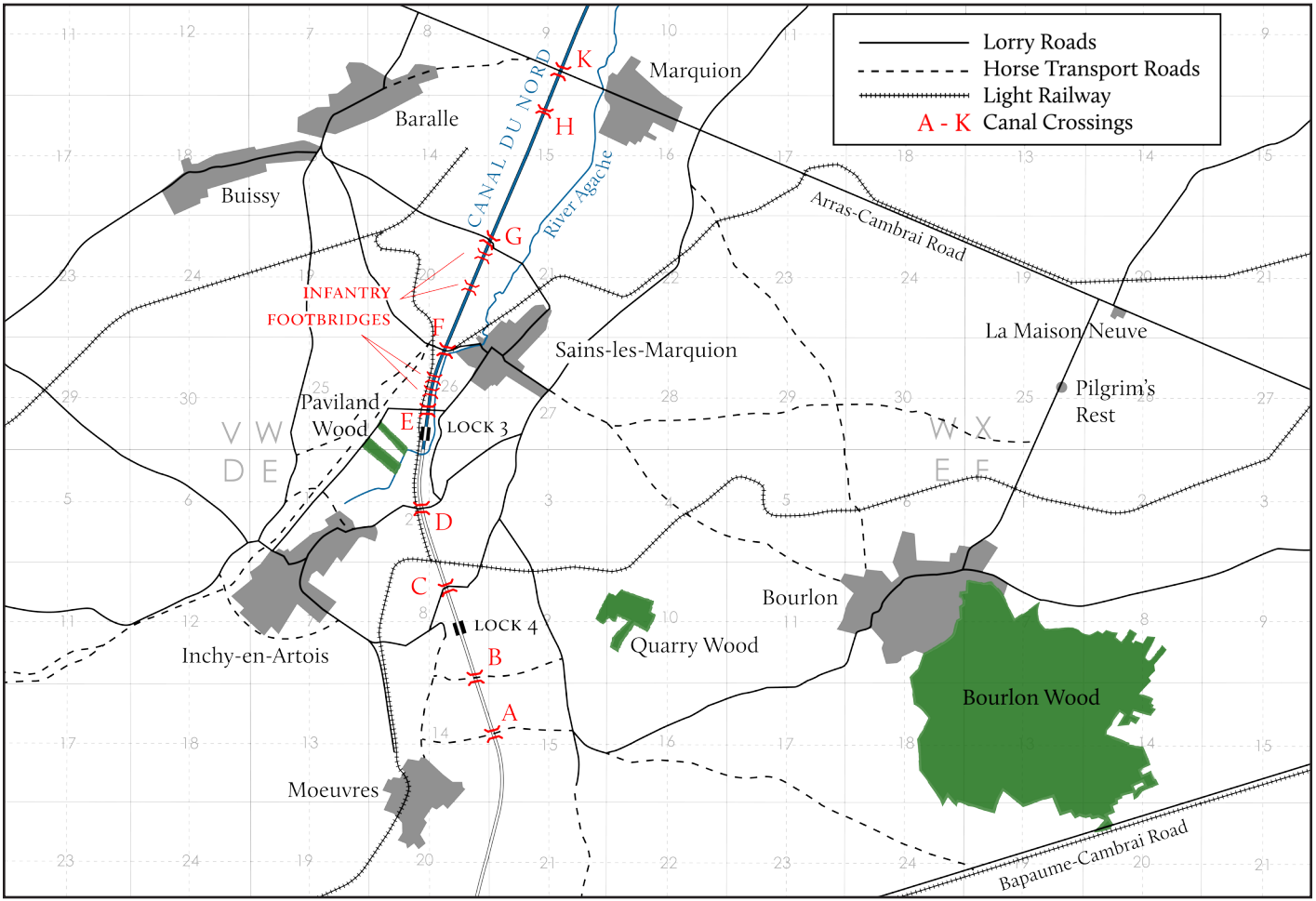
[22] Gerald W.L. Nicholson, *Canadian Expeditionary Force 1914-1919* (Ottawa: Queen's Printer, 1964), 433-34; War Diary [hereafter WD], 3rd Brigade, CE, September 1918, Engineer Instructions No. C.3, 2 September 1918, LAC.
[23] WD, 3rd Battalion, CE, September 1918, Operation Order No. 108, LAC; Appendix H, Report by 1st Brigade, CE, MG30, E100, Volume 37, File 168, LAC.
[24] Hugh Urquhart, *Arthur Currie: The Biography of a Great Canadian* (Toronto: J.M. Dent & Sons, 1950), 249; Mark Humphries, (ed.), *The Selected Papers of Sir Arthur Currie: Diaries, Letters, and Report to the Ministry, 1917-1933* (Waterloo: LCMSDS Press of Wilfred Laurier University, 2008), 116.
[25] After the war, legions of rats from the canal infested Sains-Lez-Marquion and Inchy-en-Artois.

Sensée with the Canal de la Somme and sloped upwards from the Canal du Nord towards Quarry Wood and Bourlon Wood in the east. The canal, between 20 and 40 yards wide, narrowed to about 12 yards near Marquion. Towpaths, roughly 12 to 15-foot-wide, bordered it. From Lock 3 to the Bapaume-Cambrai Road south of Moeuvres, the dry canal bed was either level with the surrounding terrain or partially excavated several feet below ground level. Narrow-gauge tracks ran down the centre between Locks 3 and 4. Banks rising above ground level from the chalky excavation spoil lined the canal—similar to an aqueduct. From Moeuvres to Inchy-en-Artois, the banks' height varied up to 20 feet. In some areas the unfinished eastern bank was considerably lower than the western bank. These banks were either sloped or sheer and were pockmarked with burrowed cuttings for road and track passages. North of Inchy-en-Artois, the canal's interior banks were revetted with 4 feet of brick.[26] At Sains-Lez-Marquion, the canal bed was 16 feet below the towpath.

At the Arras-Cambrai Road (see appendix A: map grid reference W.9.d.2.4), stagnant spring water filled the canal. Farther south (W.21.a.0.6)—about 500 yards north of Sains-Lez-Marquion—the terrain on each side of the peaty canal became marshy in wet weather, further widening the logistical and tactical obstacle. Numerous water-filled drainage ditches paralleled the canal on both sides. North of Lock 3 (W.26.c.9.4) to Palluel, the canal contained, on average, 8 feet of water. The River Agache, a sluggish swampy stream lined with willows, ran parallel to the canal, about 300-500 yards east of it above Lock 3 and west of the canal below the lock beside Paviland Wood to Inchy-en-Artois.[27] North of Sauchy-Cauchy, it crossed again to the west side of the canal. The river varied in width from 6 to 15 feet. Near Sains-Lez-Marquion, the 9-foot-wide Agache ran 9 to 12 feet deep.[28]

In mid-September, Currie—whose corps overlooked the marsh and the water-filled canal from Sauchy Cauchy to Sains-Lez-Marquion—advocated side-stepping 3,000 yards south to avoid this

[26] WD, 1st Infantry Brigade, September 1918, Appendix 17, LAC.
[27] W. Hastings Anderson, "The Crossing of the Canal du Nord by the First Army, 27th September, 1918," *Canadian Defence Quarterly* 2, 1 (October 1924): 65; Michel Gravel, *Tough As Nails* (Ottawa: CEF Books, 2006), 70.
[28] Intelligence File, RG9, III-C-1, Volume 3912, Folder 42, File 5, LAC.



serious obstacle.[29] On 20 September, the 2nd Canadian Division shifted south to Moeuvres' northern edge, taking over a section from the Third Army's XVII Corps' front line held by the 52nd British Division. The British XXII Corps moved south occupying the old Canadian front to 1,200 yards north of the Arras-Cambrai Road. The Third Army now held a 10,500-yard dry canal stretch and the First Army held 2,600 yards.[30]

The Canadian Corps' new battle front ran 6,400 yards along the canal's western bank, varying 50 to 500 yards back from it.[31] From its southern (E.14 central) to northern boundary (W.4.c.2.7), the frontage encompassed the northern outskirts of Moeuvres (1,500 yards north of the Bapaume-Cambrai Road), Lock 4, Inchy-en-Artois, Lock 3, and Sains-Lez-Marquion. It ended 1,200 yards north of the Arras-Cambrai Road. The Hindenburg Support Line crossed the Canal du Nord opposite Moeuvres at E.21.a.1.7. The XXII Corps took over control as far south as the Arras-Cambrai Road on 25 September.[32] During the night of 25-26 September, the 1st and 4th Canadian Divisions and the 11th and 56th British Divisions relieved the 2nd Canadian Division at the canal.

"[T]he Canal du Nord was impassable on the northern 3,800 yards. The Corps had, therefore, to cross the Canal du Nord on a front of 2,600 yards, and to expand later fanwise in a north-easterly direction to a front exceeding 15,000 yards."[33] The corps would launch its attack on Friday, 27 September at this constricted bottleneck from the jumping-off line, ranging 300 to 750 yards from the canal. Only a small portion of the artillery could be sited forwards in the narrow gateway. Unlike the straightforward frontal attack at Amiens, Canal du Nord incorporated "risk and manoeuver."[34] Upon returning from

[29] Arthur Currie to Frank Underhill, 17 September 1920, MG30, E100, Volume 27, File 7, LAC.

[30] James Edmonds, *Military Operations France and Belgium 1918 Volume IV 8th August- 26th September* (London: The Imperial War Museum, Nashville: the Battery Press, 1993), 426.

[31] Lieut.-Gen. Sir Archibald Macdonell, "The Old Red Patch," *Canadian Defence Quarterly* IX, 1 (October 1931): 13.

[32] WD, Canadian Corps General Staff, Volume 37, September 1918, RG9, III-D-2, Volume 4789, Folder 3, LAC.

[33] Arthur Currie, *Canadian Corps Operations During the Year 1918: Interim Report* (Ottawa: Department of Militia and Defence, 1919), 57.

[34] Shane Schreiber, *Shock Army of the British Army: The Canadian Corps in the Last 100 Days of the Great War* (St. Catharines, ON: Vanwell, 2004), 110.

Canadian Corps headquarters after examining Currie's complicated operational plans, the deeply disturbed Horne declared three times: "I don't believe I ought to let them do it." Horne's senior staff officer Maj.-Gen. Hastings Anderson replied: "If Currie says they can do it, … they will."[35]

The corps' first phase—a two-division assault on the dry 2,600-yard frontage—entailed three intermediate objectives marked on maps as the Red, Green, and Blue Lines. The Red Line formed an arc north of Sains-Lez-Marquion, curving southeast along the Marquion Line. The Green Line included Marquion (400 yards east of the canal and intersected by the Arras-Cambrai Road), Quarry Wood (across from Inchy-en-Artois), a portion of Bourlon village, and Bourlon Wood's western border. The Blue Line stretched from south of Sauchy-Lestrée, southeast to Pilgrim's Rest, extending to the light railway junction east of Bourlon Wood, and ending at the corps' southern boundary at Fontaine-Notre-Dame. The advance to the Blue Line was arranged as a set-piece infantry and artillery operation under a creeping shrapnel, high explosive, and smoke barrage with pauses at the Red and Green Lines. The 1st Canadian Division—on the left with a 1,100-yard restricted frontage—would swing left in a fanlike action and capture Sains-Lez-Marquion and Marquion. The 4th Canadian Division—on the right with a 1,500-yard frontage—planned to capture Bourlon village and Bourlon Wood. They faced three German divisions (7th Cavalry, 12th, and 187th) between Inchy-en-Artois and the Canal de la Sensée (12,000 yards distance) plus five more in reserve.[36]

The Brown Line designated the second phase's single objective on a 10,000 yard four-division front. From south to north, the 3rd, 4th, and 1st Canadian Divisions and the 11th British Division were to advance to the Brown Line. The 169th Brigade, 56th British Division, XXII Corps was left of the 11th British Division. The 3rd Canadian Division and the 11th British Division movements needed traffic control to avoid undue congestion.[37] The second phase's fulfillment relied on the engineers for artillery and light railways passages. "The

[35] Wilfred Bovey, "General Sir Arthur Currie: An Appreciation," *Canadian Defence Quarterly* XI, 2 (January 1934): 148-49.
[36] Anderson, "Crossing of the Canal du Nord": 65; MG30, E5, Volume 3, Battle BW Intelligence Summaries Folder, LAC.
[37] Canadian Corps Bourlon Wood Instructions No. 1, 23 September 1918, RG9, III-C-1, Volume 3856, Folder 76, File 6, LAC.

success of the whole operations beyond the BLUE Line depends on the speed with which the CANAL is bridged, and, therefore, all units must be prepared to give the Engineers every possible facility and assistance to enable them to complete the bridges quickly."[38] Each phase included the Yellow Line (a line of exploitation) 1,200 yards beyond the Blue and Brown Lines. Patrols were to be established, enemy battery positions captured, and the frontage extended farther.[39] In total, 1,347 guns and howitzers—804 from the Canadian Corps and 543 from the XXII Corps—supported the attack.[40]

From Moeuvres, northwards, the enemy still occupied trench lines east of the canal and outposts on the western side.[41] Immense numbers of machine guns populated the canal borders, with batteries and anti-tank guns ready to sweep the approaches. During their retreat on 2 September, the enemy had blown up the metal and wooden bridges (some by aerial bombardment), heaved girders into the canal, and smashed abutments. Moreover, the Germans had mined and shelled the main roads, leaving them pitted with huge craters. Bridges constructed adjacent to the destroyed bridges would avoid time-consuming detours from the roads leading to the mangled bridges.

Under enemy barrages and gun fire, the engineers intended to provide sufficient roads, bridges, and tramways for guns, ammunition, stores, and rations for the assaulting troops. The goal was to transport guns at Zero Hour plus four hours over the southern crossings. The bridging operations were divided into three phases: infantry footbridges, crossings for first-line transport (field guns, general service wagons, and horse transport), and heavy bridges for lorries and 17-ton 6-inch howitzers.[42]

There were three main military bridge classes. Light bridges were intended for temporary use and meant for the passage of men in small numbers. Medium pontoon and trestle bridges could carry men four abreast, horses, and field artillery; a 90-foot-span bridge could be

[38] 1st Canadian Division, B-W Instructions No. 3, RG9, III-C-1, Volume 3856, Folder 77, File 1, LAC.

[39] Map "A", RG9, III-C-1, Volume 76, File 6, LAC.

[40] Anderson, "Crossing of the Canal du Nord": 67.

[41] On 16 September, the post opposite Sauchy-Cauchy was captured by the Germans resulting in eighteen missing 5th CMR men. See WD, 8th Brigade, September 1918, LAC; Charles Henry Savage Memoir 1936, CLIP, https://www.canadianletters.ca.

[42] Interim Report on Crossings of Canal du Nord, RG9, III-C-1, Volume 3964, Folder 29, File 4, LAC; Administration of Engineer Services Canadian Army Corps, RG9, III-D-2, Volume 4811, LAC.

erected in sixty to ninety minutes under adverse conditions.[43] Heavy bridges were designed to carry all army vehicles. These metal bridges required twelve to twenty-four hours' work to erect. The bridge types included cork pier (cork bales inside wooden crates), pontoon, heavy pontoon, trestle, and heavy steel. Some bridges combined pontoons and trestles.[44]

The Inglis portable military bridge—light for infantry or heavy for all arms—was made with welded steel tubes. Each light bridge bay measured 8 feet long, 8 feet high, and 8 feet wide. A heavy bridge bay measured 12 feet long, 12 feet high, and 12 feet wide.[45] The sappers used the first bay, constructed on a 2-wheeled trolley, to push the completed bridge to the other bank. A fifteen-bay bridge required forty-six wagons to transport the materiel. Both triangular (4-legged pyramid) and rectangular Inglis bridges were available.[46] Captain James Melville requested two Inglis rectangular heavy bridges for the canal and trained 200 engineers in their operation by assembling and disassembling a 216-foot-span bridge a few days before Zero Hour.[47]

"The Engineer preparations for the BOURLON WOOD operations were undertaken on five day's [*sic*] notice…"[48] All the corps' resources in engineer units along with the field companies and pioneer battalions from the 11th British Division were at Lindsay's disposal. Before Zero Hour, these resources had repaired shell-destroyed roads, built cross-country tracks for infantry and horse transport, extended light tramways to the jumping-off line, carved out dugout accommodations, and provided water for men and horses. This pooled resource repaired 18 miles of roads (excluding artillery tracks) up to the front line and constructed 7 miles of tramways, on

[43] Notes on Bridging Operations, RG9, III-D-2, Volume 4808, File 185, LAC.
[44] Summary of Operations, 1918, Canadian Engineers, RG9, III-C-1, Volume 3964, Folder 30, File 14, LAC.
[45] The Mark IV tank's width with machine gun sponsons was over 13 feet. The Mark V tank required a 14 feet, 6 inches roadway clearance. See Melville, "The Canadian Engineers," 43.
[46] RG9, III-C-5, Volume 4384, Folder 2, Files 1 and 3, LAC; Inglis portable bridge, RG24-C-6-K, Volume 22002, LAC.
[47] John Gardam, *Seventy Years After 1914-1918* (Stittsville, ON: Canada's Wings, Inc, 1983), 39; Chief Engineer, September 1918, Heavy Bridging Operations, Appendix B, LAC.
[48] Untitled three-page report, RG9, III-C-1, Volume 3964, Folder 29, File 4, LAC.

which petrol-driven tractors delivered over 3,000 tons of ammunition per day.[49]

Initially, nine main crossings over the Canal du Nord were devised. These crossings, from the corps' southern boundary frontage situated north of Moeuvres to the northern boundary above the Arras-Cambrai Road, were designated "A" through "H" and "K". "A", "B", "C", and "D" were on the dry canal bed. "E", "F", "G", "H", and "K" were over water necessitating pontoon, trestle, and steel-tube bridges, some adjacent to destroyed bridges. Upon capturing the Blue Line (3,000-7,000 yards east of the canal), the materiel for the heavy bridges at "F", "G", and "K" would be brought up. Until then, all heavy traffic would use "C" and "D".[50]

Bourlon Wood Engineer Instructions No. 1 dealt with the locations for the construction and repair of the dry crossings, bridges, tramways, and roads at Canal du Nord. Engineer units were assigned to each of these services: all four engineer brigades, all five army troops companies, both tramways companies, the four PBTUs, and three field companies along with one pioneer battalion from the 11th British Division. The 4th and 5th Army Troops Companies were responsible for erecting two Inglis steel bridges at "F" and "K" on old abutments. The 10th and 11th Battalions in the 4th Brigade, CE were assigned "A", "B", and "C". Four infantry footbridges and "D", "E", "F", and "G" were assigned to the 1st Brigade, CE. The Royal Engineers were responsible for "H" and "K" and three footbridges.[51] In the second phase, the 7th Battalion, CE would construct all temporary bridging over the Canal de l'Escaut. Engineer brigade detachments would assist the field artillery brigades with moving the guns to their new positions. Sappers would reconnoitre for booby traps and mines and repair dugouts for headquarters. In preparing for Zero Hour, sapper parties had erected and dismantled model bridges in the fields.[52]

[49] Ibid.

[50] James Edmonds, *Military Operations France and Belgium 1918 Volume V 26th September-11th November 1918, Appendix V* (London: The Imperial War Museum, Nashville: the Battery Press, 1993), 633.

[51] Bourlon Wood Engineer Instructions No. 1, RG9, III-C-1, Volume 3964, Folder 29, File 6, LAC; For heavy bridging details, see Bourlon Wood Engineer Instructions No. 3, RG9, III-D-2, Volume 4426, Folder 3, File 9, LAC.

[52] Narrative Operations of 2nd CDA, RG9, III-C-1, Volume 3912, Folder 42, File 8, LAC.

Infantry from the 3rd and 4th Canadian Divisions were to cross at "A" and "B" and the 1st Canadian Division and the 11th British Division at "C" and "D". Once the bridges at "E", "F", "G", "H", and "K" were erected, traffic would be dispersed as follows: the 3rd Canadian Division "A" and "B", the 4th Canadian Division "C" and "D", and the 1st Canadian Division "E" and "F". The 11th British Division's 32nd and 34th brigades located to the right of the 56th British Division's 169th Brigade were assigned the "G", "H", and "K" bridges.[53] The three British brigades would cross the canal between five-an-a-half and six-an-a-half hours after Zero Hour as far south as W.15, south of Marquion.[54] The "G", "H", and "K" bridges were still under construction at this time. Therefore, the brigades were likely forced to use the British-constructed footbridges erected between "G" and "H" bridges and any salvageable German footbridges. Supply dumps were completed and lorries with bridging materiel weighing 145 tons were ready to move during the evening of the 26th.

Bourlon Wood Engineer Instruction No. 3 dealt with water supply work allotment for brigade and army troops.[55] Open warfare conditions required access to water supplies and "facilities to provide for the existence of what is practically a 'moving city' with a population varying from 105,000 to 160,000 men and from 25,000 to 60,000 horses..."[56] In September, the four engineer brigades organised forward water supply sections. They searched for water sources in captured areas, collected water samples for testing and marked wells, eventually using pumping sets, water tank lorries, and sterilising lorries.[57]

In the early morning of 27 September, the Canadian Corps with the First Army and the Third Army formed a 13-mile front facing Cambrai. German flares illuminated the industrialised battlefield. As Zero Hour approached (5:20 a.m., dark and misty, forty minutes before dawn), the 1st and 4th Canadian Division shock troops were deployed along the Moeuvres-Lock 3 jumping-off line. The nearby assembly

[53] B.W. Instructions No. 2, RG9, III-C-1, Volume 3913, Folder 34, File 5, LAC.
[54] Addendum No. 1 to 11th Division Order 218, RG9, III-C-1, Volume 3856, Folder 77, File 8, LAC; 56th Division Order No. 206, RG9, III-C-1, Volume 3856, Folder 77, File 10, LAC.
[55] Bourlon Wood Engineer Instructions No. 3, RG9, III-C-1, Volume 3964, Folder 29, File 6, LAC.
[56] Administration of Engineer Services Canadian Army Corps, RG9, III-D-2, Volume 4811, LAC.
[57] Summary Canadian Corps Water Supply, RG9, III-D-2, Volume 4808, File 185, LAC.

areas were congested with artillery guns and limbers, ammunition lorries and stockpiled shells, machine gun batteries, ambulances, and transport for bridging materiel. The leading battalions spearheaded the rush across the canal the instant the thunderous bombardment erupted in a line of flashes. Bursting shell infernos, acrid cordite fumes, and the ear-piercing uproar assaulted their senses. Explosions reverberated between the banks. As dawn broke, a river of khaki advanced behind the rapid-fire 18-pounder barrage, which had pulverised the west bank and canal before creeping forwards 100 yards every four minutes towards the Red Line.[58] The 4.5-inch howitzers and trench mortars swept the ground beyond the 18-pounder barrage. Smoke drums and burning oil drums were projected across the canal, competing with incoming gas shell salvos. Field guns, Lewis guns, and rifle grenades silenced German machine gun posts, trench mortars, and rifle pits near the canal.[59] Although 60-pounders and howitzers of the Canadian heavy artillery's counter battery came into action, the enemy had shortened the range and retaliation shelling targeted the troops as they emerged from the canal stumbling through broke belts of tangled wire. Private Stan Colbeck recalled: "a shell exploded right behind us. … The screams behind us I will never forget."[60]

A 187th German infantry regiment officer witnessed the attack:

> It was still dark, when suddenly at 5:15 in the morning a heavy barrage of fire rained down on the regiment's positions. The fire was correct on the canal. Already after 15 minutes the English attacked the canal out of the woodlands in large masses. They were struck back. Two tanks that tried to enter the canal area at a place where a small rail road cut through the thick canal bank were destroyed by combined charge.[61]

The constricted 2,600-yard corridor south of Lock 3 permitted only four Canadian battalions to attack simultaneously in the first wave

[58] The creeping barrage's rate of advance was not identical for the 1st and 4th Divisional zones.

[59] Robert C. Fetherstonhaugh, *The Royal Montreal Regiment 14th Battalion, CEF 1914-1925* (Montreal: The Royal Montreal Regiment, 1927), 250.

[60] James L. McWilliams and R. James Steel, *The Suicide Battalion* (St. Catharines, ON: Vanwell, 1990), 175. Colbeck was wounded the next day.

[61] Gerhard F. Dose, "The 187th Infantry Regiment in Flanders, at Arras and Cambrai 1917/18," http://net.lib.byu.edu/estu/wwi/dose/11-Flandern-04.htm (accessed 3 June 2018).

at 5:20 a.m. These leading under-strength units, south to north, were the 4th Division's 44th and 46th Battalions and the 1st Division's 4th and 14th Battalions. The 44th crossed the canal north of Moeuvre, the 46th east of Inchy-en-Artois, the 4th to the left of the 46th and the 14th south of Lock 3, 800 yards southwest of Sains-Lez-Marquion. All four battalions slid down and scrambled across the dry canal bed where engineer parties were busily preparing the four dry crossings. "Men clambered up the eastern bank like so many hundreds of ants, while Engineers scurried around erecting scaffolds and runways to facilitate the crossing of guns and vehicles."[62] At 7:30, parties of signal linesmen, following the advancing infantry, extended telephone cables over the canal at Lock 3, running them south of Sains-Lez-Marquin.[63]

The 4th Battalion, assembled northeast of Inchy-en-Artois, overcame the 10 to 12-foot-high western bank and crossed near "C" and "D". They advanced 2,000 yards and reached the Red Line immediately behind the barrage, having spent six minutes mopping up the canal in their whirlwind attack. From Paviland Wood, north of Inchy-en-Artois, the 14th Battalion crossed the River Agache over planks. Farther north, they cut across two water-and-wire-filled ditches, at E.2.a. north of "D", capturing several concealed machine gun posts near the canal bank. On a 300-yard frontage, they dropped into the canal bed at 5:45 a.m. between "D" and Lock 3. The 1st Brigade, CE had intended to supply ten light bridges to assist the infantry over ditches near "D" and fifteen scaling ladders to mount the canal banks. The ladders and bridges were never delivered.[64] Instead, the storm troops climbed on one another's shoulders to mount the 8-foot-high west bank.[65] The 13th Battalion, following the 14th, reached the Agache, which they waded through. Farther north they encountered a stream 5 feet deep. "This was to have been bridged previous to the attack, but time had not permitted, so, with

[62] William W. Murray, *The History of the 2nd Canadian Battalion CEF in the Great War 1914-1919* (Ottawa: The Historical Committee 2nd Battalion CEF, 1947), 300.
[63] Canadian Signal Service, RG9, III-D-2, Volume 4805, File 162, LAC.
[64] WD, 1st Canadian Infantry Brigade, September 1918, Appendix 17, LAC; 3rd Canadian Infantry Brigade, RG9, III-D-2, Volume 4805, File 155, LAC. The lorry carrying the light bridges and ladders had gone astray and was never located during the night before Zero Hour.
[65] Fetherstonhaugh, *Royal Montreal Regiment,* 250; Flanders' Fields: Canadian Voices From WWI, Episode 15, The Last Push: Canal du Nord to Mons; WD, 3rd Infantry Brigade, September 1918, Appendix 15, LAC

their kilts floating the men waded [armpit-deep] through…"[66] The kilted 15th Battalion likewise had to cut across the Agache—some using planks—before reaching the canal. They splashed through ditches before crossing a footbridge opposite Sains-Lez-Marquion by 10:00 a.m.[67]

The 10th Canadian Infantry Brigade's four battalions participated in the first phase, with the Marquion Line (Red Line) as the objective. Their jump-off area was in the E.7.b and E.7.d sectors, east of Inchy-en-Artois.[68] The 46th and 44th led the attack, with the 50th and 47th respectively leap-frogging the two leading battalions at the Sunken Road, just east of the Canal du Nord Line. "Each section [of the 46th Battalion] was given a rope. If there was water in there, somebody in the section had to get out and he had to pull the rest out…"[69] At midnight before Zero Hour, 50th Battalion signallers reconnoitred the canal bank, carrying a heavy rope for stretching across the canal. They were surprised to find no water in it.[70]

The 4th Brigade, CE had provided twenty-five scaling ladders each to the 44th and 46th Battalions for surmounting the elevated banks. Keeping the 44th's leading waves clear from the barrage proved difficult owing to the rear units pressing forwards and everyone anxious to get as quickly as possible over the canal. Accordingly, their own gunfire cut down many men.[71] The 47th companies slid down the sloping brick-faced western wall and scaled the eastern bank with the 44th's ladders. Some climbed broken masonry in the embankment.[72]

The 3rd Canadian and the 11th British Divisions crossed the canal in preparation for the second phase to be launched at 3 p.m. Due to the XVII British Corps' failure to keep pace with the advance, the

[66] Robert C. Fetherstonhaugh, *The 13th Battalion Royal Highlanders of Canada 1914-1919* (Montreal: The 13th Royal Highlanders of Canada, 1925), 276.
[67] Kim Beattie, *48th Highlanders of Canada 1891-1928* (48th Highlanders of Canada, 1932), 372; WD, 15th Infantry Battalion, September 1918, Appendix 207, LAC.
[68] 4th Canadian Division Report, RG9, III-D-2, Volume 4797, File 83, LAC.
[69] McWilliams and Steel, *Suicide Battalion*, 174.
[70] Victor Wheeler, *The 50th Battalion in No Man's Land* (Calgary, Alberta Historical Resources Foundation, 1980), 345. On 29 September, life-belts were worn over tunics by Staffordshire brigade troops from the 46th British Division for crossing the 35-foot-wide Canal de St. Quentin. Hauling lines, planks, rafts, and mud-mats were also provided. See R.E. Priestley, *Breaking the Hindenburg Line: The Story of the 46th (North Midland) Division* (London: T. Fisher Unwin, 1919), 42.
[71] WD, 44th Battalion, September 1918, Appendix B, LAC.
[72] WD, 47th Battalion, September 1918, Report on Operations, LAC.

3rd Canadian Division was not engaged that day. The 11th Division proceeded into action capturing Epinoy at 7:00 p.m.[73]

Chief Engineer Lindsay had "ordered his men to work under fire to construct these logistical arteries..."[74] The Canadian engineers, following the infantry into the canal, placed four infantry footbridges across it between "E" and "G". Reports vary claiming four, six or seven footbridges were thrown across the canal, but the Canadians only carried materiel for four.[75] In fact, Canadian sappers erected four footbridges and British sappers erected three. The British sappers assembled them about a half mile north of Sains-Lez-Marquion. The 11th Battalion, Manchester Regiment crossed over these footbridges about 11 a.m. The British infantry bridge at "H" was converted midday to a pontoon and trestle bridge, leaving six intact footbridges. Additionally, 56th British Divisional engineers assembled two footbridges 300 yards south of the Arras-Cambrai Road and two north of it.[76]

The 1st, 2nd, 3rd, and 4th Brigades, CE pooled their bridging equipment for the operations, commanded by a 1st PBTU, CE officer. All four PBTUs and the motor-driven 1st Pontoon Park, RE came under enemy shelling and machine gun fire while hauling materiel for light bridges and footbridges in twelve trestle wagons and twenty-one pontoon wagons to the crossing sites. In one area, a shell killed two horses pulling a pontoon wagon.[77] In the 3rd PBTU, CE three men were wounded and one reported missing. A mule and a horse from this unit were killed and six horses wounded.[78]

The 3rd Battalion, CE constructed dry "D" and wet "E", "F", and "G" crossings. At "D" (northeast of Inchy-en-Artois near a fragmented 107-foot-span iron bridge at E.2.a) a 30-foot diameter

[73] Currie, *Canadian Corps Operations*, 59-60.
[74] Tim Cook, *Shock Troops: Canadians Fighting the Great War 1917-1918*, *Volume Two* (Toronto: Viking Canada, 2008), 517.
[75] Hodgins, Brief report on the crossings over CANAL DU NORD on Sept. 27th, 1918, RG9, III-D-2, Volume 4811, LAC; Narrative of Bridging Operations Over Canal du Nord, RG9, III-C-1, Volume 3964, Folder 29, File 4, LAC; WD, 1st Canadian PBTU, CE, Appendix II, September 1918, LAC.
[76] WD, First Army, Report on First Army Operations 26th August – 11th November, 1918, Part III, LAC; Edmonds, *Military Operations France and Belgium 1918 Volume V*, 25.
[77] Narrative in Connection with Canal du Nord–Bourlon Wood Operations, RG9, III-C-1, Volume 3964, Folder 29, File 3, LAC.
[78] WD, 3rd Canadian PBTU, CE, September 1918, LAC.

crater blocked a built-up road cut through the west bank. Work began at 7:00 a.m. and a temporary detour permitted the field artillery to cross at 8:40 a.m. The fifty sappers had two-way traffic operational after 5:30 p.m. Two enemy machine guns firing from the far bank at the approaches to the bridge delayed work until 1:00 p.m. at "E" near Sains-lez-Marquion, adjacent to a destroyed bridge. The infantry had passed over in the first rush but failed to mop up concealed tunnels and dugouts. The creeping barrage's timetable had prevented a thorough search. Forty-eight OR from B Company erected a 90-foot bridge, constructed with three pontoons (owing to 10 feet of water at the canal's centre) and two trestles, and finished it with canvas screening at 6:25 p.m. Enemy machine guns on the eastern bank held up construction until 12:00 p.m. at "F" northeast of Sains-Lez-Marquion and 100 feet south of the sheared iron bridge. As at "E", ramps were cut through the banks. Two sapper subsections completed the 60-foot-span pontoon and trestle bridge at 1:30 p.m. Work on the light bridge at "G", beside a demolished timber bridge, was delayed until 1:30 p.m., owing to heavy enemy machine gun fire from the swamp east of the canal, and finished about 4 p.m. Three Weldon trestles with a 60-foot span were constructed above the muddy bed. C Company with three officers and 134 OR had constructed "F" and "G" bridges. A heavy bridge for light tanks at "G" with footings and timber piers was started around 3 p.m. and completed the next day at 2 p.m. involving over ten hours' working time. The 104-foot bridge included four 20-foot spans.[79]

Major Bruce Ross, 3rd Battalion, CE supervised the construction of four footbridges and two light bridges near Sains-Lez-Marquion. One corporal and ten OR assembled each footbridge while under machine gun fire. Ross and his runners clashed with the fourteen-member machine gun crew, capturing seven. While throwing the first footbridge across the canal at W.26.b.2.5, Corporal Alfred Pynn's group came under heavy shelling and machine gun fire. He earned the Distinguished Conduct Medal (DCM). Sapper James Wyatt, covering the hostile machine gun with his rifle, dashed across the first completed footbridge, shot one of the remaining crew, and captured

[79] WD, 3rd Battalion, CE, September 1918, Narrative of Bourlon Wood Operations, LAC; Alexander Macphail, Construction of Canal Crossings By the 1st Brigade, CE, RG9, III-D-2, Volume 4809, File 195, LAC.

two others plus the machine gun. Wyatt earned the DCM.[80] All four footbridges were completed between 9:15 and 10:00 a.m. when Canadian and British battalions crossed over.[81]

An unplanned small bridge was constructed across a stream north of Inchy-en-Artois. The 3rd Battalion, CE along with the 1st Battalion, CE constructed three crossings over the River Agache east of "E" and "F" where the water ran 8 feet deep. These bridges, completed around 1:30 p.m., were made with Weldon trestles with multiple 30-foot spans.[82] The destroyed bridge on the Agache was repaired and re-decked for two-way traffic on the 28th. A 15-foot-span bridge over the Agache was completed on the 28th and another on the 29th for traffic from "G".

The 1st Battalion, CE tackled road and track maintenance, dugout reconnaissance, and Blue Line area consolidation. These combat engineers wore battle equipment and carried 120 rounds of ammunition. The 2nd Battalion, CE repaired roads and made a general reconnaissance for mines and booby traps. They were also responsible for the water supply and well water testing. Access to water in captured territory was important not only for drinking, washing, and cooking, but also for animal transport. Normally, horses needed watering three times a day.[83] Three new pumping installations and sufficient troughs to water 5,000 horses an hour were completed by 2:00 p.m. on the 27th.[84]

At Zero Hour, three officers and sixty OR from 10th Battalion, CE assembled to construct two dry crossings. Sappers started work at 6:00 a.m. at "A" east of Moeuvres, located below a destroyed 107-foot-span steel bridge at E.15.a. where six-foot-deep craters embedded with mines made each embankment impassable. The foot trail to the canal and the openings were improved. Spoil from the

[80] 14906 Supplement to the London Gazette, 2 December 1919; James Ernest Wyatt, RG150, Accession 1992-93/166, Box 10616-42, LAC.

[81] Appendix E, Narrative Canal du Nord–1st Brigade, CE, RG9, III-D-2, Volume 4809, File 195, LAC.

[82] WD, 3rd Battalion, CE, September 1918, LAC.

[83] The costliest single week in Canadian animal lives occurred in the week ending 3 October 1918 when 865 animals were killed, destroyed or evacuated. See Andrew S. McEwen, "Maintaining the Mobility of the Corps: Horses, Mules, and the Canadian Army Veterinary Corps in the Great War" (PhD Thesis: University of Calgary, 2016), 416.

[84] Interim Report on Crossings of Canal du Nord, RG9, III-C-1, Volume 3964, Folder 29, File 4, LAC.

thirteen-foot-high banks was used to level the 50-foot-wide canal bed, 3 feet below ground level. The sappers completed the crossing for one-way horse traffic at 7:50 a.m., and at 9:00 a.m. for two-way horse traffic.[85] Meanwhile, pioneers and engineers from the 63rd British Division erected two trestle bridges, one 500 yards south of "A" at E.15.c.2.6 and another at E.21.a.1.8. They were open to traffic by 11:30 a.m. and 6:45 p.m. respectively.[86]

At "B" south of Lock 4, detonated mines had left a large crater in the existing roadway in the sunken canal bed's centre and a smaller one in the west embankment. Sappers filled the canal bed with spoil to ground level. The 10th Battalion, CE completed "B" crossing for one-way horse traffic at 6:50 a.m., two-way horse traffic at 7:20 a.m., and two-way lorry traffic at 8:20 a.m. Engineer parties were assigned to 10th Infantry Brigade battalions to investigate booby traps. Sappers had also cut lanes through the wire in routes to the assembly areas and constructed bridges over trenches west of the canal.[87]

Two officers and thirty-seven OR from the 11th Battalion, CE were shelled as the party headed towards "C", near a collapsed 98-foot-span iron bridge at E.8.b. Four were killed and two wounded. A mine had completely blown out the road fill at this crossing. Therefore, the engineers needed to build up fill 18 feet from the crater's bottom to road level with two tanks packing in the old road material, timber and rock fill. The crossing was ready for field artillery at 8:00 a.m. By 1:45 p.m., lorry traffic was passing over the 60-foot planked roadway.[88] Two-way traffic ran the next day. The 4th Brigade, CE assisted the infantry in constructing strong points and consolidating positions gained.

The 11th British Division's 67th Field Company, RE and East Yorks Pioneers were delayed working on the bridge at "H", near the destroyed bridge at W.15.a, after the detachment lost its horses to machine gun fire; some killed, and others stampeded. The combined

[85] Report on Bridging the Canal du Nord, RG9, III-C-1, Volume 3964, Folder 29, File 4, LAC; Brief report on the crossings over Canal du Nord, RG9, III-D-2, Volume 4811, LAC.

[86] Report on the Operations of the 63rd (RN) Division from 27th September to 2nd October, 1918, Appendix B, RG9, III-C-1, Volume 3856, Folder 78, File 10, LAC.

[87] WD, 10th Battalion, CE, September 1918, page 126, LAC; 10th Infantry Brigade B.W. Operations – Preparations RG9, III-D-2, Volume 4805, File 155, LAC.

[88] A. J. MacPherson, Report on Crossing Canal du Nord, RG9, III-C-1, Volume 3964, Folder 29, File 4, LAC.

pontoon and trestle bridge for field guns and horse transport traffic was finished at 7:00 p.m.[89] Work commenced after 1:00 p.m. on the two bridges at "K" near Marquion on the Arras-Cambrai Road beside the submerged 105-foot-span iron girder bridge at W.9.d.[90] The sappers erected the medium pontoon bridge for first-line transport by 4:50 p.m. A 120-foot-long heavy pontoon Class 'D' bridge, to supplement the pontoon bridge, was ready at 7:30 p.m. to carry 3-ton lorry traffic and 6-inch howitzers. The 32nd and 34th British infantry brigades used these northern bridges.

A heavy bridging train arrived at Sains-Lez-Marquion at 1:00 p.m. carrying the materiel for two rectangular Inglis bridges. Work began at 2:00 p.m. under heavy shelling at "F" beside the sheared iron girder bridge. By 10:00 p.m., an officer and sixty-four OR from the 5th Army Troops Company, CE with assistance from C Company, 7th Battalion, CE had assembled a nine-bay 108-foot bridge, ready for traffic about 1:00 p.m. on the 28th after thirteen hours' construction. The bridging materiel for "K" arrived late in the afternoon of the 27th. Work commenced the next morning at 8:30 a.m. under heavy shelling. Four officers and seventy-eight OR from the 4th Army Troops Company, CE and five officers and 150 OR from the 4th Battalion, CE constructed the approaches and abutments, then assembled and launched the bridge. This heavy bridge opened for traffic before 10:00 p.m. after twelve-and-a-half hours' work under shell fire.[91] There were no casualties.

The 1st and 4th Canadian Divisions had captured most Blue Line objectives by 1:00 p.m. on the 27th and were firmly established that evening.[92] Also by 1:00 p.m., all four dry crossings were carrying lorry and artillery traffic, footbridges were installed and the River Agache bridged allowing the guns to partake in the operation's later stages. By 7:00 p.m. traffic flowed over bridges at "E", "F", "G", "H",

[89] Interim Report on Crossings of Canal du Nord, RG9, III-C-1. Volume 3964, Folder 29, File 4, LAC; 11th Division Report on Operations, RG9, III-D-2, Volume 4798, File 98, LAC.

[90] Canal du Nord and Bridges, RG9, III-C-1, Volume 3912, Folder 42, File 5, LAC.

[91] Interim Report on Crossings of Canal du Nord, RG9, III-C-1, Volume 3964, Folder 29, File 4, LAC; WD, Chief Engineer, September 1918, Heavy Bridging Operations, Appendix B, LAC; WD, 4th Army Troops Company, CE, September 1918, LAC; WD, 5th Army Troops Company, CE, September 1918, LAC.

[92] General Staff Report, RG9, III-C-1, Volume 3923, Folder 12, File 5, LAC. Fontaine-Notre-Dame eluded capture until the next morning by the 3rd Canadian Division.

and "K". To the sappers' credit, six footbridges, four dry crossings, and nine bridges had been completed over the canal in forty hours.

The 7th Tank Battalion allocated eight Mark IV tanks to each of the 1st, 3rd, and 4th Canadian Divisions for crushing wire barricades, suppressing machine gun nests, and mopping up pockets of resistance. The 4th Canadian Division's tanks crossed in two waves, at Zero Hour and Zero plus twenty minutes. The four leading tanks rumbled over without incident. Owing to engine trouble, a tank in the second wave failed to make the crossing. Another struck an anti-tank mine in "A" crossing's western embankment and again in the eastern embankment, blocking the passage after its left tractor belt was destroyed. Another tank towed it away. Sappers used guncotton to detonate additional detected mines.[93] The 1st Canadian Division's eight tanks crossed the canal at E.2.c.9.8 (immediately below "D") and E.2.d.1.0 (just north of "C", east of Inchy-en-Artois). Three assigned to the 1st Brigade received direct hits. The four tanks assigned to the 3rd Brigade reached the 13th Battalion who were facing intact barbed wire belts. One tank commander claimed he was short of petrol. All four tanks turned back abandoning the troops. Consequently, the 13th battalion suffered heavy casualties.[94] Seventeen tank personnel and five of the sixteen tanks became casualties that day.[95] At 1:00 a.m. on 28 September, six of the eight tanks (two in reserve) assigned to the 3rd Canadian Division's 7th Brigade crossed at E.8.d.8.0, near "B" on their way to the Marcoing Line.

Unlike the infantry, engineers and tank crews, the artillery did not cross the canal at Zero Hour; it operated from the western side. Maj.-Gen. Edward Morrison, Canadian Corps Artillery commander, explained the barrage arrangement at Canal du Nord. "[I]n order to put on a proper barrage it was necessary to concentrate 20 brigades of field artillery and ten brigades of heavy artillery on a front of 4,000 yards, and as close as possible to the jumping-off line in order

[93] In one sector, the sappers removed over 200 tank mines. See Currie, *Canadian Corps Operations*, 63.
[94] WD, 3rd Brigade, September 1918, Appendix 15, Tanks, LAC; RG9, III-D-2, Volume 4804, File 154, LAC.
[95] 7th Tank Battalion, Lieut.-Col. Thorpe, RG9, III-D-2, Volume 4807, File 173, LAC.

that the barrage should 'fanout'...."[96] In the first phase the 1st and 4th Canadian Divisions were each allotted ten field artillery brigades and two heavy artillery brigades.[97] On the 4th Canadian front, six field artillery brigades, positioned about 1,500 yards from the canal, would take part in the barrage to the Red Line. At Zero Hour and in darkness, the other four brigades limbered up and advanced to the canal's western side where the barrage from eight brigades would extend to the Green Line. The creeping barrage could not be extended beyond the Green Line. Eight brigades positioned at the canal would advance the barrage to the Blue Line.[98] On the 1st Canadian front, the artillery could cover the Blue Line from fixed positions instead of leap-frogging batteries to maintain a continuous barrage.[99] The capture of Sains-Lez-Marquion involved an innovative "monkey puzzle barrage." Instead of moving forwards, the barrage crept backwards from the far side of the village towards the 18-pounders and 4.5-inch howitzers of the 1st and 2nd Brigades, Canadian Field Artillery (CFA) which were firing at it.[100]

Without a preliminary bombardment, the attack was launched with a shrapnel, high explosive, smoke, and machine gun fire barrage. The enemy's coloured rocket display greeted the opening barrage and their artillery replied five minutes later resulting in heavy casualties in the forward-sited artillery positions. Lieutenant Ronald Sykes, 201 Squadron, RAF was flying about 1,000 feet over the battlefield. "A shell burst below me—and within a second the whole of the ground seemed to be turning over, boiling up in brown earth that had been thrown up and smoke from the bursting shells."[101] Around 8:00 a.m. 1st Canadian Divisional Artillery (CDA) batteries moved forwards over a congested road leading to "D". The 6th Battery, 2nd Brigade,

[96] Edward Morrison, *The War As Morrison Saw It: With the Conquering Canadians from Valcartier to the Rhine* (Ottawa, c1928), LAC. Another two field artillery brigades from the 11th British Division totalled twenty-two.
[97] Edmonds, *Military Operations France and Belgium 1918 Volume V*, 20.
[98] Artillery Notes On Operations of the Canadian Corps 27th September to October 1st, 1918, RG9, III-C-1, Volume 3912, Folder 42, File 10, LAC. Five Royal Field Artillery and five Canadian Field Artillery brigades provided the barrage.
[99] Gerald W.L. Nicholson, *The Gunners of Canada: The History of the Royal Regiment of Canadian Artillery, Volume I 1534-1919* (Toronto: McClelland and Stewart, 1967), 359.
[100] WD, 2nd Brigade, CFA, September 1918, LAC; Artillery, Bourlon Wood, RG9, III-D-2, Volume 4807, File 176, LAC.
[101] Peter Hart, *The Last Battle: Victory, Defeat, and the End of World War I* (Oxford: Oxford University Press, 2018), 109.

CFA crossed first over the canal at "D".[102] All 1st and 2nd Brigade batteries were across by 10:30 a.m.[103] 1st Canadian Divisional Trench Mortar Group's X Battery passed through "D" at 10:30 a.m. Batteries from the 6th Brigade, CFA moved over around noon.[104] The 1st Canadian Motor Machine Gun Brigade traversed the dry crossings at 2:45 p.m., followed by the 2nd and 5th CDA batteries between 3:00 and 4:00 p.m. The 61st Battery, CFA cut across "A" between 3:00 and 4:00 p.m. The 59th Brigade, 11th British Divisional Artillery, Royal Field Artillery crossed "D" sometime after 1:30 p.m. The 3rd Siege Battery (6-inch howitzers), 1st Brigade, Canadian Garrison Artillery (CGA), made a night crossing near the Arras-Cambrai Road during the early hours of 28 September over a pontoon bridge, likely one of the two "K" bridges, which the 7th Siege Battery, 1st Brigade, CGA had used the previous afternoon.[105]

To feed the hungry guns, tramways rapidly transported myriad shells to the front. The Canadians had made extensive use of trench tramways in forward areas and light railways in rear areas. By January 1918, the Canadian-run tramways were five times more efficient in hauling materiel than other corps-run tramways.[106] In July 1918, Canadian-constructed light railways were permitted to exceed the normal army allotment. The Canadian Corps had permission to do almost anything it liked with light railways.[107] The No. 1 and No. 2 Tramways Companies, units in the Corps of Canadian Engineers, were established in the spring of 1916. They "were authorized, formed, worked, and finally were demobilized in France, and never existed as units in any other place than the forward area."[108]

Petrol-electric and petrol-driven tractors, like their light railway steam locomotive counterparts, operated on 60-centimetre gauge track.

[102] L.M. Firth, *6th Battery, 2nd Brigade C.F.A.* (Bonn, 1919), 17, LAC.
[103] 27th September, RG9, III-D-2, Volume 4807, File 176, LAC.
[104] John MacDonald (ed.), *Gun-Fire: An Historical Narrative of the 4th Brigade C.F.A. in the Great War (1914-1918)* (Toronto: The Greenway Press, 1929; reprint Naval & Military Press, 2004), 192.
[105] WD, 3rd Canadian Siege Battery, September 1918, LAC.
[106] W.J.K. Davies, *Light Railways of the First World War* (Newton-Abbot: David & Charles, 1967), 56.
[107] Alan M. Henniker, *Transportation on the Western Front 1914-1918* (Uckfield, England: The Naval & Military Press, 2009), 327, 453; Davies, *Light Railways of the First World War*, 101.
[108] Francis E. Collinson, "The Canadian Engineers' First Tramways Company's Work in France," *Canadian Railway and Marine World* November, (1919): 575-78.

Army railway troops operating coal-burning steam-powered trains shuttled troops, ammunition, food, water, and other commodities between standard-gauge railheads and intermediate dumping points. The closest place where locomotives could safely deliver in daylight without their steam, smoke, and sparks clearly giving away their position was the end of the line.[109] The 1 to 10-ton wagons were uncoupled and the corps tramways troops took over at the transfer sidings. Closer to the front, the trench tramways merged with push trollies on trench tracks. The British, unlike the Canadians, classified all mechanically powered steam and petrol-electric narrow-gauge trains as light railways.[110] In 1918, the tramways companies constructed 192 miles of light railway and hauled 484,222 tons of materiel.[111]

"The Light Railways will be pushed forward over the Canal with all possible speed in order that Artillery Ammunition may be delivered East of the CANAL by Light Railway and thus reduce the amount of wheeled traffic over the bridges."[112] Operation Order No. 18 placed the 2nd Tramways Company, CE in charge of the 60-centimetre gauge track in the Canadian area. The 6th Battalion, CE worked on the tracks over the dry canal bed at E.8.a.9.9 near Inchy-en-Artois easterly through E5 central and also at junction W.26.b.1.9, north of Sains-lez-Marquion, north-easterly through W.22 central. This tramways crossing, over water 6 feet deep built at W.26.b.3.9, immediately north of "F", was completed on 29 September. The 8th Battalion, CE worked on light railways in liaison with the 2nd Tramways Company, CE. The 6th and 8th Battalions, CE completed the tramways bridge at E.8.a.9.9, north of "C".[113] Rail-delivered ammunition arrived well past the canal on Zero plus two

[109] Davies, *Light Railways*, 153.

[110] Love, *A Nation In Making Volume 2,* 276; Andrew Iarocci, "Sinews At War: Transportation and Supply," in *Capturing Hill 70: Canada's Forgotten Battle of the First World War*, (eds.) D. Delaney and S. Durflinger (Vancouver: UBC Press, 2016), 148; David Guay, T*racks to the Trenches: Canadian Railway Troops in the Great War (1914-1919)* (Markham, ON: Fifth House, 2017), 54, 61, 72, 81; Tramways Company, RG9, III-C-5, Volume 4446, Folder 2, File 10, LAC.

[111] Canadian Corps Tramways, RG9, III-D-2, Volume 4808, File 186, LAC.

[112] Bourlon Wood Engineer Instructions No. 5, RG9, III-C-5, Volume 4426, Folder 3, File 9, LAC.

[113] Karl Weatherbe, *From the Rideau to the Rhine and Back: The 6th Field Company and Battalion Canadian Engineers* (Toronto: Hunter-Rose, 1928), 398; WD, 8th Battalion, CE, September 1918, LAC.

days, and to Bourlon village on Zero plus four days. About 3 miles of tramways had been constructed.

CONCLUSION

The Battle of Canal du Nord although a brilliant tactical success was costly. The five-day operation resulted in 13,672 casualties in the 1st, 3rd, and 4th Canadian Divisions—3,070 more than at Vimy Ridge, 9-14 April 1917. However, infantry reinforcements from 26 September to 1 October only numbered 2,350.[114] The 20 percent loss (7 percent more than at Amiens) matched that of Passchendaele. Casualties from the four divisions and corps troops who fought at Canal du Nord and at Cambrai, 26 September to 10 October, totalled 14,849. The engineers sustained 720 casualties in September 1918.[115] Engineer (including signal units) fatalities in the Great War totalled 2,004 of the 7,180 casualties.[116] Only the infantry and artillery suffered more losses under enemy fire than the engineers.

The versatility and courage of the engineer formations—taking on the role of combat troops when required—is reflected in the 1,582 decorations awarded to them, including 1 VC, 42 DSOs, 205 MCs, 69 DCMs, and 610 MMs.[117] In a letter to Prime Minister Sir Robert Borden, Currie wrote: "Let me tell you that those bridges were begun not only under shell fire, but under machine gun fire, and yet nothing could deter the work of our men."[118] Horne too, conveyed his appreciation of the engineers' work, acknowledging their steadiness and dependability under enemy fire.[119]

[114] MG30, E5, Volume 3, Battle of BW Reinforcements, LAC.
[115] Strengths & Casualties in Various Battles, RG24-C-6-e, Volume 1844, File GAQ 11-11B, LAC; Return of Killed, Wounded and Missing (By Months), RG24-C-6-e, Volume 1844, File GAQ 11-5, LAC.
[116] *The Corps of Royal Canadian Engineers: A Brief History* (Ottawa: Department of National Defence, 1948), 36; Casualties by Enemy Fire, RG24-C-6-e, Volume 1844, File GAQ 11-10, LAC.
[117] *The Corps of Royal Canadian Engineers*, 50; Kerry and McDill, *The History of the Corps of Royal Canadian Engineers, Volume 1*, 333.
[118] Bill Rawling, *Surviving Trench Warfare: Technology and the Canadian Corps, 1914-1918* (Toronto: University of Toronto Press, 1992), 210.
[119] W.H. Anderson, First Army, 3 October 1918, RG9, III-C-1, Volume 3856, Folder 76, File 2, LAC.

The Battle of Canal du Nord certainly can be viewed as an engineers' battle based on the fundamental importance of road repair and bridge building. No less critical were the construction of tramways and dry-weather tracks and the delivery of water to roadside storage tanks in the conquered territory. Essentially, the engineers contributed to the "all-arms battle" tactics in the Hundred Days when the infantry, artillery, tanks, and aircraft maintained excellent coordination accompanied by the "meticulous planning and execution on behalf of the Corps' logistical services and the engineers in particular."[120] Currie, in a special order issued 3 October 1918, wrote: "The initiative and resourcefulness displayed by the Engineers contributed materially to the depth and rapidity of our advances."[121] The Canadian engineers had performed ubiquitous and indispensable battlefield work. These adept engineers played a pivotal role in open warfare—their crucial performance a vital factor in the Canadian victories in the last one hundred days of the war.

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ABOUT THE AUTHOR

Brian Pascas is an independent researcher focussed on the Great War's Western Front. He has been a member of the Western Front Association for over twenty years. Articles on Canadian tunnellers and the Victoria Cross have been published. His historical fiction novel, *Mud, Blood and Rum: A Year in the Trenches with the 42nd Battalion* was published in 2009.

[120] Michael P. Ryan, "Supplying the Materiel Battle: Combined Logistics in the Canadian Corps, 1915-1918" (MA Thesis: Carleton University, 2005), 137.
[121] Fred James, *Canada's Triumph: Amiens-Arras-Cambrai August-September-October 1918* (Canadian War Records Office, c1918), 54.

APPENDIX A: MAP GRID REFERENCE NUMBERS.[122]

The letter grid square is A to X.

F	A	B	C	D	E	F	A
L	G	H	I	J	K	L	G
R	M	N	O	P	Q	R	M
X	S	T	U	V	W	X	S
F	A	B	C	D	E	F	A

Each lettered grid square is divided into smaller numbered squares: 1-30 (on some maps 1-36).

6	1	2	3	4	5	6	1
12	7	8	9	10	11	12	7
18	13	14	15	16	17	18	13
24	19	20	21	22	23	24	19
30	25	26	27	28	29	30	25
6	1	2	3	4	5	6	1

The numbered square is further divided into four lettered squares (quadrants): a, b, c, and d. Lastly, this lettered square (500 yards by 500 yards) is divided into tenths giving a position to the nearest 50 yards.

a	b
c	d

9(0)	
1(0)	9(0)

For example, the bridge at "F" crossing was located at W.26.b.3.8 and the dry "D" crossing was located at E.2.c.8.9 south of "F" crossing. W.21.a.55.30 denotes 5-yard accuracy.

[122] See https://library.mcmaster.ca/how-read-wwi-map-reference-number (accessed 5 February 2019)

APPENDIX B: CANAL DU NORD AND RIVER AGACHE CROSSINGS: 27 SEPTEMBER – 1 OCTOBER 1918

Crossing Name	Map Grid Reference	Canal Condition	Engineer Unit	Completed	Crossing Category
"A"	E.15.a.1.1 (north of Moeuvres)	dry	10th Bn CE	7:50 a.m. for 1-way horse traffic; 9:00 a.m. 2-way horse traffic	roadway
"B"	E.8.d.8.1 (southwest of Inchy-en-Artois)	dry	10th Bn CE	6:50 a.m. for 1-way horse traffic; 8:20 a.m. 2-way lorry traffic	roadway
"C"	E.8.b.2.6 (east of Inchy-en-Artois)	dry	11th Bn CE	8:00 a.m. field artillery; 1:45 p.m. 1-way lorry road	roadway
"D"	E.2.c.8.9 (northeast of Inchy-en-Artois)	dry	3rd Bn CE	8:40 a.m. field artillery; 5:30 p.m. for 2-way all traffic	roadway
"E"	W.26.d.0.8 (opposite south Sains-Lez-Marquion)	wet	3nd Bn CE	6:25 p.m.	3 pontoons +2 trestles, 90 ft. span
"F"	W.26.b.3.8 (opposite Sains-Lez-Marquion)	wet	3rd Bn CE	1:30 p.m.	1 pontoon +2 trestles, 60 ft. span
"G" (light)	W.21.a.0.6 (north of Sains-Lez-Marquion)	wet	3rd Bn CE	3:30-4:15 p.m.	3 Weldon trestles, 60 ft. span
"G" (heavy)	W.21.a.0.65	wet	3rd Bn CE	2 p.m. 1-way traffic on 28th	heavy (light tanks) with 4 spans, 104 ft. length

[CONT'D] APPENDIX B: CANAL DU NORD AND RIVER AGACHE CROSSINGS: 27 SEPTEMBER – 1 OCTOBER 1918

Crossing Name	Map Grid Reference	Canal Condition	Engineer Unit	Completed	Crossing Category
"H"	W.15.a.9.7 (west of Marquion)	wet	67th Field Coy 11th British Div	7:00 p.m.	2 pontoon + 3 trestles (90 ft. span) for horsed traffic
"K" (light)	W.9.d.2.4 (Arras-Cambrai Road)	wet	11th British Div	4:50 p.m.	pontoon for horse/lorries
"K" (heavy)	W.9.d.2.3	wet	67th Field Coy 11th British Div	7:30 p.m.	heavy pontoon 'D' for motor traffic, 120 ft. span
Agache	W.26.b.3.7, W.26.b.4.8, W.26.b.9.2	wet	3rd Bn CE & 1st Bn CE	12:30-1:30 p.m.	3 bridges, Weldon trestle
Agache	W.26.d.7.8	wet	3rd Bn CE		temporary bridge
Agache	W.21.a.55.30, W.26.b.80.90	wet	3rd Bn CE & 1st Bn CE		repaired 2 destroyed bridges
Agache	W.26.b.8.9	wet	3rd Bn CE	28th	15 ft. span
Agache	W.21.a.6.2	wet	3rd Bn CE	29th 2-way	heavy traffic (light tanks) from "G"
Sains-Lez-Marquion ("F")	W.26.b.3.8	wet	5th Army Troops Coy & 7th Bn CE	1:00 p.m., 28th; all non-tank traffic on 29th	Inglis bridge

[CONT'D] APPENDIX B: CANAL DU NORD AND RIVER AGACHE CROSSINGS: 27 SEPTEMBER – 1 OCTOBER 1918

Crossing Name	Map Grid Reference	Canal Condition	Engineer Unit	Completed	Crossing Category
Arras-Cambrai Rd (Marquion) ("K")	W.9.d.2.4	wet	4th Army Troops Coy & 4th Bn CE	9:30-10:00 p.m. on 28th	Inglis bridge
between "E" and "G"	W.20.b.9.4, W.20.d.7.8, W.26.b.0.2, W.26.b.2.5	wet	3rd Bn CE	9:15-10:00 a.m.	4 cork pier and trestle footbridges
½ mile north of Sains-Lez-Marquion	W.15.a.8.5, W.15.c.3.3	wet	11th British Div		2 footbridges
Inchy-en-Artois ("D")	E.8.a.9.9 to E.6.b.2.2 (Bourlon)	dry	2nd Tramways Coy & 6th Bn CE & 8th Bn		light railway
	W.26.b.1.9 to W.22 central	wet	2nd Tramways Coy & 6th Bn CE		light railway