The Charles River Basin

Converting a foul and hazardous estuary into an urban wonderland attests to the ingenuity, determination and thoroughness of two turn-of-the-century engineers.

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There is no better example in the country of the value of the National Historic Civil Engineering Landmark (NHCEL) program than the Charles River Basin. Few among the millions who visit this famous site annually recognize it as an engineering achievement. Only those who read the NHCEL plaque on the wall of the Museum of Science overlooking the basin note its distinction.

The public views a beautiful water recreation and park facility, and rightly enjoys the outstanding landscaping. Visitors have little idea that this pleasant place once was a foul and unsightly tidal estuary — an intolerable situation that demanded correction. It was the engineering profession that solved those problems and made possible the Charles River Basin that the visitor sees and enjoys today.

Background

In early times, large expanses of salt marsh occupied both the Boston and Cambridge sides of the estuary. Through the years, these salt marshes were filled in and development took place on the new solid ground (see Figure 1). The Massachusetts Institute of Technology is located on some of this filled land. An area of some 675 acres of salt water with a mean tide range of 9.6 feet was left after filling in the Cambridge side and Back Bay in Boston in the nineteenth century. At low tide there were vast areas of odiferous and unsightly mud flats. To make matters worse, and positively unhealthy, drainage and even sanitary sewage discharges added to the pollution of the estuary. In addition, flooding at times of extra high tides posed a serious problem for people on the filled land.

Everyone agreed that the situation in the basin had to be rectified, but there was no agreement as to how it should be done. Many proposed ideas based on their own specific interests. Few viewed the problem as a whole. The major challenge at this time was the solution to the basin's engineering problems, and not the creation of a park that the engineering solutions would make possible.

Approaching the Problem

In 1891, Boston's Mayor Matthews spoke out for damming the Charles River in order to create the opportunity to have the finest water park of any city in the country. This park would be patterned after the Alster Basin in Hamburg, Germany. A group known as the Committee on the Charles River Dam was the principal advocate for the dam. Shoreline property owners formed the Beacon Street Committee to represent their interests. The Massachusetts Legislature had funded an investigation into the problem of the river from the Charles River Bridge

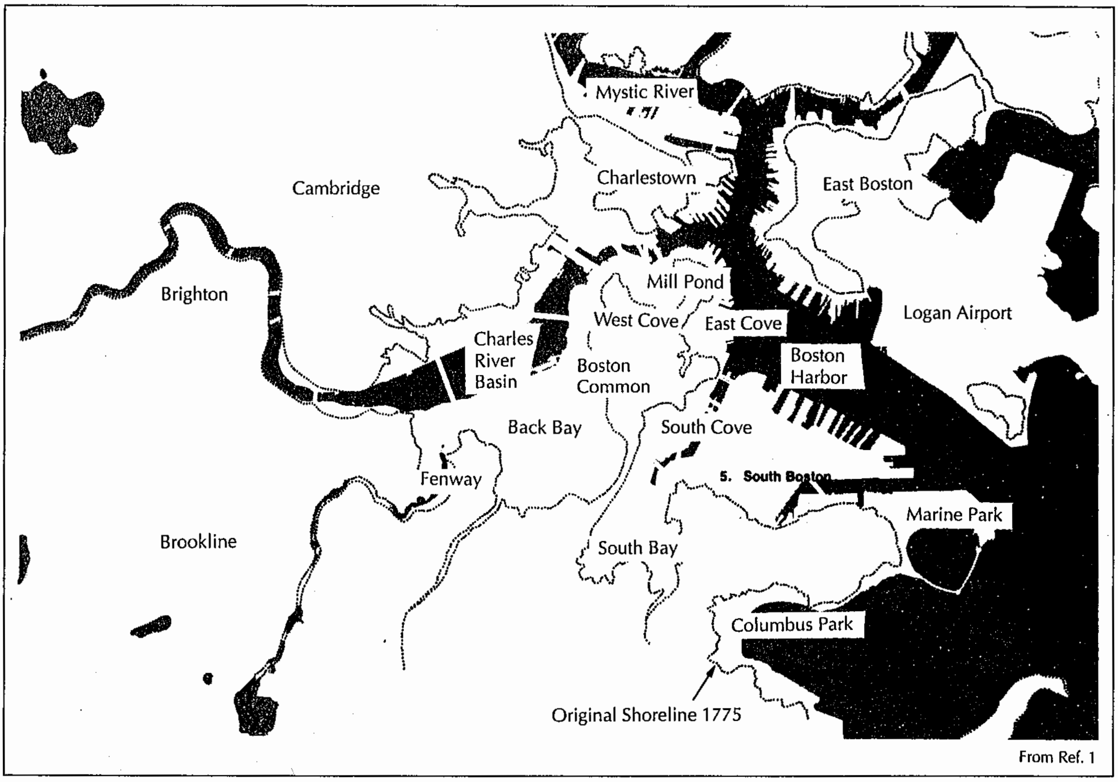

FIGURE 1. Map of the Boston metropolitan area showing the extent of land filling.

to the Waltham town line. The 1893-94 study favored a dam and a fresh water basin. This plan brought howls of protest from the Beacon Street Committee. The committee envisaged that the proposed fresh water lake would accumulate even more pollution and sewage since it would not be subject to the estuary's tidal cleansings. This possibility so alarmed the public that no action was taken on the matter. With the serious problem still in need of solution, another study was funded in 1901. The man selected as Chief Engineer of the Study Committee was John Ripley Freeman, a choice that made engineering history.

Developing a Solution

By 1901 Freeman had risen to the top of his profession as a consulting engineer in various fields, but especially in hydraulics. He was associated with the eminent hydraulics engineer, Hiram F. Mills, in his first position after graduating from the Massachusetts Institute of Technology in 1876. Ten years later, he became Engineer and Special Inspector for the Associated Factory Mutual Companies of Boston. He gained prominence for his study of fire streams. He also acted as consultant on water power and water supply projects, and served on the Metropolitan Water Board of Massachusetts.

In addition to hydraulics, his consulting work covered safety and building construction, including earthquake-resistant design. His work on water power and related projects extended to many sections of this country as well as Canada, Mexico, China, Italy and the Panama Canal. He was a leader in establishing hydraulic laboratories and hydraulic engineering research in this country. No one could have been better qualified for the complex Charles River Basin undertaking.

The first matter that had to be resolved was the severe problem of sewerage and drainage. Established practices were used and adapted to the basin's very complex conditions. The resulting design removed all sewerage and drainage discharges, actual and potential, from the basin area. The remainder of the study approached the problems of converting a salt water tidal basin into a constant-level fresh water lake. This conversion encompassed many unusual technical and environmental considerations. Not only did existing problems have to be solved, but also new problems that might be created had to be anticipated and avoided.

The thoroughness of the study was masterful. Among the subjects covered were:

- Borings and soundings of the area;
- Geological study of the estuary and Boston Harbor;
- Study of the effects of the Charles River flow in scouring the channels of Boston Harbor and the effects on the harbor of changed flows caused by a dam;
- Pollution of the Charles River above the basin;
- The possibility of malaria from mosquitos breeding in pools that would become fresh water instead of salt;
- The chemistry of the river;
- Biological problems;
- Erosion experience elsewhere;
- Effects on the commercial canals, wharves, etc., that would be within the basin;
- Upland water flow;
- Rainfall and flooding;
- Subsidence of the land and harbor;
- Effects on groundwater levels; and,
- Effects of the existing tidal flows into the estuary on the summer air temperatures in Boston (readings from all over the city for a full summer showed none).

The magnitude and thoroughness of the study is evidenced by its 600-page length, plus additional appendices on the detailed studies by special consultants that are over 350 pages long. Not only did the report resolve many of the problems to be faced or imagined by the former opponents, but it also became a model engineering study in itself that is still recognized for its outstanding quality.

Construction

The selection of the consulting engineer for the basin construction, Frederic Pike Stearns, was also a fortunate one. On the construction, he worked with the famous landscape architectural firm of Olmsted, Olmsted & Eliot. This combination of talents resulted in an engineering creation that is exceptional for its beauty, a characteristic for which Stearns' subsequent engineering creations were also noted.

Stearns was a self-educated engineer who rose to the top of his profession through diligent application to his work and studies. He exhibited a remarkable ability to work with others on projects that resulted in great engineering achievements. As a young engineer, he held responsible positions with the city of Boston in the planning and construction of the city's sewerage and water supply systems. In 1886, he became Chief Engineer of the Massachusetts Board of Health and gained a celebrated reputation for his thoroughness and good judgment. His studies of stream flows and water storage in which he established the principles for the economic development of watershed yields were especially notable.

After the Charles River Basin project he engaged in a number of planning and construction activities in greater Boston and other places. His projects were often cited for their environmental beauty and the blending of engineering structures into their surroundings.

Construction planning and design started in 1903. The first construction contract was awarded in 1907, and the work was completed in 1910. The dam was, of course, the major engineering feature of the project. The dam structure incorporated a roadway, a large lock for commercial vessels, sluice gates and overflow conduits. A dam with a width of approximately 100 feet was proposed, but it was decided to extend the 488-foot width required by the lock nearly across the river. This decision required nearly seven acres of fill, with 5.7 acres usable for park purposes.

To construct the lock, 3.5 acres had to be cofferdammed off. For all phases of the construction, the extensive piledriving was made difficult by swift currents. A shut-off dam was erected during the earth filling stage in order to reduce the washing away. Smaller locks were provided for small craft. The large lock was steam heated to prevent winter freeze-up. The eight sluice gates were 7.5 feet wide by ten feet high.

Conclusion

The Charles River Basin was a success from the beginning. In recent times, a new dam has been built and the lock arrangement was altered to accommodate large numbers of small craft rather than commercial vessels. Other changes were made for minor improvements and to adapt to new conditions. However, it basically remains an engineering monument to John R. Freeman and Frederic P. Stearns.

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REFERENCE

1. Boston Society of Architects, *Architecture Boston,* Barre Publishing, Boston, 1976.