

## APPENDIX B

History of Pollution in Woburn, Massachusetts

Chapter 1: The Industrialization of Woburn

Chapter 2: Woburn Water Supply History

Chapter 3: History of Pollution of the Aberjona River

Chapter 4: Tanneries, Piggeries, Municipal Waste,  
and Pesticides

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## CHAPTER I

### THE INDUSTRIALIZATION OF WOBURN

Woburn, Massachusetts was first settled in 1640 and was incorporated as a town two years later. The town is located ten miles north of Boston and fifteen miles south of Lowell. In 1790 Woburn's population totaled 1,727. By 1860, the population had grown to 6,287. In 1889 Woburn became a city and a year later its population reached 13,449. Its population approached 20,000 in 1935 and today totals roughly 38,000.1

Woburn's industrial history can be divided broadly into three periods: the period prior to 1865, the period from 1865 to 1940, and the period from 1940 to the present. The earliest period is best conceived of as the preliminary stage of industrialization when industries such as leather, chemicals and machinery began operating. The middle period corresponds to the rise and decline of the leather industry. The last period involves the diversification of the Woburn industrial base. No longer a one-industry town (i.e. leather), the city's economy expanded to include a range of both high technology firms and more traditional industries such as leather, machinery and chemicals.

#### **Industrial History Through the Civil War**

Although Woburn's economic base initially rested on agriculture, industry developed in the town, especially after the completion of the Middlesex Canal in 1803. Two tanneries which were crucial to Woburn's later development as a center of leather production originated in this early period. The Dow Tannery (located on Pleasant St., not too far from Horn Pond) was important in Woburn's tannery history from 1814 until its destruction by fire in 1893. The other major pre-Civil War tanning company was begun by Moses Cumming in 1836. Cummings built his tannery on the Mill Pond in the north end of the town. By 1837 there were four tanneries in the town employing seventy-seven hands. The presence of the tanners attracted a constructor of tanning machinery, James Buel, who opened a machine shop in the town in 1860, employing between eight and ten machinists.

During this period, the manufacture of shoes, not leather, was most important to the Woburn economy. In 1850, there were twenty-six boot and shoe factories in the town. Until the 1860s, when leather production outstripped the manufacture of shoes, Woburn competed with the town of Lynn (and Philadelphia) for the dominant share in the nation's shoe market.

In addition to leather and shoe production, the manufacture of chemicals had its start during this period. In 1853, the Woburn Chemical Works, predecessor to the Merrimac Chemical Company, began production near the South Wilmington railroad station in North Woburn. The company would later furnish chemicals used in the manufacture of leather to Woburn tanneries as well as chemicals for dyes used in textile mills located further north on the Merrimack River.<sup>2</sup>

### **Industrial History from the Civil War to 1940**

From the period after the Civil War until the 1940s, Woburn's industrial history centered on the production of leather and leather-related products such as shoes. Industries, including chemicals, machine-making shops and glue manufacturers, complemented or supported the manufacture of leather. Such firms were responsible for generating most of Woburn's industrial waste during this period.

In 1865, there were twenty-one tanning and currying shops in Woburn, employing 612 men. These firms were mainly located on the south-side of town on or off of Main, Green and Fowle Streets near the Winchester line and in close proximity to Russell Brook. These shops produced products valued at a little over \$2 million. By 1875 the number of shops had declined to 18, employing 808 hands and manufacturing 11,275 sides and 4,000 skins weekly. In 1879 there were twenty-four shops employing 1,288 men and producing 14,800 sides of grain and buff leather on a weekly basis. By 1884 there were twenty-six establishments employing 1,500 men. Their capital stock amounted to \$1.5 million and the value of their product equaled \$4.5 million. During the 1880s it was common for some of the larger establishments, such as the Bryant & King Company, to turn out one thousand sides of leather in a week. Until roughly 1900, these tanneries used the process of bark tanning.<sup>3</sup>

By the twentieth century, the combination of the use of the chrome tanning process with labor-saving machinery, such as the shaving machine and the staking machine, made it possible for tanneries to turn out as many as 10,000 sides of leather per week. In 1915 there were 18 tanneries employing an average of 1,274 hands. They were largely located in the central southern section of town off of Main and Fowle Streets. The value of their products was in excess of \$6 million.<sup>4</sup>

During the 1920s the number of firms in the leather industry fluctuated between 16 and 22, and the number of

employees from about 600 to over 1,500. Most firms were located in the south central part of town. In addition there were several leather firms located in North Woburn on Webster and Maple Streets. A couple of companies were located on Cedar and Salem Streets in close proximity to the Aberjona River. The 22 firms produced a product valued at almost \$8.6 million in 1925. The industry reached its peak production in 1927, with 21 firms producing in excess of \$10 million in products and employing 1,379 hands.<sup>5</sup>

The Woburn leather industry peaked in the years 1927-1928, and then experienced a severe downturn as the national economy plummeted in the late 1920s and early 1930s. In 1929, twenty firms were still operating, employing 1,105 hands, but the value of their product had declined from over \$10 million in 1928 to just over \$7 million in 1929. By 1932, the number of firms had declined to 12, employing 759 men and producing products valued at scarcely over \$3 million. The decline of the industry continued throughout the decade. In 1940 only six firms were left, employing an average of 129 wage earners and producing products valued at under \$400,000.<sup>6</sup>

The presence of the tanning and other industries in Woburn attracted a number of machine shops and foundries. In 1926 there were eight firms of this type, most located in the central southern district of Woburn on Main, Prospect and Fowle Streets in the vicinity of Russell Brook. These firms employed 144 hands and produced roughly \$632,000 worth of products in 1926.<sup>7</sup>

During the period from the end of the Civil War through its acquisition by Monsanto Chemical in 1929, the Merrimac Chemical Company experienced rapid expansion, becoming one of the largest chemical companies in the United States and the largest in New England.<sup>a</sup> From 1858-1890, Merrimac Chemical produced mainly sulfuric acid and related chemicals. Initially, sulfur was utilized in the production of sulfuric acid by the lead chamber method but in the late-nineteenth century pyrite ore was substituted as a sulfur source. After the pyrite ore was burned to produce the sulfuric acid, the pyrite slag was treated to recover copper. Piles of pyrite cinder were accumulated on the property in the expectation that a use for the byproduct would eventually be discovered. Other byproducts or wastes accumulated by Merrimac Chemical in the hope that a future use would develop for them were calcium sulphate, oxide of iron, sulphate of lead, calcium carbonate, bauxite waste mud and other unnamed byproducts.<sup>9</sup>

In 1899, Merrimac purchased a producer of arsenic insecticides, acetic acid and dry colors, the William H. Swift Company of Boston. Between 1899 and 1915, Merrimac became the leading producer in the U. S. of arsenic insecticides. In 1890, Merrimac became a large producer of aluminum chloride and was the first American plant to manufacture hydrate by the Bayer Process.

Merrimac organized the New England Manufacturing Company in 1915 to produce organic chemicals, including phenol, benzene, picric acid and toluene. Its plant was in North Woburn adjacent to the Merrimac facility. During World War I both Merrimac and the New England Manufacturing Company produced picric acid, trinitrotoluol and trinitrophenol (TNT). Light oils from coal tar distillation were also refined at the Merrimac plant during these years. Paint grinding also took place on the site.

### **Woburn Industry: 1940 to the present**

The period after 1940 saw the transformation of Woburn from the status of a two-industry town to a much more diversified industrial base. The evidence for the period is scattered and fragmented, but there clearly was a diversity of operations located in the town. The leather industry did not completely disappear from Woburn during this period, although the number of firms was drastically curtailed. In 1947 five leather and leather related firms were operating in the town including, Murray Leather Company, Woburn Japanning Company, John Riley Company, Tanners Degreasing Company and Woburn Degreasing Company. Two of these firms were located in the south central part of town; two were located in east or southeast Woburn; and one was located in the town's western part.

There was also a significant amount of metal working done in Woburn at this date. Fourteen machine shops, foundries and tin shops were located there, eleven of which were found in south central Woburn, two in east Woburn and one in North Woburn.

While the tannery industry had declined in Woburn after world War II, the chemical industry actually underwent expansion. Among the chemical companies identified in Woburn in 1947 were P. H. Revell Company which bottled household chemicals, International Minerals and Chemical Corp. which

manufactured fertilizers, Atlantic Gelatin and Independent Tallow. The Consolidated Chemical Company was located on the old Merrimac site in North Woburn and operated primarily an animal hide glue manufacturing plant. The Revell plant was located in south central Woburn, Atlantic Gelatin and Independent Tallow in southeast Woburn, and International Minerals in North Woburn. 10

By 1969, the industrial base had expanded from 74 to 120 firms. The number of leather and leather related industries remained at five, three located in southeast Woburn, one in the south central part of the town and one in North Woburn. Atlantic Gelatin and Independent Tallow were still operating, while Consolidated Chemical Company had been acquired by Stauffer Chemicals. In addition, there was a plastics manufacturing company operating in the south central part of the town. The number of machine shops, foundries and tin shops remained the same, holding at fourteen. But, by this point in time the Woburn industrial base was diversifying, hosting a range of service industries and durable goods manufacturers such as General Motors and W. R. Grace. 11

In 1985, there were over 135 manufacturing firms in Woburn, of a wide variety. As part of the Route 128 region the town has its share of high technology firms. In addition, there are several machine and machine related shops including American Shoe Machinery, Circle T & D Corp., Custom Machine Inc., Lufkin Corporation, John H. McCafferty, North Woburn Machine Co., Inc., Ober Industries, Inc., Pell Engineering, Inc., Prospect Tool & Die Company, Inc., Wells Machine Company, Inc., and Woburn Machine Company. Two companies, John J. Riley Company and Braude Brothers Tanning Corporation, are still involved in leather manufacturing. Several firms are also involved in chemical and chemically related industries including Continental Chemical & Coatings, producing solvent and water based adhesives as well as wood preservatives; Fuller System, Inc., which produces greenhouse pesticides; Hy-Trous Corporation manufacturing fertilizers; New England Resins & Pigment producing plastic and paint raw materials; and Northeastern Ammonia Company, Inc., which is involved in the production of anhydrous ammonia and related equipment. 12

## FOOTNOTES

1. William Lee Raymond, •community Survey of Woburn, Massachusetts•, 1936.
2. James Heaton, •woburn--A Leather City•, Current Affairs April 16, 1923; Samuel Drake, History of Middlesex County; Woburn Daily Times October 21, 1976; Arthur Gardner, •Report of Investigation to Substantiate the Date of 1853 as that of the Establishment of the Woburn Chemical Company•., • ms. in Woburn Public Library.
3. Heaton; Woburn Board of Trade, Woburn; An Historical and Descriptive Sketch of the Town... Woburn, 1885; Woburn Directory: 1868, 1874, 1877, 1883, 1891, 1895, 1899.
4. Shoe and Leather Reporter, May 20, 1920; Massachusetts Department of Labor and Industries, Division of Statistics, Census of Manufactures--City of Woburn 1915; Woburn Directory 1906, 1913, 1915.
5. Census of Manufacturers 1925, 1927; Woburn Directory 1925.
6. Census of Manufacturers 1927-1940.
7. Census of Manufacturers, 1926; Woburn Directory 1925.
8. Unless otherwise cited, all of the following information on the Merrimac Company comes from Stauffer Chemical Co., Woburn Environmental Studies, Phase 1 Rpt., V. 1., •Environmental Assessment•, April, 1983, pp. I-1-9.
9. Merrimac Chemical Company, Manufacturers of Chemicals, Boston, 1928, p. 79.
10. Sanborn Maps, Woburn, 1947.
11. •Insurance Maps of Woburn•, published by Sanborn Map Company, 1969.
12. George D. Hall, Directory of Massachusetts Manufacturers, 1985-1986.

## CHAPTER II

### WOBURN WATER SUPPLY HISTORY

#### INTRODUCTION

This chapter discusses the water supply history of the Town of Woburn. Woburn has had a troubled water supply history. Woburn residents frequently experienced problems with water quality and volume over the years and the city has had to change the location of its wells, its pumping equipment and its sources of supply several times. This chapter will provide only the essential facts in regard to the technological development of the system and focus instead on problems that developed at various times in regard to water quality and adequacy of supply. The report is presented in chronological fashion and is based on available materials from state and city reports, newspapers, and writings about the system. Sources are indicated in the reference notes.

It should be noted that while the Massachusetts State Board of Health (later Department of Health) analyzed the quality of the water in the Woburn system yearly from 1889-1927, (published in their annual reports), as well as afterwards, (but not published in the annual reports), the parameters being utilized for testing during much of this period do not include many of the substances of concern today. The prime concern was bacteria (coliforms as indicators), a limited number of chemical constituents such as nitrogen (nitrates, nitrites, chloride, and ammonia), metals such as iron, and qualities such as hardness, alkalinity, and acidity (pH). Color, turbidity and temperature were also of concern. In addition, tests were performed to indicate the amount of dissolved oxygen (DO) in the water and the biochemical oxygen demand (BOD) of wastes in the water, with the amount of DO being an indication of the extent to which the water was free of oxygen demanding substances. Analysis for many of the hazardous substances commonly tested for today (heavy metals and various types of organics, for instance), were not performed until recently, a result of rapid advancement in the last two decades in the field of environmental chemistry.

#### Initial Construction of the Woburn Centralized Water Supply System

Like many Massachusetts towns, the city of Woburn depended on household wells and pumps for its water supply until the post-Civil War decades. As the town grew, such



sources became increasingly inadequate both in terms of potability and the quantity available for fire fighting. As a result of these problems, between 1871 and 1873 the city of Woburn constructed a centralized water supply system. The system drew on the groundwater in the Horn Pond area for its supplies. The intention had originally been to use Horn Pond water directly but in constructing the pumping engine house an underground source of purer quality than the pond was tapped and substituted for the pond water except in emergency situations.<sup>2</sup> The water was drawn from a so-called •filter-gallery•. Later examinations strongly suggested that the water in the filter gallery was drawn from the pond, although filtering greatly improved its quality.<sup>3</sup> The use of driven wells tapping groundwater supplies was common as a source of supply in small towns, although large cities tended to rely primarily on surface sources.<sup>4</sup>

### **The Development of Major Quality Problems and the Construction of New Wells. 1890-1920**

By the 1890s, the Woburn system was displaying difficulties, generated primarily, according to the Massachusetts State Board of Health (MSBH), by an increase in consumption. Taste and odor were a problem, as was adequacy of supply.<sup>5</sup> An 1895 examination by the MSBH of Horn Pond reported that it was seriously polluted by tannery and other manufacturing establishments. (Increased settlement around the pond was also a source of pollution.) Tannery wastes had greatly increased the chlorine in the water. The Board also warned of the dangers of drawing water directly from the badly polluted Horn Pond. According to the report, water from the filter gallery, although drawn from the pond, was much purer than the surface water and suitable for drinking.<sup>6</sup>

In 1903, the MSBH analyzed the Woburn water supply at the request of the City Commissioner of Water and Water Supply in order to see if the quality had deteriorated. The MSBH reported that the filtration of the water from Horn Pond was becoming less thorough, as shown by the increase in free ammonia and iron. The MSBH recommended that Woburn seek an additional water supply from another source in order to reduce the draft on the filter gallery. It suggested that such a source could be obtained by constructing another filter gallery or by digging wells near Horn Pond but distant from the existing filter gallery. It also indicated that, •A supply of water can be obtained from the metropolitan water district, and this may be the most economic plan of securing a water supply for the future.• It would be almost three-quarters of a

century, however, until the city of Woburn ceased to rely solely on its groundwater for a source of supply and began to fill part of its needs from an extra-local source.<sup>7</sup>

In the years from 1906-1908, problems concerning the quality and quantity of the water supply became more pressing. Because of reductions in the flow from the filter gallery, the city began to draw water directly from Horn Pond into its system for potable purposes. In 1906, the MSBH warned that Horn Pond Brook and its tributaries in Woburn was •The most seriously polluted stream in the water-shed of the Mystic River above Upper Mystic Lake.•<sup>8</sup> The pollution was caused by tannery wastes that entered streams that ran beneath factories or through factory yards as well as by human wastes. In 1907, the MSBH reacted to the city's continued use of Horn Pond water by warning that •it was not safe to drink this water unless it has previously been boiled for at least fifteen minutes.<sup>9</sup>

In search of a solution to its water supply problems, in 1908 Woburn submitted plans to the MSBH for a new well (a •suction well•) to be located in the Horn Pond area southwest of the old filter-gallery and for a group of tubular wells on the west side of Horn Pond. The MSBH approved of this plan to take water from the uninhabited western shore of the pond and also recommended that the city provide a covered reservoir as a means to prevent deterioration of the water and of avoiding •the offensive taste and odor which have been the source of much complaint for many years.•<sup>10</sup> Again, this was a suggestion that would be made to the city by engineering consultants and the MSDH throughout the twentieth century. Woburn constructed its new well in 1908 and equipped it with a Platt pump. The well was located a few feet south of the old pumping station. Another 50 new 2 1/2-inch wells were dug in the Sucker Brook Valley on the west shore of Horn Pond. The MSBH analysis of water quality from the new source indicated a much higher quality than the water in Horn Pond.<sup>11</sup>

#### **Deterioration of the Water Supply in the 1920s and Construction of a Third Set of Wells**

In the early 1920s the Woburn water system again developed problems. In the summer of 1923, the city's reservoir was extremely low due to dry summer conditions, again necessitating drawing raw water from Horn Pond. The Woburn Health Department warned citizens to boil their drinking water if the •unsanitary• Horn Pond water was utilized.<sup>12</sup> The Woburn Superintendent of Public Works argued, however, that the Health Department advisory was unnecessary. He charged that the Board

of Health was motivated by a desire to tie Woburn into the Metropolitan System, as it had been advised to do by the MSBH. He maintained that pollution in the pond could be dealt with by chlorination or by filtration at a much cheaper cost than membership in the Metropolitan system.<sup>13</sup>

On Sept. 7, 1923, the MSBH wrote the Woburn Board of Health warning that Horn Pond was "a most objectionable source from which to take water for water supply purposes" and that the water would have to be boiled if it was fed into the city's distribution system. The MSBH recommended that a temporary supply be sought from the neighboring towns of Stoneham and Winchester.<sup>14</sup> Faced by this warning, the City Council appointed a special committee to investigate the water situation and to make recommendations for improvements. After its investigation, the committee reported that "conditions at the reservoir...are a disgrace to the city and a menace to the health of the community."<sup>15</sup> Dependence on Horn Pond water, however, continued with as much as half of the total amount pumped occasionally coming directly from the pond.<sup>16</sup>

In October, 1923, in order to deal with the possible health dangers stemming from use of the Horn Pond water, the city installed a chlorinator at the pumping station.<sup>17</sup> During the summer of 1924, this resulted in taste problems, and the Woburn Board of Health received 87 complaints about the drinking water.<sup>18</sup> One Woburn resident wrote to the Massachusetts House Ways and Means Committee, then investigating the question of the Woburn sewer, that from July through September, 1924, when the Horn Pond water was being utilized, "the City of Woburn had no water fit for human consumption." He added, "some chemicals were put into the water to kill the bacteria, which was the cause of much sickness. The more a person drank of the water, the thirstier he would get, so that a person's energy was greatly reduced."<sup>19</sup>

In 1926, in response to the difficulties with the old wells, the city constructed a new well ("A") utilizing an electrically driven Layne Pump. It was located 207 feet south of Horn Pond and about 300 feet east of the pumping station. This well tapped the same aquifer as the previous wells. Its purity was affirmed by tests made by Metcalf & Eddy, a Boston Engineering Consulting firm and by the MSBH, and in 1927 the water from the new well was turned into the system.<sup>20</sup>

The development of the new well, however, did not solve the city's water problems. Faced by increasing consumption and inadequacy of supply, the city continued to chlorinate and use Horn Pond surface water. The use of the Horn Pond supply led

to charges in the City Council by one councilman in July, 1929, that the Mayor and the newly appointed Water Commission were endangering lives by relying on •filthy• Horn Pond water rather than seeking a new source of supply.<sup>21</sup> While bacterial analysis by the MSBH found that the chlorinated water was safe to drink, the MSBH also warned that •sole reliance• on the chlorinatin apparatus as protection against disease was dangerous.<sup>22</sup> Horn Pond was designated as an •emergency water supply• for Woburn by an Act of the General Court in 1929.<sup>23</sup>

Faced again by severe reductions in its water quality, the city began seeking a new source of supply. It hired a geologist and the engineering consulting firm of Metcalf & Eddy for this purpose.<sup>24</sup> The Metcalf & Eddy investigations resulted in discovery of •good water bearing material• below the Horn Pond surface and at a greater depth than the old driven wells. In 1931, the so-called •sowler System• was utilized to construct three new gravel packed wells (•S•, •C•, and •O•). Tests and analssis by the MSBH provided evidence of the water's high quality.<sup>25</sup> These wells, boasted P. D. Bowler, president of the company that constructed them, gave Woburn •a water supply...second to none in the entire country both in purity and actual cost of production. Woburn has a supply for all time in its underground deposits and will never have to go into the Metropolitan system or engage in the construction of filtration plants.<sup>26</sup>

#### Deterioration of the Third Set of Wells .1935-1958

In spite of predictions, the water system continued to have difficulties. A short time after it began operating, Well •C• pumped fine sand and had to be abandoned.<sup>27</sup> In 1935 the water supply became muddy and •offensive in taste• for several days, although free from bacteria. The problems were traced to the Layne pump plus excess demands on the system caused by a large fire.<sup>28</sup>

To deal with the supply problem, in 1937 Well •A2• was constructed on the south shore of Horn Pond to a depth of 0 feet and Well •E• was constructed to a depth of 60 feet. Improvements were also made in the distribution system.<sup>29</sup> During the World War II period and immediately after, however, the system again produced inferior water. In 1943 and 1944 householders complained that the water was •unclean•, and the Woburn Superintendent of Public Works recommended that the water system be cleaned, •In order that this unsatisfactory and unhealthy situation may not become progressively worse.<sup>30</sup> In

1946 the Superintendent reported that during the high usage summer months, water all over the City, particularly in the Montvale section, becomes dirty and unusable. He recommended renewing Wells A and C as a means to generate new supply.<sup>31</sup>

A further episode occurred in November, 1950, when a power failure caused the electrical pumps to shut down and water was again drawn directly into the system from Horn Pond. The water was shown to be safe for drinking at time of analysis.<sup>32</sup> The city made some improvements in the distribution system between 1950 and 1960, when it installed booster pumping stations and constructed a small concrete reservoir and a large steel reservoir.<sup>33</sup>

In 1954 tastes and odor again developed in the water supply and Woburn residents made a number of complaints to the city. In order to eliminate the tastes and odor, the Department of Health recommended that Horn Pond Hill Reservoir be cleaned annually and that deciduous trees near the reservoir be removed and coniferous trees planted to prevent leaves from blowing into the reservoir.<sup>34</sup> It was obvious that major overhaul of the system was needed, and in 1955 the City contracted with Whitman & Howard, Inc. to do a study of the water system and recommend improvements.<sup>35</sup>

#### The 1958 Whitman & Howard Report and the Origins of Wells G and a

The Whitman & Howard report was delivered to the city in August, 1958. It provided a thorough analysis of the problems with the existing Woburn water system and made a number of recommendations for improvements. Its discussion of problems relating to water quality and supply, to the condition of the system, and its recommendations, are summarized below (page numbers noted refer to pages in the report):

##### A. Analysis of the System:

1. The reservoir's open construction exposed its contents to animal and human pollution. Biological growths in the reservoir created taste and odor problems although cleaning the reservoir annually pretty much solved the problem. (p. 6)

2. Pressure losses in the system were caused by the location of the reservoir which resulted in deriving all water either from the wells and/or from the reservoir through the same pipes at the instant of demand. (p. 6)
3. The distribution system in North Woburn was inadequate leading to pressure drops. There was also inadequate pressure in West Woburn. (p. 8)
4. Tests of water pressure for fire protection showed several localities where the flow was much lower than that in 1937. (p. 10)
5. Deterioration was present in the older unlined water distribution mains. (p. 15) The system's major mains could not carry required water without large pressure drops. (p. 18)
6. Per capita water consumption was very high from 1915-1925 probably due to tannery use and leakage. Per capita consumption from 1937-1957 was variable from year to year but showed a tendency to increase yearly over time. (p. 25)

B. Ground Water Supply:

1. The report stated that Woburn is situated over two ancient river beds: one running from near the Atlantic Gelatin factory at the Winchester-Woburn line northerly under the Aberjona River to Mishawum Pond to the Wilmington line: a second "is believed" to begin in Winchester under the Aberjona River at Judkins and Wedge Ponds and to run northwesterly along Horn Pond Brook to Horn Pond itself. Many industries draw underground water from the aquifers underlying the Aberjona River. The Horn Pond aquifer had been used for public water supply since 1873.

2. Industrial Water Supplies:

--Atlantic Gelatin (5wells): wells not used for drinking purposes due to evidence of previous or present pollution of the aquifer (demonstrated by the high chloride content), the water from these wells is not used for drinking purposes. (p. 30)

--John J. Riley Co.. (1 well}: •The water is polluted and is used for industrial purposes only. (p. 30}

--Consolidated Chemical Industries (6 wells}: •The water from the two deep wells is reported to be of good quality. (pp. 30-31}

--Independent Tallow Company (well field}: •water shows indications of pollution and a high iron content has been reported. (p. 31}

--Sylvania Electric Products, Inc. (3 wells}: •Two of the wells are within 150 feet of a 24-inch sewer, and an application for use of the water for drinking purposes was turned down by the Department of Health. (p. 31}

### 3. Public Groundwater Supplies:

This section described the various wells as follows:

--Well •A2• (1937}, •the most productive source of public water supply in the City. (p. 32}

--Well •a• (1931}: •This well is said to have been constructed without engineering supervision, and no concrete data on the construction methods employed has been found. Acidification is necessary at about two year intervals. (p. 32} Recommends cleaning and surging in 1958. (p. 33)

--Well •O• (1931): Also constructed without engineering supervision. Required acidification in 1949.

--Well •E• (1937): This well is the second major source of city water supply. It and A2 •are believed to be excellent, dependable, long-lived water supply sources. (p. 33)

The report also notes that among the abandoned groundwater wells were the old filter galleries, a driven well close to Well •O•, and Wells •A• and •C•. Wells •A• and •C•, however, were held to hold •considerable promise• for renewal.

### 4. Important Groundwater Conclusions:

--•Much of the ground water potential of the City of Woburn has been meticulously investigated in the past. • (p. 34)

--•The Aberjona River valley still has a potential for ground water supply for certain industrial used [sic], but the ground waters of this valley are, in general, too polluted to be used for public water supply. • (p. 34)

--•Based on knowledge of previous investigations, the Horn Pond area is, undoubtedly, the best potential source for an additional public ground water supply. • (pp. 34-35)

--•An unexplored area lies west of Mishawum Pond, between the Pond and the Reading-Woburn line. • (p. 35)

#### C. Test Well Investigations:

A number of test wells were driven and the results of the analysis of their quality was provided. A number of the tests produced water of poor quality and only one, in the so-called •Akerson Gravel Pit• east of Mishawum Pond, produced •good quality water. • (p. 36) Pumping tests were recommended at the so-called Collins Farm in the vicinity of Well •F•, and a location near the Horn Pond Pumping Station. (p. 38) Incomplete pumping tests indicated that the water-bearing strata in the Akerson Gravel Pit area was too limited to warrant development, that the well near the Horn Pond Station could deliver 2 M.G.D., and that the well in the vicinity of •E• could produce about .7M.G.D. without drawing on •E•. (pp. 38-39)

#### D. Recommendations:

1. Raising the level of Horn Pond - recommended as •extremely desirable• (pp. 39-40)
2. Improvements to Storage Facilities and Distribution System: Four alternative plans presented for storage facilities, and Plan IV. providing for new 4.4 M.G. tank on Rao Rock Hill was recommended. (pp. 41-72)
3. . Metering was recommended for the unmetered one-third of the town. The report noted that •unless a strong



policy of metering is pursued, the improvements proposed herein may prove inadequate in a relatively short time. (p. 74)

E. Maintenance of the Water System:

The report noted that the water system had not been properly maintained for a long period of time. This neglect was blamed on limited budget, too few water department employees, a low pay scale and a general city-wide indifference to Water Department maintenance. Serious deficiencies were noted in the lack of an inspection program (no program of cleaning and surging and inspecting pumps has ever been established), and the failure to properly surge and clean any well until the spring of 1958. (p. 81)

F. Connection with the Metropolitan District Commission:

The Report concluded by observing that if the recommendations for improvements made in the report were implemented, and if the projected increases in consumption were accurate, Woburn would not have to connect to the Metropolitan District Commission for supplies until 1975 or later. (p. 86)

G. Appendix 1: Effect of City Wells on the Level of Horn Pond:

The report observed that in cases where well supplies were adjacent to surface waters, the probability exists that during dry periods some of the water pumped from the wells may be directly or indirectly drawn from the pond, lake or river. (p. 1-1) Tests showed that the level of Horn Pond water was affected by pumpage from the wells adjacent to the pond. (pp.1-2)

Wells G and H; From Construction to Shutdown. 1958-1979

The 1958 Whitman-Howard Report resulted in construction of a new well (Well F) at the westerly side of Horn Pond as had been recommended. This well was put on line in 1961.<sup>36</sup> Supply still remained insufficient, and in 1963 Whitman & Howard were again diggin test wells in Woburn in search of ground water supplies.<sup>3</sup> These tests were at sites located near the Aberjona River and apparently drew from the Aberjona aquifer. No information was available to this writer to explain why, so soon after the construction of Well F, Woburn needed to seek further supplies. In addition, no explanation

was available in the form of a report or a letter as to why, after the Whitman & Howard Report of 1958 had rejected the use of the Aberjona groundwater as •too polluted to be used for a public water supply• (presumably by industrial rather than bacterial wastes), wells were being sunk in that aquifer.

In November, 1963, L. M. Pittendreigh of Whitman & Howard wrote to the Massachusetts State Division of Health (MSDH) that the most promising area for a water supply suggested by the preliminary tests was in the vicinity of Well •16• near the Rod & Gun Club. He also commented favorably on Well •9•, in the same general area and Well •a•, south of Salem Street.<sup>38</sup> Results of tests of the water at these wells conducted by the MSDH Lawrence Experiment Station were included with the Pittendreigh letter. These tests were for the standard parameters utilized in 1963 and included no tests for metals aside from iron and manganese or for various organic pollutants such as chlorinated hydrocarbons.

The Pittendreigh report was reviewed for the MSDH by Senior Sanitary Engineer H. D. Nickerson. He noted that the water was, according to preliminary test, •of relatively good chemical characteristics.• He also noted, however, that the wells were in the vicinity of the J. J. Riley Tannery •and as a result, the chloride content is somewhat higher than normal.• The Sanitary Survey of the area •indicates no immediate source of pollution...•<sup>39</sup> Following this report, Worthern H. Taylor, Director of the State Division of Sanitary Engineering, wrote to the Woburn Public Works Department that •Examination of the sites shows that there are no sources of sewage pollution in their immediate vicinity, although the J. J. Riley Tannery is located in the general area.• Taylor noted that the water from Sites 8 and 16 contained •a relatively large amount of chlorides, but generally the water from all three sites is of suitable quality for public water supply purposes. The Division of Sanitary Engineering approved the three sites as suitable for extended testing.<sup>40</sup>

The pumping tests were held at two sites in February and March, 1964. One test well was in the vicinity of a truck terminal south of Salem Street and the second was in the vicinity of the rifle range north of Salem Street. On May 19, 1964, L. M. Pittendreigh wrote to Woburn Mayor Edward F. Gill that the tests showed that the water quality in these wells •was found to be comparable with the present ground water supplied to the City of Woburn, being low in iron and managanese.• Pittendreigh recommended the construction of two gravel packed wells at the sites of Test Wells 8 and 16 and the acquisition of all land within a minimum radius of 400 feet

from the proposed gravel packed wells. •rn summarizing the test well investigation, • Pittendreigh commented, •we feel that the City is fortunate in finding an additional groundwater supply of good quality in East Woburn and that the development of this supply will aid in overcoming the City's Water Problem. •41

At the end of May, 1964, Whitman & Howard submitted a report on their test well work to the MDPH and asked for approval by the Department for construction of Gravel Packed Wells.42 Senior Sanitary Engineer Nickerson again reported on the tests to his department. He observed that the Whitman & Howard report on their test well work lacked •many pieces of engineering information relative to site No. 8 (and No. 16). • Chemical analysis of both the wells showed the water to be •low in turbidity, sediment, color, odor, moderately hard, low in iron and manganese, and to show the presence of some organic materials •••• Chloride content at 8 was approximately 39 parts per million and 20 ppm at 16. Nickerson noted that •the areas at site No. 8 and 16 are satisfactory from a sanitary point of view in that there are no immediate sources of pollution in the general area. • However, • he added, •there is some question as to the actual capacity of the proposed gravel packed wells. •43

After receiving the Nickerson report on the pumping tests, W. H. Taylor, Director of the Division of Sanitary Engineering, responded in July to the Woburn Department of Public Works. He noted that analyses of the water at Site 8, south of Salem Street, •showed the water would be relatively hard, to contain some organic material, and to contain a larger amount of chlorides than usual for ground water of the area. • The relatively high chloride content, • he added, •may be due to industrial operations in the area and in the future it may be necessary to limit the yield of any permanent well at that location to maintain a suitable water quality. • In regard to Site 16, Taylor noted that the water was •relatively hard, but otherwise of good chemical quality and suitable for a public water supply. • Approval was given for the construction of two gravel packed wells at Sites 8 and 16, with a third well to be possibly added at the site of 16 after the first two were in operation. The city was required to acquire all land within at least 400 feet of each site before they could be used as sources of public water supply •to allow for the proper development and protection of the sources. •44

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During the summer of 1964, the plan for land takings was approved by the MSDH and construction of the wells proceeded. S During the period the wells were under construction, the Woburn system experienced difficulties with

•dirty water• and heavy growth of aquatic weeds and algae in Horn Pond. According to Whitman & Howard, the dirty water was a result of the adherence to the sides of pipes of material such as iron bacteria or manganese slimes. This caused the quality of the water at many locations in the city to be •far from the good quality that you have at the wells.• Whitman and Howard recommended a flushing of the mains and a calgon treatment to deal with the problem.<sup>46</sup> Horn Pond was chemically treated by the Allied Biological Control Corporation in November, 1966. City wells along the shore of the pond were shut down during this period.<sup>47</sup>

Well G (formerly Well 8) began service in the latter part of 1964, while Well H (formerly Well 16) was put into service during the first half of 1967. However, during the summer of 1967 the MSDH recommended that both be taken out of service •due to the poor bacterial quality of the water supplied therefrom.• The MSDH required •that these wells may not be used as sources of public water supply without continuous chlorination to assure the safety of the water.•<sup>48</sup> Chlorination facilities were installed at one of the wells (apparently •a•) on April 3, 1968, and probably at •G• shortly after that.

When the chlorinated water first entered the system there were many complaints of its taste and odor from East Woburn residents. •The odor,• wrote one resident, •is almost like a clear bleach...Why can't we have water like the rest of Woburn?•<sup>49</sup> Adjustments were made of the chlorine dose to attempt to control the bacterial quality of the water without imparting a chlorine taste. City officials maintained that after the initial flurry, complaints had ceased until a resident mailed a complaint to the Boston Herald in August.<sup>50</sup> Debate in the Woburn City Council over the water question led to the Council authorizing the Mayor to enter into an agreement with the Metropolitan District Commission (MDC) about joining its system.<sup>51</sup>

During the same spring and summer (1968) there were complaints of •red water• in the system as well as of chlorine taste.<sup>52</sup> Whitman & Howard attributed the color to the city's many miles of unlined old cast iron pipe. After submitting engineering plans, the MSDH gave the firm permission to add •calgon• (sodium hexametaphosphate) to Wells •G• and •H• to inhibit the precipitation of the iron.<sup>53</sup> The treatment was also intended to adjust the water's pH content.<sup>54</sup>

In February, 1969, the City of Woburn increased the chlorine feed rate at Well •G• by 50 percent based on test results.<sup>55</sup> Complaints about the taste and odor of East Woburn water were raised anew. Residents protested that the water was •very unpotable, • very hard, • and had a •strong chemical taste.• The problem existed in both Wards 4 and 5.<sup>56</sup> Aldermen from Wards 4 and 5 insisted that Well •G• be closed for the winter and Council appointed a special committee to discuss the water problem with the Mayor and city officials.<sup>57</sup> At a meeting between city officials and engineers from Whitman & Howard, City Engineer George Olson observed that the problem was not an easy one to solve and that city officials had been working on it. Nothing was wrong with the water, he claimed, since the chlorine was present to control bacteria.<sup>58</sup> The City proceeded to investigate the prospects of connections with the M.D.C. through the neighboring town of Stoneham.<sup>59</sup> In April, the Woburn Times reported that a neighborhood committee was being organized to explore the problem and to attempt to close down Well •G•; in late August a group of East Woburn residents presented the Mayor with a petition protesting the inferior quality of their water.<sup>60</sup> Although the Mayor argued that the chlorination of •G• had been •unreasonably• ordered by the MSDH because the bacterial contamination was in Well •H•, he promised to close •G• by mid-September. By October 1 the well was closed.<sup>61</sup>

While Well •G• was shut down during the fall and winter of 1969-70 other potential threats to the Woburn water supply developed.<sup>62</sup> Plans were announced for construction of a new industrial park to be called •Industri-Plex 128•, to be located at the junction of Routes 128 and 93, at a site formerly occupied by the Stauffer Chemical Companies.<sup>63</sup> Upon examination of the site, the State Division of Environmental Health observed that the 450 acre site, which was located in the Aberjona River Valley, was just north of Wells •G• and •HM located in the river flood plain. The Division warned that •the proposed filling and drainage may adversely affect the City of Woburn's public water supply during high flows and flood conditions of the Aberjona River••••• It recommended that construction take place only if the abandoned lagoons and dumps of the Stauffer Chemical Company •be excavated and disposed of in an area which will not be affected by flooding." and that all sewer construction and lift station plans be approved by the Division.<sup>64</sup>

Because of limits in the supply, in the spring of 1970 the City of Woburn again began pumping from Well •G• in order

to meet increased water demands. According to the Woburn Times, complaints about taste and odor problems in the water soon began to pour again like so much water through a broken dam.<sup>65</sup> City officials maintained that Well 'G' had to be used at peak times until M.D.C. connections were made. Engineer John Nason, located at the Woburn Pumping Station, observed that the 'absolutely safe' water from 'G' was needed because the city had 'taxed' its older wells during the winter.<sup>66</sup> In the fall, in response to complaints about water quality in East Woburn, Nason prepared a memorandum in which he commented about the low levels of Horn Pond and the Horn Pond aquifer, and recommended that until Woburn had an M.D.C. connection, Well 'G' should not be shut down.<sup>67</sup> His recommendation was concurred in by the Superintendent of Public Works who noted that the dry hot summer had badly depleted ground water supplies in the Horn Pond area.<sup>68</sup>

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Water was pumped from Well 'G' into the system up until January, 1971, when it was again closed.<sup>69</sup> On May 10, Well 'G' began pumping water again, only to be closed at the request of East Woburn Councilman Mahoney who said he was 'bombarded with calls of complaint' about the water. Mahoney noted that if the well had not been shut down, 'this would have been the fourth successive year that the residents would be compelled to use it for drinking and other household purposes, i.e., putrid, ill smelling and foul water.'<sup>70</sup> By July, however, as hot weather depleted the reservoirs, Well 'G' was again put into service.<sup>71</sup>

Complaints about water from Well 'G' appeared to subside for the remainder of the summer. The main problem mentioned in regard to water quality during the remainder of 1971 and into 1972 concerned sodium chloride (salt) in drinking water. According to John C. Collins, Director of the Division of Environmental Health, Woburn was 'one of the communities in the Commonwealth where corrective action is most needed to reverse the trend of increasing salinity.'<sup>72</sup>

Hot weather in the summer of 1972 again brought depletion of the Woburn water supply and warnings by Superintendent of Public Works Albert J. Wall that a 'ban' on certain water uses would be implemented or 'the controversial 'G' Well' opened again unless water users cooperated to reduce consumption. The Woburn Times editorialized that, 'It took long enough to close down the offensive 'G' well, and in our opinion, it should never be opened again to service homes in this city.'<sup>73</sup> Voluntary restrictions on water use appear to have avoided the crisis, and Well 'G' was apparently not activated in the summer of 1972.<sup>74</sup> A similar situation prevailed in the summer of 1973.<sup>75</sup>

Throughout 1972, 1973, and into 1974, under the leadership of the Woburn Conservation Commission, water quality questions focused on problems in Horn Pond rather than Well •G•. The initial concern involved the dumping of salt laden snow in and around the pond but extended to other contaminating substances.<sup>76</sup> In March, 1974, an extensive survey of Horn Pond conducted by Habitat, Inc. identified four of the major pollutants in the pond. High counts of chlorides, nitrates, phosphates, and coliform bacteria were noted, all at levels above those recommended by government standards for class B ponds (•drinking water•). The report observed that the •most critical problem that threatens the water quality of Horn Pond is the rapid accumulation of nutrients, particularly phosphates and nitrates, which stimulate the growth of aquatic weeds and algae.•<sup>77</sup> In addition, dissolved oxygen levels were low in the deeper ends of the pond. Among the pollutants identified were sewage, fertilizers, lead and road salt.

The summer of 1974 brought a return to the cycle of water shortages and threats to reactivate Well •G• by Superintendent of Public Works Wall.<sup>78</sup> On June 17, Woburn City Engineer Thomas J. Mernin wrote the Director of the State Bureau of Water Supply notifying him that the City was •considering its East Woburn Well Field for emergency water supply purposes. • He included copies of the chemical analysis and noted that he had been informed by Kenneth Tarbell of the Bureau of Water Supply (Tewksbury office) that the Bacterial Analysis for both wells was zero. The chemical analysis included the parameters of turbidity, sediment, color, odor, pH, alkalinity, hardness calcium, magnesium, sodium, potassium, iron manganese, silica, sulfate, chlorides, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, and copper.<sup>79</sup> Over the protests of Alderman Donald H. O'Brien, Well •G• was activated in August. Superintendent Wall admitted that the treatment of the water created taste and odor problems as well as discoloring sinks and tubs, but he insisted he had no alternative.<sup>80</sup> In fact, the severity of the drought compelled the City to consider activating Well •a• as well as •G•, a position that aroused a •storm of protest from East Woburn residents. •<sup>81</sup> Well •G• continued to feed water into the system until December, when the demands of Ward 5 residents as well as Alderman O'Brien, forced the city to again close the well.<sup>82</sup>

Throughout the 1970's, the solution to Woburn's water problems was consistently presented as a tie-in with the M.D.C. system. Legislative provision for this connection was provided at the end of 1971 and the beginning of 1972, and a contract signed in August, 1972.<sup>83</sup> The agreement called for Woburn to

purchase at least one-third of its water supply from the M.D.C. Construction of a water main connecting Woburn and the M.D.C. supply at Spot Pond in Stoneham was well underway when, in January, 1975, a fire destroyed the M.D.C. pumping station at Spot Pond, interrupting the Woburn connection. The city would be forced to depend completely on its groundwater supplies for some time. In view of this situation, Alderman Donald O'Brien attempted in February to commit the city to a summer water curtailment program in order to avoid use of water from Well G.85 He was unsuccessful in this regard.

The summer of 1975 again brought the now all-too familiar cycle of unusually hot weather accompanied by increasing demands on the Woburn water supply and threats and discussions in regard to reactivating Well G. After a hot spell in May, Well G was reactivated for three weeks.86 At the same time, George J. Coogan, Director of the State Bureau of Water Supply and Water Quality, warned the Woburn Board of Water Commissioners that water in Wells G and A was of poor quality. He wrote that analyses of the water showed that it contained elevated levels of nitrates, ammonia nitrogen, chlorides, sulfates, sodium, manganese and hardness and has poor physical characteristics in addition as evidenced by the test results for color, odor, turbidity and sediment. Coogan observed that his Department discouraged continued reliance on these sources to meet warm weather demands. He advised the City to seek more satisfactory sources of supply or treat these supplies completely to make them more acceptable.87 There is no evidence that Well G was turned on again during the remainder of the summer of 1975, perhaps because of the ineffectiveness of a water ban.88 However, because of a damaged pump in another well and a drop in the level of the reservoir, it was activated in November 1975, prompting the familiar complaints from residents of Wards 4 and 5 about taste and odor.89

The continual problems with the Woburn water supply and especially with Wells G and A resulted, at the beginning of 1976, in City Council establishment of a select committee to study the water problem and the appropriation of \$28,000 to fund a study of the causes of the odor and color problems in Wells G and A by Dufresne-Henry, Engineering Corporation of Vermont. Engineer L. M. Pittendreigh, who had worked on the Woburn water system for Whitman & Howard, was now employed by Dufresne-Henry and may have been responsible for the contract. Fifth Ward Alderman Bernard J. Golden, chairman of the council committee on water, saw the proposed study as either eliminating the wells or correcting their problems.90 Later in



the spring, various city departments agreed to cooperate on the •slue Water Project• seeking to restore Horn Pond, which was undergoing •rapidly accelerating deterioration of the quality of the water.91

The summer of 1976 found the Dufresne-Henry study in progress at the same time as dry conditions forced the reactivation of both Wells •G• and •a•.92 The Woburn Times editorialized that the failure to rectify the city's water problems were caused by the Mayor's deletion of funds from the budget for system improvements recommended by the Superintendent of Public Works. The Mayor's explanation was that the •taxpayers can't afford it.93 On June 24, the DWPC warned the city to •investigate treatment at G and H wells or to look for additional sources.94 Hope was expressed that the Dufresne-Henry engineers had found a solution to the problems of taste and odor.95

The Dufresne-Henry engineers maintained that the problems in the wells were caused by interaction between the chlorine added to the water to control coliform bacteria, and the manganese in the distribution system. As a solution to the problem, they suggested injecting air in perimeter wells to cause physical and chemical action in the ground water.96 In February, 1977, the Dufresne-Henry plan for dealing with the problems in Wells •G• and •a• was reviewed by Fred Barker of the Massachusetts Department of Environmental Quality Control (DEQE). Barker questioned the effectiveness of the method recommended by Dufresne-Henry and recommended that filtration of the water from the wells, not air injection, was the solution.97

During the summer of 1977, Dufresne-Henry investigated the possibility of a new well site between Wells •G• and •H•.98 At the same time, with the approval of the DEQE, Dufresne-Henry conducted tests of their air inaection system and suspended the use of chlorine in Well •G•. 9 In January, 1978, L. M. Pittendreigh of Dufresne-Henry reported to Superintendent of Public Works A. J. Wall that the suspension of the chlorine treatment had eliminated the taste and odor problems as well as eliminating complaints from East Side water users. The DEQE, therefore, lifted the chlorination requirement on condition that twice weekly samples were taken for coliform contamination. The DEQE, however, found that there were unacceptable levels of manganese in the ground water at •G• and •a• and asked that it be removed. This required the construction of a treatment plant at a cost of approximately \$1,500,000. Pittendreigh recommended that planning for a

treatment plant begin and that an additional gravel packed well be constructed between •G• and •H• so that •the full capacity of the ground water resource which exists in the Aberjona River Valley can be utilized. •such a project,• he added, •will forestall the need for complete reliance on MDC water for many years and will be more cost-effective and economical in the long run.100 Investigations for a new well drawing from the Aberjona groundwater and located between Wells •G• and •H• were already underway. The DEQE conducted tests of water from a sample well in this area identified as 1-77 and found •high concentrations of hardness, sodium, iron, manganese, sulfate, chloride, ammonia and C.C.E. suggesting that it lies in that same aquifer as Wells G and H.• The DEQE indicated that water from this site, if used as a public source, would •require treatment.101 [(C.C.E. or OC-A (Organics-Carbon Adsorbable Method) is carbon-chloroform extract, •a mixture of organic compounds that can be absorbed on activated carbon under prescribed conditions and then desorbed with the solvent chloroform.• It was used to identify •organic contaminants• (but not chlorinated solvents). The Fourteenth Edition (1975) of Standard Methods for the Examination of Water and wastewater, indicates that •special effort is needed to make this method useful for drinking water analysis.•)]102 In June, 1978, the DEQE approved the construction of the well as a source of water supply if the water were subject to treatment.103

On May 22, 1979, the DEQE informed the Woburn Board of Water Commissioners that analysis of samples of water from Wells •G• and •H• indicated •the presence of trichloroethylene concentrations of 117.6 ppb in the sample from Well H and 267.4 ppb in a sample collected from Well G respective.• Such concentrations, noted the DEQE •are significantly above the 10 (or 100) ppb maximum guidelines for trichloroethylene in drinking water established after consultation with the Massachusetts Department of Public Health and the Federal Environmental Protection Agency.• The DEQE advised that •the water from Wells G and H should not be used for public water supply purposes,• and that a •water emergency• was found to exist in Woburn. 104

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## FOOTNOTES

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## Chapter III

### A HISTORY OF POLLUTION OF THE ABERJONA RIVER

#### Introduction

The Aberjona River is part of the Mystic River system, one of the three major river systems which discharge their waters to Boston Harbor. It is the source of the Mystic and has its origins in a marshy area to the north of Reading, Massachusetts. It flows south through the towns of Woburn and Winchester and then discharges into the upper Mystic Lake. Along its route to the lake, the river travels through wetlands and boggy areas as well as undergoing several impoundments. Its major tributaries are Hall's Brook, Sweetwater Brook, and Horn Pond Brook; there are also other minor tributaries. Much of the Aberjona watershed lies in the buried preglacial valley of the Merrimack River and is underlain with deposits of permeable material. In 1973, the Massachusetts Division of Water Pollution Control described the Aberjona as, "somewhat unique in that by nature it is a 'leaky' river." That is, because the groundwater and surface water hydrologic systems are closely related, groundwater withdrawals for industrial and municipal use actually cause the river to experience losses of flow during its travel downstream!

The Aberjona River traverses an area that has historically been characterized by industrial development, most extensively in the town of Woburn. The various Woburn industries, especially the tanning industry and different branches of the chemical industry, have made use of the Aberjona for both process water and for pollution discharge. The use of the river as a discharge point has resulted in a long historical record of pollution. In most cases, the loudest complaints about river pollution have derived from the immediate downstream community of Winchester. The various Woburn industries have been identified as the chief polluters of the Aberjona by various state bodies, by academic investigators, by engineering consulting groups, by the press, and by various citizens groups, especially from Winchester. This chapter will discuss these reports and complaints concerning the pollution of the Aberjona for over a century.

#### The First Pollution Investigations and the Passage of Aberjona River Pollution Control Legislation: 1871-1911

The Massachusetts State Board of Health (MSBH) was founded in 1869 in order to develop a comprehensive program •to

prevent unnecessary mortality from all causes.<sup>2</sup> It was the first state board of health established in the nation. Early in its history it became concerned with the pollution of municipal water supplies by industrial and municipal wastes. One of the first studies it conducted in this regard involved the pollution of Mystic Pond and its sources (eg. the Aberjona River) by Woburn industries. From 1871 through 1911, the state investigated the growing pollution of the Aberjona a number of times. These investigations culminated, as will be discussed, in the legislation of 1911.

The prime sources of pollution in the Aberjona and its tributaries during this period were the tanneries and leather-related industries in Woburn and the chemical works. In addition, wastes from the Woburn Gas Works were also a problem. These pollution conditions were described in the annual reports of the MSBH and in special state investigations. The tanneries were located on tributary streams to the Aberjona such as Russell Brook, Town Meadow Brook, Willow Brook, on the Aberjona itself, and on Horn Pond. The large chemical works, Merrimac Chemical, was located near Willow Brook. The concentration of industries discharging into the relatively small streams greatly increased the scope of the pollution problem.<sup>3</sup>

Among the conditions noted in the investigations during this period were discoloration of water (the color and opacity of very foul sink-wash near one factory), offensive odors, and high chlorine counts. In addition, ammonia water and some tar were disposed of by the Woburn Gas Company into Russell Brook. Extensive fish kills were common and one report observed that, cattle have refused to drink the water of the Aberjona River.<sup>4</sup> The material dispensed of by the tanneries that appeared most dangerous to the investigators in the 1870's and 1880's was spent bark liquor containing gallate of iron that was injurious to vegetation and renders the stream useless for domestic purposes, and water-washings, lime, hen-manure and fleshings, which caused problems of smells. Some of the tanneries disposed of their liquor refuse by allowing it to flow into pits and thence to soak slowly into the gravelly subsoil...., a procedure disapproved of by the MSBH.<sup>6</sup>

In the first decade of the twentieth century conditions in the Aberjona and its tributaries continued to deteriorate. Complaints were heard most frequently from residents of Winchester concerning nuisances created by Woburn firms and the destruction of fish in the streams. The water in Russell Brook, where a number of tanneries were located, was particularly polluted. Refuse from a glue factory was also

found to be causing serious pollution in the Aberjona.<sup>7</sup> Protests over this pollution resulted in passage of two pieces of pollution control legislation by the Massachusetts General Court, one in 1907 (chapter 235) relating to Russell Brook or its tributaries and the other to the Aberjona River and its tributaries. The 1911 act was intended to prohibit the entrance or discharge of sewage into any part of Aberjona River, or its tributaries, and to prevent the entrance of discharge therein of any other substance which might be injurious to public health or might tend to create a public nuisance. A fine of not more than \$500 was established for each offense and the MSBH instructed to give advice on pollution reduction to any factory owner on the Aberjona or its tributaries.<sup>8</sup>

#### Chemical Wastes, Tannery Pollution, and Sewers: 1911-1956

During the years just before World War 1, and during and after the war itself, complaints about the discharge of oil and acid from North Woburn Chemical Works were added to those about tannery pollution and house wastes. In 1916 the Merrimac Chemical Company and its subsidiary, The New England Manufacturing Company, a manufacturer of picric acid, trinitrotoluol and trinitrophenol (TNT), were accused by the MSBH of polluting the river with acid and oil, killing the fish and giving it a green color. The MSDH, however, argued that while the acid drainage was objectionable for certain reasons, it was not injurious to the public health nor did it create a public nuisance.<sup>9</sup> By 1917 the chemical firms had taken action to reduce the acid discharge. Leachate from tannery wastes, effluent from a gelatine factory, and from piggeries, however, still polluted the river.<sup>10</sup>

In the post-war years, river pollution continued from firms in North Woburn. One source of pollution derived from chemical company wastes (salts of iron) that imparted a reddish color to the river while another was gelatine factory effluent that created a scum on the river. The greatest concern, however, was with tannery wastes.<sup>11</sup> According to the MSDH, the problem resulted from the reluctance of tanneries to build individual treatment works because of the possibility that a sewer might be constructed. Even those tanneries that attempted to treat their wastes were not especially successful. Several of the Woburn tanneries were connected to the Boston Water Board's Mystic Valley sewer, but others discharged their wastes to the river with minimal treatment.<sup>12</sup> As pollution increased, demands for construction of a sewer to

North Woburn, especially stemming from Winchester groups, grew.<sup>13</sup> (There were also many complaints from Woburn residents about tannery odors.) In the legislative sessions from 1921-23, several bills were introduced providing for sewer construction in the Aberjona River Valley as part of the Metropolitan District Commission (MDC) system. In each case, however, the bills were defeated because other communities viewed the legislation as an attempt by Woburn to shift the costs of a sewer it should be providing itself to the MDC.

While the State Attorney General had maintained early in 1923 that the industrial pollution of the Aberjona did not constitute a violation of the 1911 act, by the end of the year he had changed his position. On November 27, Attorney General Jay R. Benton informed the Commissioner of Public Health that the word "sewage" in the 1911 bill was "not limited to household wastes and human excreta, but includes filth and refuse from manufactories as well as from dwellings."<sup>14</sup> In July, 1924, the MSDH took action to prosecute five tanneries under the formerly dormant 1911 statute.<sup>15</sup> The Woburn Times warned that this action "seriously menaced" the Woburn tanning industry since the manufacture of leather required water and inevitably produced wastes.<sup>16</sup>

The MSDH believed that the ultimate solution to the Aberjona pollution problem was construction of a sewer connecting North Woburn industries to the MDC system rather than prosecution.<sup>17</sup> Faced with a difficult situation, the legislature finally approved an allocation to share the costs of the construction of an additional main sewer in the Aberjona Valley as part of the MDC system. Passage of the bill, however, did not guarantee expedient action and there were numerous delays and problems in construction. Throughout the late 1920s the Aberjona remained extremely polluted from tannery wastes. In 1927, a boom year for tanneries, more organic wastes entered the river than at any previous year for which there were records.<sup>18</sup> In 1929, with the sewer still not in operation, the State Board of Health brought injunction proceedings against two Woburn firms, charging them with polluting the Aberjona.<sup>19</sup> The injunction, however, appeared to be more a means to compel the city of Woburn to reconstruct a leaky section of the sewer it had constructed in 1927 than a serious move against the tanneries.

Throughout the first half of the 1930s, the attention of the MSDH shifted to discoloration of the Aberjona caused by seepage from chemical deposits at the now inactive plant of the Merrimac Chemical Company, (On Nov. 15, 1929, the Monsanto

Chemical Works purchased the Merrimac Company. From 1931-1934, no operations were conducted at the plant site. The New England Chemical Company purchased a large part of the site in 1934 and began construction of an animal hide glue manufacturing plant in 1934. The plant was started up in March 1935.)<sup>21</sup> The MSDH originally identified this seepage as coming from deposits of iron pyrites, but later suggested that other •partially-spent chemicals• were involved in polluting the river.<sup>22</sup> In its 1928 catalog, the Merrimac Chemical Company noted that it deliberately accumulated piles of chemical by-products (•industrial wastes•), in the expectation that a use for the by-product would eventually be discovered. It identified these by-product materials as calcium sulphate, oxide of iron, pyrites cinder, sulphate of lead, calcium carbonate, bauxite waste mud, •and others.<sup>23</sup> Merrimac was a producer of a wide range of chemicals, including arsenate of soda (used for insecticides), various acids, alumina compounds, sulphur compounds, sodium salts, and ammonias.

By the last half of the 1930s, the MSDH was again concerned with the problems caused by sewage overflow from the newly constructed but inadequate North Metropolitan Sewerage System. In addition to sewage flowing into the river from the surcharged sewer, industrial wastes from the tanneries, from a manufacturer of poultry feed, a maker of gelatine, and from a glue works were identified as polluting the river.<sup>24</sup> Conditions were so bad in 1937 that it was necessary to treat the river and part of the Upper Mystic Lake with chlorine. In addition, oil was sprayed on the river surface to prevent the emergence of insects because of the pollution.<sup>25</sup>

Correction of the Aberjona River sewer problems were the responsibility of the City of Woburn. The sewer overflowed in 1939 and 1940, and the MSDH called it a •menace to the purity of the water of the Aberjona River.<sup>26</sup> It warned that unless the city provided more adequate pre-treatment works for industrial wastes, kept the sewer clean, and provided a •more adequate• sewer, it would proceed against it under the 1911 act concerning pollution of the Aberjona.<sup>27</sup> While the war delayed any such legal action, in 1947 the Attorney General brought an action against Woburn to prevent it from polluting the Aberjona with human and industrial wastes that •created a condition injurious to the public health• and caused an odor. The city protested that the statute did not apply to a municipality, but the Massachusetts Supreme Judicial Court held otherwise.<sup>28</sup>

Forced to act, the city hired the Boston engineering firm of Metcalf & Eddy to study their sewer problems. Metcalf & Eddy found that the problems with the sewer derived from

inadequate maintenance by the city and the volume and composition of the wastes contributed to the sewer by the glue works of the Consolidated Chemical Industries and the John J. Riley Tannery. The engineering consultants recommended that the city institute a policy of regular cleaning of its trunk sewer and important branches and also regulate the discharge of industrial wastes in regard to quantity and quality. It also made certain technical recommendations to the Consolidated Chemical Industries and the John J. Riley Co. in order to reduce the flow of their wastes.<sup>29</sup>

The city thereupon began a program of regular sewer maintenance in regard to the Aberjona Valley trunk sewer, eliminating the periodic overflows that had plagued it since its construction.<sup>30</sup> Unfortunately, the material removed from the sewers was often left on the ground near the manholes furnishing a pollution potential when rainfall occurred.<sup>31</sup>

#### The Development and Discovery of New Pollution Sources: 1956-1984

During the period before the 1950s, pollution investigations of the Aberjona focused primarily on tanneries, runoff from waste piles on the old Merrimac Chemical Company site, and the sewer problem. The post-war years, however, saw a change, as was discussed in Chapter I, in the industrial mix present in the Woburn area, with a decline in the number of tanneries and a rise in the variety of firms conducting other forms of industrial activity. In addition, these years also witnessed a growing sensitivity to types of industrial effluents of relatively little concern in the past. What remained the same was that most protests about conditions in the river stemmed from Winchester groups. In June, 1956, for example, the Winchester Star published a front page article decrying conditions in the Aberjona. "This river of ours," editorialized the paper, "has to be seen and smelled to be believed." Later in the month a group of Winchester city officials and residents toured the river ("without benefit of gas masks") and then described the conditions they had found to MSDH and MDC officials. In places they found the river covered with "sort of a sludge" and discolored, while in others they found the banks covered with piles of industrial wastes and sewage. They visited a number of industrial plants and found conditions "that conceivably could contribute to the present condition of the river..."<sup>32</sup>

The result of the Winchester protest was an examination of "sanitary conditions" in the Aberjona by the MSDH. The engineers examining the river for the MSDH found that by the

criteria of dissolved oxygen standards, the river was of good sanitary quality at the time of examination, a period of high stream flow. They also noted that municipal and industrial water use probably added to low flow conditions in the summer and fall. While they found no sewers or industrial plants discharging directly to the river, they identified a drainage ditch at the Wilmington-Woburn line that carried a small volume of chemical wastes into the pond just east of the Dehydrating Process Co. as requiring action. The source of this discharge was identified as National Polychemical. In addition, they found that there was a constant, largely irreducible minor contamination...from surface drainage from farms, truck gardens, fertilized lawns and flower gardens, industrial establishments, and other sources inevitable in a heavily populated watershed. Among the direct sources of pollution identified, was drainage from North Woburn piggeries and from truck farms. In addition, the possibility existed of pollution through drainage from stock piles of raw products used in the industries, spillage from trucks transporting these raw products and accidental overflow of industrial wastes. The piggeries and the Woburn municipal dump at the head of Mishawum Lake were identified as being a particular drain on the river's oxygen balance.

The report also discussed the principal industrial wastes that were discharged to sewers and existing pre-treatment works. It noted, for instance, that the Beggs Cobb tannery had a pre-treatment plant of excellent design, that produced a sludge that was hauled by truck to a local dump. The Consolidated Chemicals Industries Division, Stauffer Chemical Company, which manufactured glue from hide and leather trimmings on the old Merrimac Chemical site, provided the largest waste flow of any plant to the Aberjona Valley Sewer. Sludge from the firm's pre-treatment facilities was placed in basins and lagoons. In regard to the J.J. Riley plant, sludge from the basins was pumped to a lagoon adjacent to the plant, while buffing dust wastes are discharged to a separate lagoon from which there is no outlet. All of the industrial waste pre-treatment plants except that of J. J. Riley showed varying degrees of neglect. The recommendations for improvements included more adequate collection and lagooning of piggery wastes, the collection and treatment of drainage from industrial stockpiles, and the removal of sewage cleanings from the river banks. No comment was made about the potential for groundwater pollution from the lagoons.33

One result of the renewed concern over pollution conditions in the Aberjona was a clean-up of the river bed and its banks by crews from the MDC. Booms were strung across the river to block the sludge that filled the river from floating down the stream and debris and sludge were removed from the water and the banks.<sup>34</sup> However, reports in the following years of river conditions suggest that the clean-up was only cosmetic and that the basic polluting problems remained. During the rest of the 1950s, and through the 1960s and early 1970s, several investigations reported the continuation of old pollution problems as well as a set of new ones. Wilmington groups sponsored two of these studies, while a third was conducted by a representative of the MSDH. Although the three reports differ somewhat in their conclusions and recommendations, they agree on the high degree of pollution from various industrial sources. Conditions in the river were exceedingly bad in the 1960s because of a combination of increased industrial development in the Woburn area and cycles of drought and flooding in the Aberjona River Valley, triggering concern by citizens groups. In 1955 and 1962, the region experienced damaging floods, while from 1963 through 1967, summer drought •caused objectionable conditions• along the river including a massive fish kill of undetermined origin in 1963.<sup>3</sup>

The Aberjona Watershed Committee of Winchester, reacting, as had previous Winchester groups, to conditions in the river, contracted with the Boston engineering firm of Camp, Dresser & McKee in July, 1967, to perform a study of the Aberjona. The report, issued in 1967, amplified many of the environmental problems noted by previous investigations as well as identifying some new pollutants not previously of concern to water quality investigators. Among these were wastewater overflow from National Polychemicals (a division of Stepan Chemicals) in Wilmington; high chloride content from street wash and from salt stock piles near the river; large stockpiles of inert material •with some form of sulfate on Stauffer Chemical property• that generated runoff that eventually reached the Aberjona; pollution of the river by Woburn piggeries that piled or buried their manure •wherever it is convenient to do so•; and odors from a gelatin plant. In addition, thermal pollution from two Woburn food plants was identified as a possible •factor in creating objectionable conditions during times of low flow.• The report notes that the use of pesticides in the Aberjona rivershed was minimal, although larvacide spraying was carried on for mosquitoes and both Winchester and Woburn carried on •fogging operations•..for insect control.• These were not held to •cause any significant pesticide pollution to the water of the river.• The report



recommended that a stream clearance project be undertaken; that pollution from the National Polychemical Plant, the Woburn piggeries, and the food plant thermal pollution be abated; and, that funds be obtained to install and operate pumps along the river to augment flow during dry summer months.<sup>36</sup> A 1969 study of the National Polychemicals site by a firm of consulting engineers noted that yard drainage, process area floor drainage, and all wastes except •the hydrazine scrubber liquor and the acid waste from the Kempore Process• were discharged into a creek tributary to the Aberjona.<sup>37</sup> Another study of the site performed by consulting engineers in 1980 found that all waste material from the plant eventually •either leached or drained into the ditch paralleling the Boston and Maine railroad tracks and proceeded ultimately to the Aberjona River. •<sup>38</sup>

Articles appearing in the Winchester, Woburn and Boston papers concerning water quality in the Upper Mystic Lake stimulated Robert M. Cady of the Northeastern Office of the Massachusetts Division of Water Pollution Control to perform a sanitary survey of the Aberjona and its tributaries in the summer of 1970. While Cady did not agree with all of the pollution sources identified by Camp, Dresser, & McKee, he identified some new ones not previously noted. For instance, Cady found that the Woburn food companies were not sources of thermal pollution and that the largest piggery had been abandoned and was not actively polluting the river. The second piggery identified by Camp, Dresser & McKee, however, was in poor condition and provided a potential source of •organic and coliform pollutants...during a vigorous runoff or thaws, as were buried pig carcasses and pig excrement on the site of former piggeries. • Camp, Dresser & McKee had described the Woburn Municipal Dump as •well operated• and •not a serious source of pollution to the river•, but Cady found that drainage from the dump had a high BOD (Biochemical Oxygen Demand), and high fecal and total coliform bacteria counts. Drainage from the dump, he noted, •will be a constant source of pollution until abated or at least lessened. •

Other specific Woburn or Wilmington industrial pollutant sources identified by Cady included a garage whose pits overflowed oil and grease into the Aberjona River; a barrel company that dumped fly ash and chemical residue onto the ground adjacent to a drainage ditch which drained into Lake Mishawum; a barrel company whose barrel cleaning operations spilled over into a railroad drainage ditch that eventually entered the river; and, piles of salt at a salt distribution center. In addition, the National Polychemicals Co. in Wilmington was identified as emitting drainage containing

salts, oils, formaldehyde, acids, and organic nitrogen compounds that polluted the waters of the Commonwealth. 39

Cady summarized his report by noting that Hall's Brook, a tributary to the Aberjona, gathered drainage from a number of the polluting industries on its way to the Aberjona. It also absorbed drainage from the abandoned pits and sludge on the Stauffer Chemical property. These pits contained wastewater with high levels of hexavalent chromium. Cady found that the drainage ditch from the Stauffer property into the Mishawum Lake contained the same black wastewater as was observed in the settling lagoons. The ditch also received drainage from the abandoned animal hide dumps. Cady recommended that his department become involved with elimination of the latter as well as instituting a thorough program of water quality sampling to ascertain the full condition of the Aberjona.40

An event not reported on by Cady but of possible importance in terms of its environmental impact was the draining of Mishawum Lake in December, 1969. The lake had originally been a swamp in the Aberjona system. It was first dammed in the seventeenth century with a mill dam to form the lake or pond originally called Richardson's Pond.41 The pond or lake furnished a water supply for North Woburn industries. Over the years it had become badly polluted by chemicals, was discolored (red), and emitted an odor. When the dam was breached in 1969, the lake's polluted contents flooded into the river system.42

In 1970, the year that the Cady investigation was made, the Massachusetts Division of Water Pollution Control and the MDC joined to sponsor formation of the Aberjona River Commission. The Commission proceeded to contract for a study of the river to be directed by Fred L. Defeo, a graduate student at Tufts University. Defeo and a group of Tuft's students conducted a careful study of the Aberjona watershed, identifying sources of pollution and potential trouble spots. To a large extent Defeo built on the previous Camp, Dresser & McKee and Cady studies, although providing a greater degree of detail. Defeo listed the sources of pollution by tributary. The variety noted indicates the extent to which many different types of firms in addition to chemical companies and tanneries were involved in pollution of the Aberjona. For instance, those identified as polluting Sweetwater Brook included a manufacturer of acids and solvents; a metal pipe and tool company; and a car wash and parking lot. Halls Brook was polluted from spillage from two barrel companies, the acidic wastes of a chemical company, the Woburn Dump, and by material

from the waste lagoons on the former Stauffer Chemical Company site. Some of the worst pollution entered from a drainage ditch that carried a variety of acids, oil and other chemicals from National Polychemicals, Inc., as well as from the Woburn Dump. In addition, the river and its tributaries were filled with a large amount of debris.<sup>43</sup>

Defeo also conducted analysis of the water quality, using the standard parameters of pH, alkalinity, suspended solids, chlorides, and coliform bacteria. He found that the river had a high acid content (blamed on National Polychemicals) for much of its upper length, high chlorides, and BOD. He also noted that the ground water in the area of the drainage ditch was highly polluted. Defeo recommended that the most important sources of pollution needing abatement were the Stauffer Chemical site, the Woburn Dump, and National Polychemicals. He noted that all three sources were on "implementation schedules" from the Division of Water Pollution Control, although problems were to continue into the future.<sup>44</sup>

In 1973, the Massachusetts Division of Water Pollution Control conducted a study of the Aberjona as part of a larger investigation of the Mystic River. The Division of Water Pollution Control observed that the Aberjona carried a much greater pollutational load in 1973 than in 1967, but higher flow conditions diluted the pollutant concentrations. It optimistically noted that reductions in ammonia-nitrogen, nitrate-nitrogen, and coliform bacteria as well as an increase in DO "shows the river is on its way to recovery." The report noted many of the same major polluters as had been observed in the 1967, 1970 and 1972 investigations. According to the Division investigators, the National Polychemical Company was no longer discharging its wastes directly into adjacent wetlands, but accumulations from past disposal practices as well as failures of its pollution control equipment continued to pollute the basin. In addition, leachate from the Woburn landfill continued to be a problem, draining into a ditch which entered Hall's Brook. Finally, the Industri-Plex Industrial Park construction was said to have provided a "temporary water quality problem on the Aberjona River", because of an increase in suspended solids. The report also noted that high concentrations of zinc, at levels "potentially lethal to game fish," had been recorded in Upper Mystic Lake, and that it appeared the zinc came from the Aberjona River. In its conclusions, the report was optimistic that the problems of the Mystic system and the Aberjona River would be solved by the end of the decade.<sup>45</sup>

The 1973 report, however, over-estimated the extent to which polluters of the Aberjona were controlling their waste flows. Several investigations during the 1970s noted, for instance, that direct pollution of the Aberjona from the National Polychemicals site (the Stepan Chemical Corporation after 1971) was continuing. In 1974, Robert Cady of the Massachusetts Division of Water Pollution Control reported that •the firm is still polluting the waters of the Commonwealth. Samples collected by Cady showed large amounts of ammonia and chloride, as well as other pollutants in the drainage ditch and in storm waters.<sup>46</sup> A 1976 study by the EPA showed a continuation of runoff with high nitrogen concentration and high BOD that affected the Aberjona and the Mystic Lakes. The nitrogen concentrations were at a level •toxic to fish,• while the high BOD caused dissolved oxygen (DO) depletion in the Upper Mystic Lake.<sup>47</sup> A further study of this site conducted for the EPA in 1980 found that seepage from the property of •at least one priority pollutant (dioctylphthalate)• into the Aberjona was probably occurring •by way of Halls' Brook Storage Area•.<sup>48</sup>

In addition to the continued pollution of the river and its tributaries from the National Polychemicals (Stepan site and later Olin), other pollution sources lowered water quality in the Aberjona. When the Metropolitan Area Planning Council issued its preliminary report for the Mystic River Basin in October, 1977, it found the entire length of the Aberjona in violation of its assigned water quality classification of Class B water (•suitable for bathing and recreation purposes, water contact activities, acceptable for public water supply with treatment and disinfection, are an excellent fish and wildlife habitat, has excellent aesthetic values and suitable for certain agricultural and industrial users.•) The river exceeded the EPA ammonia limit, with the Stepan Chemical Company suspected as the chief source of the contamination. Other named sources of pollution included the Woburn landfill; wastes from barrel companies; •drying beds• on the former Stauffer Chemical Co. site; and, discharges of metals and •possibly organic chemicals• from past and present industrial sites.<sup>49</sup>

Throughout the decade of the 1970s, newspapers in both Winchester and Woburn periodically featured stories concerning cleanups of the river by troops of boy scouts and other groups of citizens as well as warnings of various types of pollutants.<sup>50</sup> In addition, the records of both the DEQE and the EPA contain a number of letters concerning polluting acts committed by various firms in the river and its tributaries.

These included spills of oil and various hazardous chemicals and acids on the ground (and in the sewers also), and the improper storage of barrels with hazardous wastes, all of which had the potential of entering the river.

In spite of heightened enforcement procedures by both the DEQE and the EPA during the latter part of the decade and into the 1980s, the river and its tributaries remained in violation of Class B standards. The worst conditions were in two of the Aberjona's tributaries, Sweetwater Brook and Hall's Brook. According to a study performed by Camp, Dresser & McKee in 1981, the quality of Sweetwater Brook is often roughly equivalent to that of treated sewage in terms of BOD and fecal coliforms. Hall's Brook contained very high ammonia-nitrogen concentrations which remained elevated when the stream entered the Aberjona. Pollution conditions were especially acute during periods of low flow.51 In its latest survey of state water quality (1984), the Massachusetts Division of Water Pollution Control found neither the Aberjona nor the Mystic River as meeting its assigned Class B standard.52

## FOOTNOTES

1. Massachusetts Water Resources Commission, Division of Water Pollution Control, The Mystic River Part C (Boston: 1973), pp. 12-14, 29.
2. Barbara Gutmann Rosenkrantz, Public Health and the State: Changing Views in Massachusetts. 1842-1936 (Cambridge: Harvard University Press, 1972), p. 1.
3. Annual Report MSBH, 1874, pp. 127-129.
4. Annual Report MSBH, 1871, 387-389; 1874, 128; 1875, 357; 1876, pp. 242-244; and, Report of a Commission Appointed to Consider a General System of Drainage for the Valleys of Mystic. Blackstone. and Charles River. (Boston, 1886), pp. 14, 17-21.
5. Annual Report MSBH, 1875, p. 357.
6. Annual Report MSBH, 1874, pp. 127-129.
7. Annual Report MSBH, 1904, 106; Report of MSBH on the Purification of Mystic River ••• 1906, pp. 5-6 Winchester Star, Sept. 30, 1910.
8. •An Act to Provide for the Protection of the Public Health in the Vicinity of the Towns of Winchester and Stoneham and the City of Woburn, • Chap. 291, Acts, 1911, p. 252.
9. Annual Report MSDH, 1915, 249-250.
10. Annual Report Massachusetts State Department of Health (MSDH), 1915, p. 250, and *ibid.* 1916, p. 30, 286; Winchester Jan. 14, July 14, Aug. 4, 1916; and Report of the Joint Board on the Protection of Mystic Lakes, House Doc. No. 10, Jan., 1918.
11. Annual Report MSDH, 1923, p. 46.
12. Annual Report MSDH. 1922, pp. 43-44.
13. See, for instance, Winchester Star, Aug. 22, 1924; Woburn Times, Sept. 18, 1924.

14. Jay R. Benton, Attorney General, to Dr Eugene R. Kelley, Nov. 27, 1923, Henry Lee Shattuck Collection. Mass. Historical Society.
15. Woburn Times, July 19, 1924.
16. Woburn Times, Sept. 18, 1924.
17. Annual Report MSDH, 1924, p. 46; Report of the Department of Public Health Upon Certain Questions Affecting the Sanitary Condition of the Aberjona River and its Tributaries, House No. 238, Jan., 1926.
18. Annual Report MSDH. 1927, p. 30.
19. Woburn Times, Sept. 12, 1929.
20. See. for instance, Annual Report MSPH, 1929, pp. 32-33.
21. Stauffer Chemical Company, woburn Environmental Studies: Part I Report 1985. I-6-11.
22. Annual Reports. MSPH. 1932, p. 131; 1933, p. 133; 1934, p. 141.
23. Merrimac Chemical Company, Boston, 1928, p. 79.
24. Report of the Special Commission on the Investigation of the Discharge of Sewage into Boston Harbor and its Tributaries, House No. 1600, Dec., 1936 (Boston, 1937).
25. Annual Report MSPH, 1936, pp. 185-186; 1937, p. 191; and, Winchester Star, Jan. 22, May 21, and June 25, 1937.
26. Annual Report MSPH, 1939, p. 169.
27. Annual Reports 1940, p. 07.
28. Attorney General vs. City of Woburn, 322 Mass., pp. 634-638.
29. Metcalf & Eddy, Engineers, •Report to Mayor William Kane, Woburn, upon Investigation of Aberjona River Valley Sewer and Industrial Wastes Discharged There•, March 12, 1947.
30. •Engineer's Report: to MSDH, May 24, 1957, • in accord with Chap. 139, Resolves, 1956.

31. •Report of the Dept. of Public Health Relative to an . Investigation of the Sanitary Conditions of the Aberjona River and the Mystic Lakes,• under Chap. 139, Resolves, 1956 (June, 1957), p. 8.
32. See, Winchester Star, June 22, 29, July 6, 13, 27, 1956.
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## Chapter IV

### Tanneries. Piggeries. Municipal Waste. and Pesticides

#### Introduction

This chapter discusses several activities which may have contributed to environmental conditions in Woburn. These activities include waste disposal from piggeries and tanneries, as well as municipal refuse disposal and the use of herbicides and pesticides within the city.

#### The Tannery Industry

The Tanning Industry is an industry with a relatively long history. In 1869, there were over 7,000 tanneries in the United States, although by 1976 the number had shrunk to 298. As was noted in Chapter 1, the tanning and related leather industries were important in Woburn from the middle of the nineteenth century until after World War II. Tanning essentially involves the production of various types of leather from cattle hides, sheepskins and goatskins. The wastes from this industry have been ranked in the past as among the heaviest and most polluting of all industrial wastes.<sup>1</sup> They have been characterized as having a disagreeable appearance, a bad smell and a high degree of intractability.<sup>•</sup> In addition, the various tanning processes involved the use of chemicals that would today be characterized as hazardous.

The primary tanning processes, both of which took place in the various Woburn tanneries, can be generally characterized as vegetable tanning and chrome tanning. Vegetable tanning is used primarily for heavy leathers and chrome tanning for light. Vegetable tanning, using natural tannins was utilized almost entirely up until World War I.

Chrome tanning and other synthetic tanning materials developed around this period, and by 1977 approximately 85 percent of the leather produced in the nation utilized chrome process.<sup>2</sup> Tanneries, regardless of method, produced a heavy volume of wastes with a large amount of suspended matter. They included a variety of toxic and non-toxic material. The suspended matter included such constituents as hair, flesh particles and suspended particles of lime and calcium carbonate. These have a high BOD

(Biochemical Oxygen Demand). Tannery wastes were inherently putrescible and could become highly offensive in terms of odor. Spent tan liquors from vegetable tanneries produce high colors in receiving waters while wastes from chrome tanneries essentially lacked color. Among the toxic materials that could be present in the waste stream were arsenic, which was frequently used in the removal of hair from hides, and chromium (trivalent), which was present in the discharges of the spent baths of mineral tanning agents and in the sludge. In addition, other chemicals were present such as lime and sodium sulfide that could have negative effects on the environment and on the operation of biological sewage treatment plants.<sup>3</sup>

Chapter III of this report on the pollution of the Aberjona River has already observed how tannery wastes such as bark liquor, water-washings, lime, hen-manure and fleshings created offensive problems in the river and its tributaries in the late-nineteenth century. Considerable wastes were also disposed of on-site. The 1874 report of the MSBH noted, for instance, that some tanneries disposed of their "liquor refuse" by allowing it to flow into pits and thence to soak slowly into the gravelly subsoil...<sup>4</sup> Some tanneries instituted treatment processes for their wastes and disposed of the liquid residual in sewers, if available. Sludge from the chrome tanning processes however, was not permitted into the Metropolitan District Sewer and was piled on private dumps. In addition, in the pre-World War I period, these treatment processes did not necessarily work effectively.<sup>5</sup>

In the first decades of the twentieth century, the Woburn Times reported many problems with tannery wastes on site. Most of the reporting concerned the creation of offensive odors which constituted a nuisance and were said to lower property values.<sup>6</sup> Some tanneries deposited their sludge on dumps on private property while others kept it in catch basins for two months and then piled it on a dump near Russell Brook, producing "a very irritating, obnoxious odor." The Bay State Leather Company (formerly the Champion Company), for instance, deposited its sludge on an "inadequately underdrained open field, causing, according to the Woburn Board of Health, a nuisance and a menace to the public health..." Odors were also produced from its settling tanks and sludge beds.<sup>8</sup> When tanneries first received shipments of hides, hundreds of hides were hung on company fences to dry, and "blood, juice and other offal" collected in the street gutters. The fields adjacent to the railroad tracks were said to be "broad expanses of glittering patent leather."<sup>9</sup> The tanneries protested that the odor problems were a result of the absence of a sewer to

dispose of their wastes, but the existence of a sewer would still have necessitated a disposal site for sewer sludge from the chrome tanning treatment processes since they were not allowed in the sewers.

The use by tanneries of local dumps for sludge disposal continued well after World War II. An EPA sponsored national inventory in 1976 for instance, found that most tannery wastes were deposited in landfills or open dumps (60%), and the remaining 40% to trenches, lagoons and holding ponds.<sup>10</sup> Although the tanneries were greatly reduced in number after World War II, and although those that remained in Woburn improved their pre-treatment plants, they were still faced by the necessity of sludge disposal.<sup>11</sup> In addition, because of land use changes, present residential areas may be located in areas where tanneries formerly stood. There is at least one block in the city of Woburn that was the site of a tannery in 1918, but which had become largely residential by 1926.<sup>12</sup>

### The Woburn Piggeries

Another source of nuisances and threats to the public health from waste disposal in Woburn were the North Woburn piggeries. Although not an industry in the normal sense of the word, piggeries were still private operations conducted for profit that produced a waste product. In 1920 there were 37 piggeries in the city, and a number still remained after World War II. In the 1950s and 1960s, Woburn attempted to eliminate the piggeries, although there were still eight in 1965.<sup>13</sup> In 1957, the MSDH found that the piggeries were a source of direct contamination to Hall's Brook and the Aberjona. The pollution is evident to the eye. noted the report, in the form of turbid water, profuse fungus growth on banks and bottom and odorous scum accumulations along the banks.<sup>14</sup> In 1967, the piggeries located in North Woburn still constituted a problem. The largest piggery had about 1,000 pigs and the pigs were fed trucked-in and cooked garbage. The pig manure was piled or is buried wherever it is convenient to do so. Drainage from the piggeries was polluting the Aberjona River and Mishawum Lake.<sup>15</sup>

In May, 1968, an investigator for the MSDH reported that about 20 loads of decomposing pig manure had been removed from the site of a former piggery off Olympia Avenue in Woburn and dumped in a nearby marsh and small pond. This pond and marsh were drained by a flowing brook that drains into the Aberjona River upstream from the Rifle Range Wells. The distance from well H to the dumping site was, according to

the investigator, 1,700 feet.<sup>16</sup> In 1970, another MSDH investigator examined one of the remaining piggeries and found that •organic and coliform pollutants can originate from the farm intermittently, i.e. during vigorous runoff or thaws. The same investigator reported that a contractor excavating the Industri-plex site had •unearthed pig carcasses and pig excrement which was still quite odorous. •It can be thus assumed, he added, •that these former piggeries have contributed pollutants to the Aberjona Watershed ...<sup>17</sup>

### The Woburn Dumps and Landfill

Historically, in Massachusetts cities and towns, rubbish and ashes were usually disposed of in open dumps, often located on the fringe of the community. Material deposited here was usually burned. Garbage was often collected separately and fed to pigs. This was the pattern in Woburn until after World War II. In 1920, the city had an open dump used for rubbish deposit and burning that was located about five minutes north of the Commons on Winn Street. In addition, garbage was collected separately to be fed to pigs on a pig farm located about 1 1/2 miles from the Commons. From 1930-1935 a dump was maintained on Main Street in North Woburn, and from 1935-1954 another dump was operated on Mishawum Road. In the years before 1945, there were often complaints about nuisances from the dumps. In addition, throughout the 1930s and 1940s, residents registered hundreds of complaints each year concerning garbage and rubbish collection.<sup>18</sup> A number of private dumps also existed in Woburn, while dumping on open lots was not uncommon.<sup>19</sup>

The city of Woburn developed a dump in North Woburn after World War II. This dump was also an open burning dump. It had a history of •tires, odors, ro ents and hazardous conditions.<sup>20</sup> The dump accepted industrial wastes such as tannery sludge.<sup>21</sup> It was also the site for the deposit of potentially hazardous material from outside the city. In 1967 for instance, •Muck• from a dredging operation in the Mystic River in Somerville was dumped at the •old• city dump as well as at Newton Street and Olympia Ave. This material contained various proportions of sulfides. The MSDH •memorandum• concerning the mater al noted that •disposal of these materials near a ground water supply could be affected by leaching ...<sup>22</sup>

In 1965 the city began operating a dump at Merrimac Street and New Boston Street in North Woburn as a Msanitary landfill. Sanitary landfills involved the technique of

excavating trenches on a site, covering the wastes deposited there with the excavated fill on a daily basis and then compacting the material. The landfill was located in a swampy area that drained into a ditch tributary to Mishawum Lake and at the northern edge of the Aberjona aquifer. According to Woburn Mayor John W. Rabbitt, the landfill was never run properly because we dumped into brooks. It should have never been put there because it was in the middle of a wetlands area. In addition, no system was constructed to prevent leachate from entering the brook or the groundwater.<sup>23</sup> A report in 1970 noted, for instance, that drainage from the dump contained a high BOD, fecal and total coliform count.<sup>24</sup> Another study in 1971 reported that the landfill was actually operated as an open face dump, since the cover material is inadequate and poorly applied. In addition, material was dumped directly into the water surrounding the dump, draining eventually into the drainage ditch which led to the Aberjona.<sup>25</sup>

In addition to the poor drainage and conditions at the landfill, there were incidents specifically involving industrial wastes. In 1968 for instance, 25,000 gallons of paint deposited at the dump by a Malden manufacturer burned and exploded.<sup>26</sup> In July, 1971, investigators from the Woburn Conservation Commission reported that large quantities of sludge from animal hides processed for gelatin manufacturing was dumped on the ground. This material had formed a hard crust over a sticky innermass.<sup>27</sup> Actually, the gelatin company had been depositing its sludge at the landfill since 1966, causing problems primarily of odor and nuisances.<sup>28</sup> In September, 1972, the gelatin waste was among the complaints cited against the Woburn Landfill by the OEQ.<sup>29</sup> Because part of the area occupied by the landfill had been previously used as a dumping ground for chemical wastes, dump excavations created the potential for disturbing the wastes and creating a hazard. In October, 1969, for instance, residents of North Woburn threatened to bring a suit against the city because excavations in the dump in 1968 had permitted organic wastes containing chemicals from a processing plant in Woburn, rubbish and other refuse to contaminate the groundwater and their driven well.<sup>30</sup>

Throughout the 1970s, there was a steady stream of citations by the MSDH and the DEQE concerning the improper operation of the Woburn landfill. The most common citations involved improper operation and covering of daily refuse; inadequate spreading and compaction of refuse; inadequate disposal of waste sludge from the gelatine manufacturing process; dust; odors; inadequate drainage; inadequate

supervision; and maintenance of conditions favorable to the production of insects and rodents. Such violations, wrote the DEQE in 1983, "are contributing to leachate pollution of adjacent wetlands and causing a public health nuisance."<sup>31</sup> The landfill, observed the consulting engineers hired by the city in the summer of 1983 in response to a DEQE order to correct its deficiencies, had a "sad and sordid history." To rectify the situation "which is not only in violation of the statutes governing landfills, but is also far less than cost effective for the City," said the consultants, "will require an entirely new attitude and a commitment by the City."<sup>32</sup>

The Use of Herbicides and Pesticides by the City  
of Woburn and by the Boston and Maine Railroad  
on its Right-of-Way in Woburn

The use of chlorinated hydrocarbon compounds for herbicides and pesticides was extremely widespread during the post-World War II decades. The City of Woburn utilized various chlorinated hydrocarbons to control mosquitoes during the 1970s and probably before. Spraying of insecticides was also intended to protect against foliage-killing insects. The program began in the early spring and continued through the summer. At times spraying was so heavy that visibility was reduced. In August, 1973, for instance, an automobile struck a pedestrian reportedly because the "fumigating mist" was so thick.<sup>33</sup>

Spraying of trees was conducted in the morning by the Woburn Tree Department while the Woburn Health Department "sponsored" the mosquito "fogging" that was conducted at night. The insecticides used by the Tree Department consisted of three chemicals: malathion, methoxychlor and kelthane. To kill mosquitos the Health Department used malthion and kerosene. "The pesticide and kerosene mixture," wrote a Woburn Times reporter, "forms a fog which rolls along the ground and kills any adult mosquitoes." In the spring the Board of Health sprayed the wetlands with an insecticide called abate, developed to kill mosquito larvae. All of the insecticides, according to a Woburn Times article, were registered with the Massachusetts Board of Pesticides.<sup>34</sup>

These pesticides, however, as the Woburn Times article noted, included very toxic compounds among their breakdown products. Malathion, for instance, is a mixture of the chlorinated hydrocarbon aldrin, a pesticide, with other herbicides and insecticides. Widespread aldrin-dieldrin

contamination of biological systems appeared in the 1960s and in March 1971, the EPA canceled all federal registrations of products containing aldrin and dieldrin. In September, 1974, the EPA announced suspension of the use of aldrin/dieldrin except for termite control.<sup>35</sup> Methoxychlor is a chlorinated hydrocarbon insecticide of long residual activity. A DDT analog, it has relatively lower toxicity to mammals and does not bioaccumulate.<sup>36</sup> Kelthane (Dicofol) is an important analog of DDT and contains about 10 percent DDT. While it does not appear to degrade directly to DDT, it can degrade to 4,4-dichlorodibenzophenone (DPC), a pathway in common with that of DDT.<sup>37</sup>

Another important use of herbicides in the Woburn area was by the Boston & Maine Railroad in an attempt to control weeds along its trackage. Before the 1960s a common method of weed control was to spread diesel fuel oil on the trackage. Various herbicides were used in this period to inhibit and control weed growth. The substances used included chlorinated hydrocarbons. In the mid-1960s, the railroad contracted with professional weed control organizations to keep its tracks free of weeds. According to an officer of the railroad, "The development of environmental protection laws in the mid-1960s was one reason for which railroads and others elected to contract for services with professional applicators trained and qualified in the use of these products." During the 1970's the herbicides used by the railroad included bromacil, 2-4 D, monosodium methane arsenate, atratol, diquat, amdon, banvel, and EVIK.<sup>38</sup>



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