

sewer parallel to, and at the level of the river, with its outlet far enough below the city to avoid creating a nuisance, is impracticable, in consequence of the low elevation of the land adjoining the river, and the want of sufficient slope to carry off the sewage in a pipe or sewer of practicable size.

In the system adopted, and now partially constructed and in operation, the sewage is all carried southwardly for about a mile from the highest street which runs through from the mountains to the river, and is then conveyed through Fifth South street for two miles to a well near the river bank, from which it is pumped during eighteen hours of the day through a 12-inch pipe two miles long, and discharged into a canal built to relieve the Jordan during excessive freshets, and is carried off in that canal to be discharged in Salt Lake.

This method of disposal proves to be expensive, and the pumping plant which has been put in is already very much too small for the work required. Sixty per cent of the sewage which is now delivered at the pump well has to be allowed to flow directly into the river, and to pump the remaining 40 per cent over into the surplus canal costs \$5000 per annum. The sewage which flows to the pump station is delivered from sixteen and a half miles of sewers, affording drainage to 400 acres of property, out of the 2000 acres which are more or less occupied by dwellings and business houses above the low lands adjoining the river; and which ought to be all provided with sewer facilities at as early a day as practicable.

In making provision at this time for disposing of the sewage from this section of the city, there ought also to be included an additional area which is rapidly becoming occupied by residences, to the southeast of the new city hall, and above the elevation on which it is situated. As nearly as can be estimated, the habitable area, more than thirty feet above the river, for which sewerage facilities and disposal ought to be provided, is 3000 acres. There is also an area of about 2500 acres east of the Jordan river, for which sewerage must some day be provided, and another area of 2500 acres west of the river which will need sewerage. Both of these areas lie so low that there is no possibility of disposing of the sewage, except by pumping. The sewage from the 3000 acres lying on the high levels can, however, be disposed of by gravity without pumping or other means requiring constant skilled labor, and the question for us to consider is, whether the cost of such disposal would be greater or less than the apparently simpler mode of letting the sewage flow down to the lower level, and pumping it to some distant outlet, such as the surplus canal, or rendering it inoffensive, and discharging it into the Jordan river.

In considering these alternative plans for disposing of the sewage, the market value of the effluent is very important. In the climate of Utah, water is the one commodity which makes land not only productive but simply habitable, and the first thought which occurs to one on viewing the present method of sewage disposal in Salt Lake City, is that the city is expending annually a large sum to throw

away and render absolutely valueless a sufficient quantity of water to render productive more than 3000 acres of farm land, and that, too, water of a superior quality for irrigation purposes to any that could be procured from natural sources in the mountains, being not only enriched by domestic wastes, but raised in temperature.

In other climates where water is plentiful and the land needs other fertilizers to make it productive, many efforts have been made to utilize the solid products of city sewage and permit the water to flow to waste after having been rendered innocuous. None of these efforts have proven sufficiently remunerative to warrant their adoption, except as a sanitary necessity, and it would be folly to attempt them here, where the conditions which call for their trial do not exist.

The first point to which my attention was turned was, therefore, the existence of a locality to which the sewage water could be diverted with the greatest benefit and at the least expenditure, and the entire territory to the west and north of the city was examined with that in view.

Along the western front of the city, between the base of the hill and the surplus canal, a distance of three to five miles, the ground lies so low that sewage from the hill cannot be distributed over the surface without being carried at least three miles in iron pipes under a head, and then either pumped from sumps or allowed to rise above the surface. In the latter case the conduits would be inverted siphons, in which the flow would be fluctuating and irregular, and they would certainly be frequently clogged by the deposits from the sewage, whether pumped or siphoned. There would be needed not less than three such conduits, five miles long, each capable of carrying off sewage at the rate of 10,000,000 gallons in twenty-four hours. In case of pumping there would further have to be not less than three pumps and pumping plants, capable of pumping a out 600,000 gallons an hour to a height of twenty feet. The annual cost of operating this pumping plant would not be less than \$20,000 per annum, equivalent to the interest on \$400,000. This is exclusive of the cost of the plant.

The present pumping plant, owing to an insufficient size of the force main, does a duty equivalent to pumping 50,000 gallons an hour under a head of forty feet.

The territory on which this sewage would have to be distributed for irrigation is now in condition to be abundantly supplied with water by gravity from the upper waters of the Jordan.

This whole scheme appeared so unwieldy, complicated and expensive, that attention was turned to the project recommended by the city engineer for conveying the sewage of the plateau by gravity to a tract of land lying four miles north of the city, for which there is apparently no supply of water available from mountain streams, all the water from the range to the eastward being already utilized on lands directly at the base of the mountain.

The very thorough surveys made by the city engineer, show that it will be practicable to intercept all the sewage

flowing from the city, above a plane thirty feet above the Jordan, and convey it by a conduit of a total length of seven miles to the surface of the tract above mentioned, which lies between the foot-hills and the Jordan, has a soil suitable for immediate production of crops, if moisture is supplied, and extends with a gentle slope several miles to the northward.

I have carefully examined the line and profile proposed for this conduit by the city engineer, and am of the opinion that its construction presents the most feasible and economical method of disposing of the present and future sewage of so much of Salt Lake City as lies above a line beginning at Liberty park on the south, and curving around past the new City hall, the Union Pacific railroad depot and the Deseret University, to near the Warm Springs bath house.

The method of construction proposed by the city engineer, partly of concrete and partly of brick, appears to me to be well devised and economical. In form and dimensions, I recommend that the conduit be circular inside and of 42 inches in diameter, and on a grade of one foot in 2000 feet, from the corner of Fifth South and First East streets to the corner of Second South and Second West streets, thence of 48 inches diameter, on a grade of one foot in 2000 feet, to the intersection of Fourth West and North Temple streets, and thence of 60 inches diameter, on a grade of one foot in 2500 feet for about 27,000 feet, to the terminus in section 12, at an elevation of about 4253.6 feet above the sea.

The estimates of costs prepared by the city engineer appear to be liberal, and so far as I have been able to judge of the cost of that character of work in this locality, I have no hesitation in saying that I believe that the whole proposed work can be executed within the estimates.

As regards the existing pumping plant, while it is entirely insufficient for the present and future needs of the city, there does not appear to be any immediate necessity for its enlargements, if the proposed gravity intercepting sewer is constructed at once. It will then be available for disposing of the sewage of the bottom lands for several blocks north and south on Fifth South street. When the amount of sewage from this district shall exceed 750,000 gallons a day another outfall main will be necessary, and it would be advisable to lay that up to the gravity sewer and pump into that sewer, so as to utilize the sewage on the irrigation grounds, instead of pumping it into the surplus canal, where it can never be of use to any one and would be a nuisance to the adjacent lands, which are now being occupied, while at the proposed disposal grounds it would be available for irrigation, and even if not needed could be discharged into the river at a point where no habitations are likely to be built for a great many years.

If, as the experience of other cities would indicate as likely, the enriched and tempered water supplied from the sewer comes into great demand, it will be practicable to increase the normal flow in the sewer by diverting it into some of the surplus waters from City Creek and the other irrigation canals of the city, which are now permitted