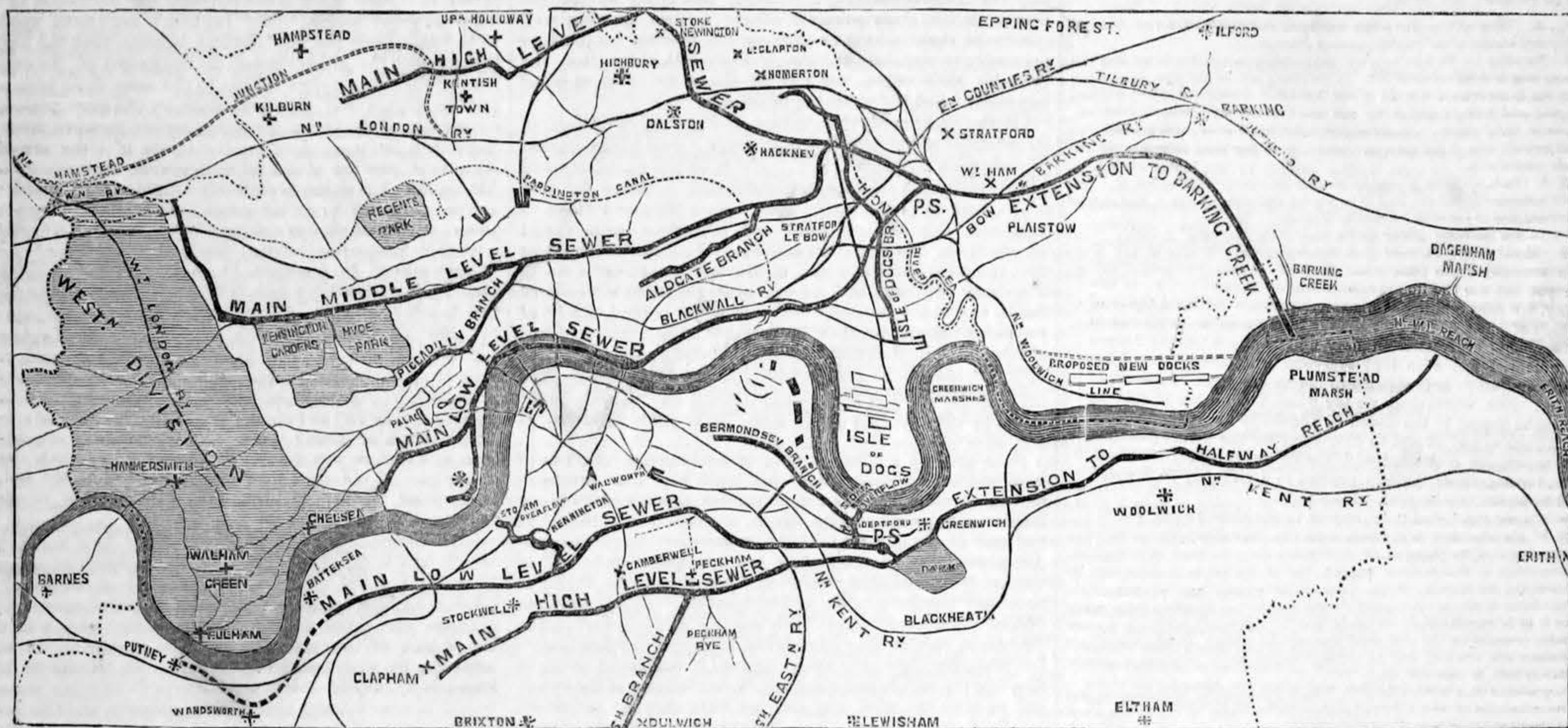


## METROPOLITAN DRAINAGE.



## THE MODE OF DRAINING LONDON PROPOSED BY MESSRS. BIDDER, HAWKSLEY, AND BAZALGETTE.

THE report of the engineers of the Metropolitan Board of Works, on the main drainage of London, has just been issued in a complete form, with plans of the proposed modes of constructing the intercepting sewers and the main outfall channels; and the accompanying plan, which will be interesting to many of our readers, will be found to embrace the main features of the scheme. The authors of the report state that they have come to a clear and decided opinion that the remote outfalls proposed by the Government referees are unnecessary for effecting the objects of the 135th section of the Metropolitan Local Management Act, and that their own experience has informed them not only that it is extremely undesirable, in a sanitary point of view, to cause sewage matter to become intermixed with sea water, and especially under circumstances which will occasion it to be brought up the river by the flood tide, but that if the sewage matter were poured into a much larger volume of fresh or freshened water, in a flowing stream, it would become immediately oxygenised, and cease to exist as a noisome and offensive agent. They state that the experiments of Dr. Letheby and Dr. Odling, to which we have elsewhere referred, have fully confirmed their views.

They have, therefore, unhesitatingly selected for recommendation, as points of outfall, places situated in approachable situations as near as possible to the metropolitan boundary, and as far as possible from human habitations. Barking Creek on the north side, and Crossness Point on the south side, they consider fulfil all the favourable conditions that are attainable on either side of the river. Both are situated in low and dreary marshes, where neither the works nor the sewage can give reasonable cause of offence to any one. Barking Creek is about two miles from Woolwich, and about  $4\frac{1}{2}$  miles from Erith. Crossness Point is midway between the two places, and about  $3\frac{1}{2}$  miles from each. The mean sectional area of the river at these places is *four times as great as at London Bridge*, and the average volume of tidal water, *about 400 times as much as the volume of the sewage water to be admitted into it*. The river is fresh, or nearly so, at low water, and only moderately mixed with salts of marine origin at high water—more so, they state, than they could wish, but much less so than at any point lower down the river.

These points of outfall now suggested, they say, contrast favourably with the outfalls which have recently been much under discussion, and popularly known as B\*. The B\* outfall on the north, is situated at the mouth of Rainham Creek, and, on the south, at a point of the river about a mile above the town of Erith. These points of outfall were recommended to the First Commissioner of Works by Captain Burstal, R.N., whose conclusions were arrived at from observations made on the river with floats. Upon these conclusions the First Commissioner suggested to the Metropolitan Board the points of outfall recommended to him by Captain Burstal, and the Metropolitan Board, desiring to meet the views of the Government, adopted the points so recommended. Appended to another communication from Captain Burstal to the Government referees is a note referring to diagrams, showing the results of the experiments with floats. With respect to reasoning upon these diagrams, the authors of the report state that it may firstly be observed that any views that are not based upon a knowledge of the deodorising effects of air and water upon sewage must necessarily be empirical. But they think it is not needful at present to consider this part of the question, for the fact is that the diagram embodies, as it appears in the Government Referees' Report, an error which is fatal, not only to the diagram, but to any theory the referees may have built upon it. This diagram is alleged to have been constructed upon observations made by the late Mr. Frank Foster, to show the "results of experiments with floats to ascertain the reach of flood and ebb tide in the River Thames, above and below Barking Creek." But on comparing this diagram with the original observations, as deposited in the office of the Metropolitan Board of Works, it appears that the former is extremely erroneous. The original observations indicate, by figures denoting the hours and minutes, the reach of the floats on the flood and ebb tides of each day. Beyond these figures are placed certain bent arrows, to indicate the change of direction taken by the floats. In the diagram the bent arrows have been made to indicate the extent of the reach of the flood and ebb tides; and this mistake causes differences in the calculations of the reach of those tides of sometimes as much as seven miles in a single tide.

With respect to the outfalls at B\*, it should also be observed that those points are  $3\frac{1}{2}$  miles below the metropolitan boundary

on the north side, and  $2\frac{1}{2}$  miles on the south. The additional cost which such extensions would involve would amount to not less than £350,000, exclusive of any increased pumping power and reservoirs they might render necessary. Beyond expressing an opinion that the sewage water may be delivered at B\* under such circumstances as will render it inappreciable at Erith to every ordinary sense, as well as to the most elaborate chemical inquiry, Messrs. Bidder and Hawksley state that they have little to observe with respect to these points of outfall. They will undoubtedly answer the proposed purpose, but certainly not so well, either in a sanitary or in a pecuniary view, as points situated higher up the river.

There is, however, this special reason to be urged against placing the outfalls below the metropolitan boundary, to which it may be useful to advert. Mr. Bazalgette, in one of his communications to the Board, has already shown that for many miles there are no points below the metropolitan boundary so remote from habitation and population, and therefore so well fitted for points of outfall, as the points close to the boundaries of the metropolis itself. At these points the banks of the river for several miles are low, marshy, and uninhabited; but beyond these points towns and villages on the river side become more frequent.

Apart from the chemical, economical, and sanitary grounds on which the Metropolitan Board of Works' engineers prefer outfalls situated at the points mentioned, they observe that many difficulties will be encountered by attempting to obtain a more remote outfall. The necessary declivity of the sewer will soon bring it to a level at which it cannot empty itself at any period of the tide. This is a very serious consideration, whether in regard to the making or repairing the channel, or in regard to cleansing it from the deposits brought down by the flood waters. Moreover, a sewer so constructed will either drain all the adjacent wells of their spring water, or feed them with sewage water, according as the water naturally stands in the wells above or below the water in the sewer. At Gravesend, for example, either of these results would prove a serious evil. Unless also a large sum were expended in making the sewer of greater diameter, and in providing a correspondingly increased flow of water through it, the necessary inclination would bring the outfall to so low a level as to necessitate the aid of much pumping machinery.

They state that they are of opinion that, if the local circumstances favoured such an arrangement, it would be preferable to place the outfalls within the metropolitan boundary rather than without it, especially on the south side of the river, where a very eligible situation presents itself in the Greenwich Marshes, not far from the terminus of the river branch of the North Kent Railway. They believe this point is sufficiently far down the Thames to effect all sanitary objects connected with the river, and are quite sure that if the sewage water were discharged below low-water mark, and at a suitable period of the tide, its presence would not be observed in the river, either at Woolwich or below. If this arrangement could be effected, a large expenditure, otherwise to be incurred in carrying the outfall sewer through the centre of the town of Woolwich, and to a point five miles lower down the river than the Greenwich Marshes, would be saved. The terms of the Metropolitan Local Management Act appear, however, to preclude the possibility of effecting such an arrangement.

Messrs. Bidder and Hawksley, assuming, then, that the points indicated will find favour with the Board, and receive the approval of the First Commissioner of Public Works, state that it remains only to describe the arrangements which they advise to be adopted for effecting the discharge of the sewage, not merely under the most favourable conditions, but under such circumstances as ought, in their opinion, to preclude the possibility of reasonable objection by other parties locally interested. They state that they are convinced that the sewage might, in regard to health, be safely emitted at all periods of the tide; but, as in this case, some part of it would be washed up the river with the flowing tide, though certainly in an oxygenised and, therefore, innocuous condition, they propose to construct reservoirs into which the sewage should be received for the purpose of being sent down the river during the first two and a-half hours of the ebb tide. They propose, also, that these reservoirs shall be arched and turfed over, so as neither to permit the escape of effluvia, nor present an unsightly appearance.

On the north side the quantity of sewage to be received will amount to about 14,000 cubic feet per minute for six hours of the day, and to about 4,700 feet per minute on the average of the remaining eighteen hours. The area of the reservoir should be about twelve acres.

On the south side, for the like periods, the respective quantities of sewage will be about 8,000 feet and 2,700 feet, and the area of the reservoir about seven acres.

On the north side the low level sewage will be raised at Abbey Mills, by mechanical power, to a height of about thirty-four feet, and will thence flow by gravitation into the reservoir; and on the south side the whole of the sewage will be similarly raised into the reservoir near the outfall from a depth of twenty-five feet.

It is also proposed that in both cases the sewage should be discharged into the river through submerged pipes terminating below low-water mark.

The reservoirs are proposed to be constructed so as to enable the precipitation of the sewage matter to be effected by the application of lime. The authors of the report state that they have twice visited Leicester to see the process in operation, and have examined the state of the water, both immediately on quitting the works and after admixture with about twice its own volume of other water in the river. They say they can speak positively to the fact that the process is most successful; the water is completely deodorised, as well as rendered bright and tasteless. It does not subsequently become putrescent, although diluted with only twice its bulk of other water; both fish and vegetation have returned to the river within a short distance of the works, and the workmen at the water-mills on the stream have recovered their health, which had previously been seriously affected by the foul condition of the river, and now state they have nothing to complain of, even in the hottest months of the year.

They do not, however, believe this process to be needed for the prevention of injury to the Thames, or to the health of the population residing on its banks; and certainly do not recommend it for adoption because, when produced in large quantities, the precipitated matter is unsaleable, and must be removed at considerable expense.

An objection has been made that the admission of sewage water into the river will be liable to create shoals in the navigable channel. They state that it is scarcely worth while to argue this point, because the sewage matter emitted from the large sewers in London does not produce shoals, nor, in fact, can it, especially when, as in the case before them, the detritus of the roads will be detained and removed before the water is allowed to pass into the reservoir, and because sewage deposit being nearly of the same specific gravity as water, is most easily moved by water, and is, moreover, always undergoing the process of destructive decomposition. They state, therefore, they have no hesitation in recording their decided conviction that shoals will not be created by the admission of sewage water into the Thames in the manner proposed.

Finally, they explain that the outfall channel between Abbey Mills and Barking Creek may be constructed on a much improved principle. They recommend the formation of a public road of 40 feet in width through the marshes, under which shall be built a triple culvert of brickwork capable of transmitting the whole of the sewage of the north side of the metropolis. Each of these culverts would be of 9 feet diameter, and be formed of the proper figure to support a roadway. They believe this road would be of great advantage both to the Board and the public; that it would afford a very convenient means of communication between the pumping station and reservoirs; would facilitate the examination and repair of the northern outfall channel, and would give to the public a very desirable means of access from Bromley through Plaistow to the Barking-road, and thence forward to the Thames; and, eventually, they believe, this would become a road of much importance to the extending districts at the eastern extremity of the metropolis.

We have thus given, nearly in the words of the report, the nature of the recommendations of the engineers to whom, in connexion with Mr. Bazalgette, the Metropolitan Board of Works submitted the question of the drainage of London. The plan, we presume, will now be submitted to the Chief Commissioner of Works, perhaps to be returned to the Board again with instructions to alter it and make it conformable to the Act of Parliament, which we cannot understand how it can be now considered to be; or, possibly, considering the recommendations contained in the report of the Royal Commission, the Government may feel disposed to agree to the project as it now stands, altering the Act if necessary, or at least suggesting some means by which the vast increase of expense in carrying the outfalls to Sea Reach may be met.

Messrs. Bidder and Hawksley estimate that the cost of their proposed scheme will be £2,300,000, whereas they calculate the Government Referees' plan would at least amount to £9,000,000.