PLAINTIFF'S EXHIBIT

CAP-1034

REPORT ON ASBESTOS/CEMENT PIPE USE IN THE EAST BAY MUNICIPAL UTILITY DISTRICT

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REPORT ON ASBESTOS/CEMENT PIPE USE

IN THE

EAST BAY MUNICIPAL UTILITY DISTRICT

Objectives, Concept and Approach

East Bay Municipal Utility District (EBMUD) was the first of 20 water systems studied under the Municipal Analysis Program (MAP) of the Association of the Asbestos Cement Pipe Producers.

The objectives of the MAP 20-city survey are:

- o to document the performance of A/C pipe;
- o to compare A/C performance with that of other pipe construction materials; and
- o to identify research needs for the industry.

The purpose of the site visits, all to water systems serving 50,000 or more persons, can be summarized as the "conduct of an autopsy of A/C pipe." Information and data on all facets of a water system's operations relating to pipe use are being studied. The broad functional categories covered by this fact-finding mission are as follows:

- o Operations
  - Decisionmaking, Specification, and Procurement
  - Installation and Testing
  - Operation and Maintenance
  - Repair and Replacement
  - Detection and Prevention
- o Financial
- o Institutional

Data and information priorities have been established: operations data is more critical to accomplishment of objectives than financial which in turn is more critical than institutional.

The desired output or result of this survey is to build a comprehensive data base on A/C performance which can be used to develop technical bulletins, mount public relations or advertising

campaigns, or respond to Association member requests for user information.

Background on EBMUD Site Visit

The two-day site visit to EBMUD was conducted on January 5-6, 1982. The timing of the visit coincided with the heaviest rainfall in the San Francisco Bay Area in the past forty years. Numerous mud slides and flooding conditions resulted. Nevertheless, the site visit was only impacted moderately; the EBMUD crews were not installing pipe because of soft soil conditions and emergency responses which took precedence.

During the course of the visit, the following persons were interviewed:

Gordon Laverty, Manager of Interdepartmental Programs
Jerome B. Gilbert, General Manager
Richard Kolm, Acting Chief Engineer
Walt Ramos, Acting Manager, Distribution Engineering Division
Donald E. Crum, Manager, Maintenance Department
A. A. Langosch, Controller
James Close, Area Superintendent, Maintenance Department

Gordon Laverty coordinated interviews and made introductions and arrangements. Both he and Jerry Gilbert, the recently appointed General Manager, showed great interest in the project. EBMUD is willing to cooperate for several reasons: 1) they feel they have a responsibility to the water industry; 2) they feel they may learn something from AACPP visits to other utilities; and 3) they have a vested interest in A/C pipe (having more than 1000 miles in the ground) and want to protect that interest.

All EBMUD personnel were extremely courteous and cooperative. The investigator has studied many water systems in Canada, Europe, and the U.S. in recent years. EBMUD ranks in the upper echelon with respect to class of personnel and efficiency of operations.

General Background Information on EBMUD

The District is the second largest retail water distributor west of the Mississippi in number of customers. Its service area consists of a 305 square mile area, which includes much of the intensely urban developed areas of Alameda and Contra Costa Counties. The Utility District serves 16 incorporated cities, the largest of which are Oakland, Berkeley, Alameda, and San Leandro, and 14 unincorporated communities. Total population served is about 1,125,000 persons; there are 330,000 total service connections.

EBMUD was created by a vote of the people of Alameda and Contra Costa Counties in May 1923, under the provisions of the Municipal District Act of 1921. Broad powers to provide light, water, power, heat, transportation, and telephone service are granted under this Act, but the District presently exercises only those functions relating to water supply and recreation, and through its Special District No. 1, sewage disposal.

The District is governed by an elected seven-member Board of Directors. Each Director is elected by the voters in a particular District ward to a four-year term. The General Manager of EBMUD (since April 1, 1981) is Jerome B. Gilbert. Mr. Gilbert has reorganized the system since taking control, the principal change being a separation of the functions of water operations and maintenance. These departments previously were one department. An organizational chart is included as Appendix A.

EBMUD's financial condition is excellent. In fiscal 1981, operating revenues exceeded operating expenses by almost $16 million. Long-term debt ($138.8 million) amounts to only 26.6% of total capitalization ($521.3 million), a low debt-asset ratio for a public utility. System revenues from all services amounted to $56.3 million for the fiscal year ending June 30, 1981.

EBMUD employs more than 1100 persons, more than 950 of which work in the water system portion of operations. Total water consumption in 1980 was 67,179 million gallons, an average production of 184 mgd.

The Transmission and Distribution System

At the end of fiscal year 1980, EBMUD had 3449 miles of water distribution pipe in its system. Of this total, about 1060 miles were asbestos/cement pipe.

The District does not want a lot of different pipe construction materials in the system. Currently, they have about 1500 miles of cast iron, 1060 miles of A/C, 10 miles of PVC, and the balance in mortar lined and coated steel and miscellaneous (includes galvanized iron, wrought iron, screw and sheet metal pipe).

Asbestos/cement pipe use dates back to 1934 in EBMUD. Asbestos/cement is said to be the "bread and butter" pipe of the District. Of 48 miles of pipe purchased in an average year, approximately 35 miles (184,800 lineal feet) is A/C. A/C is purchased only in 6-inch and 8-inch sizes, however.

In fiscal year 1981, EBMUD installed 84,289 feet of 6-inch A/C and 55,135 feet of 8-inch A/C. The District also maintains an inventory of approximately 15,000 feet of 6-inch A/C and 6,000 feet of 8-inch A/C.

EBMUD has had negative experiences with 12-inch A/C. Supposedly, the problems occurred in instances in which A/C was used on steep slopes. When A/C fails, the potential water damage is much greater than a similar break in steel. The utility has, in its own words, "had to literally buy some houses" as a result of water damage. A subsequent result is that 12-inch A/C (of which they have 200,000 feet in the ground) is no longer purchased.

About five years ago, EBMUD began buying PVC pipe. The District wanted to test PVC in different soil conditions over a period of time. One of the reasons given for purchasing PVC is that it is a "hedge" against the use of A/C. The Utility District felt the need to do this partly as a result of publicity arising from a 1978 University of California doctoral thesis entitled "Asbestos in Drinking Water and Cancer Incidence" which "suggests an apparent correlation between water supplies high in naturally occurring asbestos and higher-than-expected cancer of some body sites."

The utility purchased about 19,000 feet of PVC in 1979, 20,000 feet in 1980 and 1981, and plans to purchase approximately 60,000 feet in FY-1982. There has been some discussion about making a wholesale switch from A/C to PVC. If such an occurrence takes place, it will probably be years away. Also, EBMUD officials feel the need to "hedge" on the use of PVC as well since manufacture and cost of PVC is inextricably linked to the availability and cost of petrochemicals. However, there is a trend toward increased PVC use. As an example, all repairs (except in steel) are made with PVC sections.

EBMUD uses a continuously welded steel cylinder with cement lining and coal tar coating in larger pipe sizes (12-30 inch). They have experienced few problems with this material.

No ductile iron pipe is purchased. The reason given is the high cost.

The budget for total pipelines installed was slightly less than $21 million in FY-81. Of this total, about $12 million was expended on transmission lines (20 inches and larger) while almost $9 million was spent for pipe installations of 16 inches and smaller.

Total miles of projected pipe installation in FY-82 through FY-86 amount to 54.3, 43.9, 39.5 41.0 and 39.5 miles per year. Of this total mileage of 218.2 miles, 69.2% (151 miles) will be for main extensions, 17.8% (38.9 miles) for replacement because of condition, 3.1% (6.7 miles) for replacement due to freeway work, and 9.9% (21.6 miles) for improvements. The total five-year budget for this proposed construction program (including an escalation factor of 8%) is $46,887,000.

OPERATIONS

Decisionmaking, Specification, and Procurement

The purchasing specification for all pipe construction materials is a function of the engineering department. The specification according to Messrs. Kolm and Ramos is "well established over years of experience." Soil characteristics and seismic conditions are the key external design considerations. The basic rule used is that where soil is stable, they will use A/C. There are several constraints placed on the use of A/C, mostly because of its brittle nature:

- The Hayward Fault Zone runs north-south through the area served and is continually moving; no A/C is used in a known fault zone.
- One area served by EBMUD (Harbor Bay Isle) is man-made, created by dredge and fill, and therefore is characterized by a high water table and considerable differential settlement. A/C is not used in this area.
- A/C is not used on steep slopes.
- A/C is not used in right-of-way areas for fear of damage by various types of contractors.

As a result of these constraints on use, A/C is now used only in paved areas.

Several types of soil characteristics are found in EBMUD service area--clay or adobe, loam, sandy, and rock and gravel. The clay soils are the most corrosive, accounting for almost 84% of the leaks in cast iron pipe. Thus, soil characteristics are a significant factor in pipe specification.

The low cost, light weight, ease of assembly, and essential freedom from corrosion were factors which led to large

scale usage of A/C pipe. According to the District's Chief Engineer, "it is the least expensive pipe that meets performance standards."

The District buys A/C Class 150 pipe only. This appears to be a result of evolution; however, it could be based on load factors. When the suggestion was made to Donald Crum, Manager of Maintenance Department, that some of the problems experienced with 12-inch A/C could be alleviated by specifying Class 200 pipe, he readily agreed--adding he had never thought of purchasing Class 200.

With regard to internal design considerations, the primary criterion is the static pressure in a given pressure zone. If the pressure does not exceed 140 psi, then A/C can be used safely. A/C is specified for service pressures of 40-140 psi. The minimum service pressure design is 40 psi with delivery at 33 psi static.

Although the District's engineers state that aggressiveness of water is not a design consideration, it is a standard District practice to add lime or sodium hydroxide to eliminate acidity in treated waters to make them non-corrosive. The District maintains an Aggressiveness Index of 12 or more to prevent corrosivity of water to A/C pipe.

Decisionmaking on Pipe Construction Materials

Technically speaking, the chief engineer is responsible for performance standards and selection of materials that meet those standards. EBMUD has a Pipe Committee which makes purchase recommendations. Persons from the engineering, operations, maintenance, purchasing, and finance departments are represented on the Committee. The final approval of all purchases by the General Manager is required.

There are virtually no consumer constraints on decisionmaking although there have been incidents in which the public protested the use of A/C. One such incident occurred in Berkeley a couple of years ago. A professor at the University of California vigorously protested the installation of A/C in his neighborhood. The entire section of pipe, recently installed, had to be excavated and removed after the professor protested to a Board member. Another public incident was the doctoral thesis on asbestos and cancer mentioned earlier. Members of the Board of Directors have on occasion questioned the use of A/C. But there appears to be no "groundswell" of opposition at present.

Method of Procurement

EBMUD purchases both A/C and PVC on an annual contract basis. It is not a fixed amount annual contract. Suppliers bid on the unit cost of materials specified and guarantee the prices for the life of the contract. Multiple deliveries are made as pipe is needed by the District. The purchase specifications note "the quantity of pipe specified is approximate only and may be increased or decreased in any amount to conform to the District's needs." The specification also notes the quantities will not vary by more than 50% plus or minus.

There are several interesting terms and conditions in the specifications. One such condition deals with re-testing:

> If the pipe is to be transshipped, the pipe and couplings shall be re-tested at the location of the last point of loading with certification of re-flex testing and re-hydrostatic testing per AWWA Standard C400-77.

Another pertains to transport method:

> The pipe and couplings will be transported from the point of final hydrostatic testing to the point of delivery only on pneumatic-tired trucks.

Both of these provisions were added to the specifications because of problems encountered as a result of rail shipment. The district was experiencing hairline cracks in rail-shipped pipe which did not show up until the pipe section was installed and hydrostatically tested.

All three major U.S. manufacturers of A/C pipe are on the acceptable bidders list, although Capco has only been on the list for about 15 months. There were only three bidders on the most recent procurement: Johns-Manville in San Mateo, Certain-Teed from its home office in Valley Forge, PA, and Groeniger and Company in Hayward (a Capco distributor).

Installation and Testing

Installation of distribution pipe is performed in one of two ways: District forces install the pipe or a so-called applicant's contractor installs it. In 1981, about 14 miles of pipe were installed by District forces, and 34 miles were installed by contractors retained by developers (applicant).

Standard specifications for installation of water mains 16 inches and smaller by the applicant have been developed by District engineers. The District supplies pipe materials, valves, hydrants, couplings and other appurtenances. The District also performs a rigorous inspection of installation, flushes and chlorinates the pipeline, flushes again after chlorination, tests for contamination, hydrostatically tests the section up to maximum pressure of 140 psi, and makes all service connections and wet taps.

The contractor is responsible for excavation and trenching, actual installation, backfilling, and compaction. The contractor also is responsible for restoring all damaged property including sidewalks and curbing "to a condition as good as it was when he entered upon the work."

The width of trench required for A/C pipe is 1.6 feet for 6-inch diameter pipe and 1.8 feet for 8-inch diameter pipe. The standard minimum depth of cover is 42 inches from the top of the curb. There is no maximum depth although the Maintenance Department Manager believes there should be.

The specifications call for "support of the pipe on the trench bottom by an earth mound at each of two support points located one-fifth of the pipe length from each end. The required clearance under couplings is two inches minimum. The pipe barrel is required to be supported clear of rock. All horizontal and vertical bends, dead ends, tees, and crosses are anchored with concrete in accordance with the manufacturer's installation guide. Watertight plugs are to be installed in open ends of pipeline at the end of each working day. Joints are assembled "according to manufacturer's instructions."

Tracer wire (AWB No. 12 TW solid) is required in all A/C and PVC lines. Identification tape, 3 inches in width, blue and black-imprinted with "CAUTION--BURIED LINE BELOW," is installed 1 foot above and along the centerline of all A/C and PVC pipe.

Backfill material specified is either select natural materials (selected by engineer) or natural sand or fine slurry quarry waste. In almost all cases, the backfill material used is a fine crusher run with the largest particles about 3/4 inch in diameter. Compaction is accomplished by jetting; at least 85% relative compaction as determined by California Compaction Test Procedure 216, or to densities equal to those of adjoining existing materials is required.

Recommended work practices are used by both District forces and applicants. The installation specification prohibits the use of power driven saws with abrasive discs for dry cutting or beveling A/C pipe. Use of compressed air for cleaning A/C also is specifically prohibited.

EBMUD performs all wet taps using a Mueller tapping machine or a modified shell cutter (developed by Don Crum). District forces install the gate valve and split tee or nozzle, and make the tap. The contractor then completes the service connection.

Installation Cost

In 1978, the District conducted a comprehensive study of the continued use of A/C pipe. Included as part of the study was an installation cost analysis of several alternate pipe materials. Table 1 shows the installation costs developed by EBMUD officials. A/C and PVC have virtually identical installation costs in the 6-inch diameter size, about $38 per installed foot; A/C is slightly less expensive in the 8-inch size ($44.92 versus $45.38 per installed foot).

These figures are now more than 3 years old; 1982 installation costs are not available, but are estimated at $50 per installed foot.

For planning purposes, the District estimates January, 1982 costs of various types of installations of distribution pipe as follows:

Category	Estimated Cost Per Mile	Cost Per Installed Foot
Applicant installation of main extensions	$135,000	$25.57
District forces installation of main extensions	225,000	42.61
District forces--main replacement	425,000	80.49
District forces--improvements	400,000	75.76
Main Replacement by Contractor	430,000	81.44

Obviously, 6-inch diameter pipe would be much less than this average set of figures while 16-inch pipe would be much higher than average. It is interesting to note that the cost of replacing a main is about twice as much as main extension.

CAPCO JEN 0023567

TABLE 1

EQUIVALENT INSTALLATION COSTS* OF ALTERNATE PIPE MATERIALS

(A.C., D.I. and P.V.C. Pipe is AWWA Class 150 - Steel Pipe is EBMUD Std.)

Number of Test Installations	Type of Pipe Material	Weight per Unit Length	Cost of Pipe to District**	Cost of All Other Material & Paving	Cost of Labor, Eqmt., Inspection & Other	Overhead Costs	Estimated Total Cost
	6" A.C.	161#/13 ft.	$2.20/ft.	$10.66/ft.	$13.84/ft.	$11.44/ft.	$38.14/ft.
(4)	6" DUCT IRON	338#/18 ft.	4.09/ft.	7.82/ft.	18.92/ft.	12.27/ft.	43.10/ft.
(7)	6" PVC PLASTIC (SDR 17)	110#/20 ft.	3.00/ft.	8.03/ft.	14.74/ft.	12.69/ft.	38.46/ft.
	6" ML & PCS	494#/30 ft.	4.02/ft.	13.75/ft.	19.29/ft.	16.02/ft.	53.08/ft.
	6" FG/PVC	42#/20 ft.	3.77/ft.	-	-	-	-
	6" AC VINYL***		2.62/ft.	-	-	-	38.56/ft.
	8" A.C.	244#/13 ft.	3.20/ft.	12.06/ft.	16.35/ft.	13.30/ft.	44.91/ft.
(1)	8" DUCT IRON	479#/18 ft.	5.55/ft.	16.29/ft.	17.82/ft.	12.82/ft.	52.48/ft.
	8" PVC PLASTIC (SDR 17)	190#/20 ft.	4.75/ft.	(No Data in District Files - Extrapolated from 6")			45.38/ft.
	8" ML & PCS	735#/30 ft.	5.19/ft.	13.67/ft.	20.38/ft.	16.90/ft.	56.14/ft.
	8" FG/PVC	66#/20 ft.	5.33/ft.	-	-	-	-
	8" AC VINYL***		3.76/ft.	-	-	-	45.47/ft.

* All Job Costs Have Been Adjusted to 1978 and Include Length & Severity Factors.

** Based on Suppliers Quotes and Purchasing Records, P.S.L. 12/15/78. Other A.C. & Steel Pipe Costs are Derived from Standard Cost Tables.

*** Asbestos Cement Pipe with Vinyl Lining at an estimated cost of $0.07/inch/foot Added to the Pipe Cost. Manufacturers Refused to Quote Since This Option May Not Be Available at this Cost on the West Coast.

CAPCO JEN 0023568

Ease of Installation

As noted earlier, there are several test installations of PVC in the District. When asked their preference as to ease of installation, PVC or A/C, the response was mixed. The A/C coupling will flex, thus allowing it to be used in a curvilinear street. The PVC is longer (by seven feet), and the pipe itself will bend, but not the joint. PVC is somewhat lighter than A/C. However, A/C couplings slip into place more easily than the PVC joints.

A/C is not used in downtown areas with lots of deflections because concrete anchors have to be installed at each deflection joint. This is not only costly but also adds a potential for a snap break.

Operation and Maintenance

EBMUD has an excellent maintenance department which has a number of innovative practices and programs. As mentioned earlier, the District has considerable external corrosion problems resulting from adobe soils. EBMUD began summarizing their "history of leaks" in an annual main leak repair report twelve years ago. To combat corrosion, they initiated a program in 1969 of installing magnesium anodes anytime a metallic pipe is exposed for repair. Some 4460 anodes have been installed in the 12-year period. This policy of anode installation has two purposes: to protect pipe already damaged by corrosion and to provide a relatively inexpensive method of protecting pipe from future corrosion.

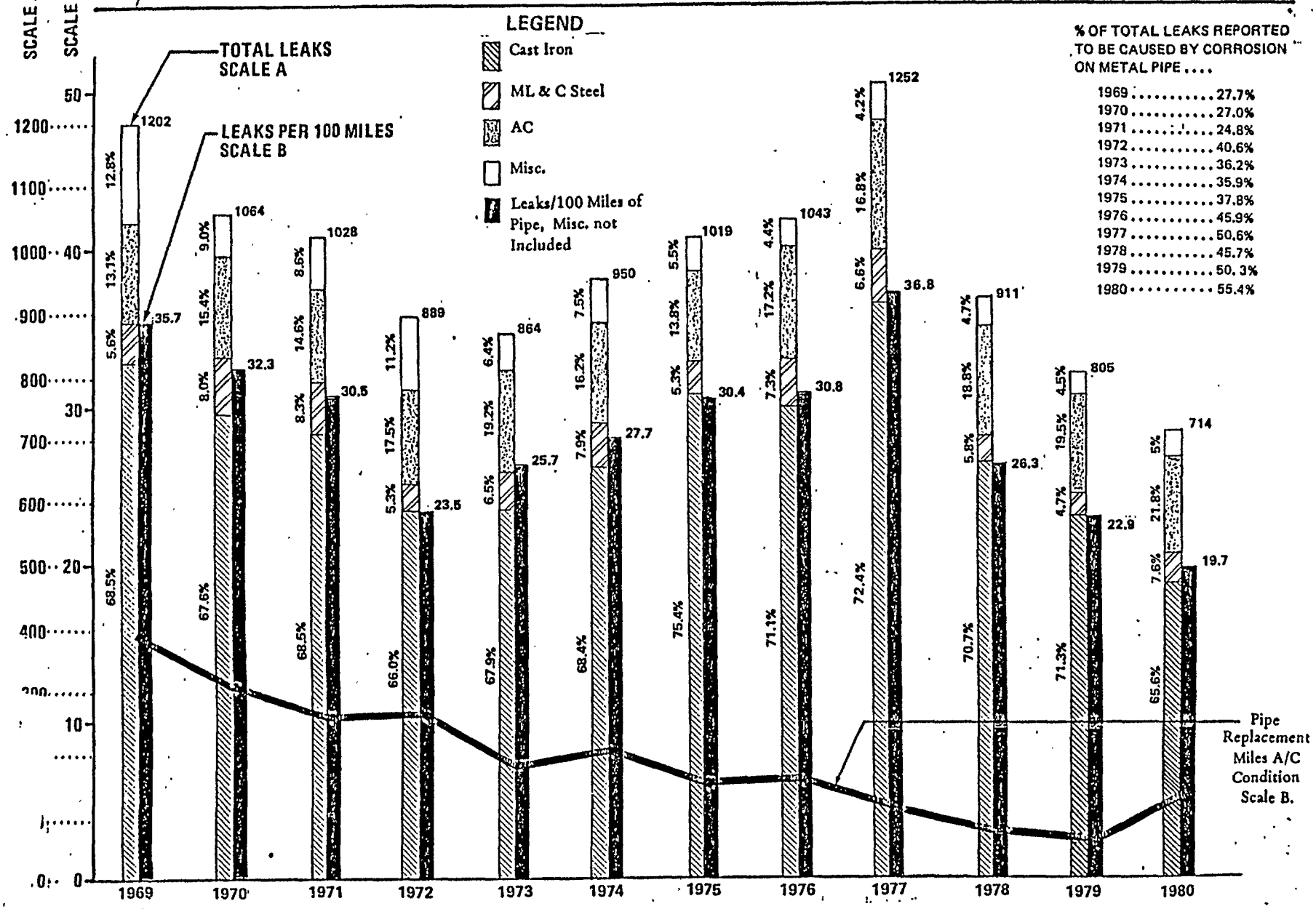
A bargraph summarizing the leak frequency over the past dozen years is shown on the following page. The frequency of leaks has decreased each year for the past three years since the number peaked at 1252 in the drought year of 1977. In 1980, 714 leaks were recorded. Of this total, 156 leaks or 21.8% occurred in A/C pipe. The largest number by far was in cast iron--a total of 468 (65.6%). The District's corrosion engineers estimate that 260 of 468 cast iron leaks (55.4%) were due to corrosion.

With the average age of cast iron pipe increasing each year with only a few miles being replaced on an annual basis, water system engineers feel that 714 annual leaks is very low. Though their corrosion report does not openly state a fear of large scale problems with the old CI mains in the future, it is implicit.

Summary of Leaks

1969 - 1980

EBMUD



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CAPCO JEN 00023570

With regard to A/C leaks, the following data can be extracted from the leak report provided:

- Almost half (75 of 156) of the leaks occurred in clay soil.
- There is no pattern as to the clockwise position in which breaks occurred.
- The number of A/C leaks per 100 miles of pipe ranges from a low of 11.8 in 1972 to a high of 22 in the drought year of 1977. The number has decreased in each of the past three years from 22 to 14.7. Leaks per hundred miles of CI are about twice those of A/C (29.5) while leaks in steel are about one-half the total of A/C (6.9 per 100 miles).
- Most A/C repairs (73.8%) were made with leak clamps. A pipe section was replaced in 10.9% (17) cases.
- Almost half (45.6%) of A/C leaks in 1980 were circumferential; only 18 of 156 (11.5%) were described as being "large holes." Seventy-three such breaks occurred in cast iron.
- In 81.5% of the cases, the part of the A/C pipe damaged was the barrel (as opposed to joint, valve, etc.).

A second pattern to main breaks has been observed. The 5-year leak average reveals most leaks occur in December and January(70-90 each). The frequency decreases to about 50 in the period March through July, rises in August and becomes erratic until rising dramatically in mid-November.

EBMUD records show an "unaccounted for water" percentage of about 9%. Although the District expends almost 2 man-years per year on leak detection and location, Gordon Laverty does not believe the 9% figure to be correct. He does not believe the meters at the seven District filtration plants are accurate enough to allow accurate quantification.

The engineering department was questioned about the changes in C-factor of various pipe materials over time. Richard Kolm, Acting Chief Engineer, noted C-factors were virtually the same in A/C, PVC, and iron. This is a bit difficult to believe, but is conceivable given the District practice of maintaining an Aggressiveness Index of more than 12.

Repair and Replacement

Repair

EBMUD classifies mainbreaks as either major or minor, depending on the type of repair required. If only clamps, couplings, anodes or a combination is used, it is considered a minor break. A major break is one in which pipe is cut in and/or tees, gates, or sleeves are installed.

In 1980, the following types of breaks were recorded:

Material	Major	Minor	Total
A/C	27	99	126
Cast Iron	108	167	275
Steel	4	23	27
PVC	0	1	1
Mortar Lined and Coated Steel	1	5	6

Most of the A/C breaks (88 of 126) were in 6-inch pipe. This is to be expected since the water system has more 6-inch pipe in the ground. Of the 27 major breaks, 20 were in 6-inch, 5 in 8-inch, and 2 in 4-inch A/C.

The average repair cost for a major A/C break was $1267.32 while the average cost for a minor break was $856.59. The average cost per break was $951 compared to $524 per break for CI and $1232 per break for steel.

Total A/C repair costs in 1980 amounted to $118,840. Cast iron repair costs were almost twice that, or $209,419.

The total cost to the District for mainbreaks in 1980 was $392,874. Costs include labor, equipment, material, rock, and paving. Labor costs constitute 47.4% of total repair costs.

Replacement

The rate of replacement of water mains has declined markedly since the 1950's and 1960's. The solid horizontal line on the bar chart shown on page 11 accurately portrays the replacement trend in the past dozen years. Main replacement has steadily decreased from about 15 miles in 1969 to lows of 2.4 miles in 1979 and 3.1 miles in 1980. The shorter total lengths in these years reflect the Utility District's efforts to reduce cash flow requirements.

CAPCO JEN 0023572

The amount of pipeline replacement work done by District forces is governed by staffing levels and availability after giving first priority to necessary pipeline installations such as freeway and street improvement, and installations to serve new development. Replacement "on account of condition" is expected to range from 5.5 to 8.8 miles per year with an average of approximately 7.5 per year; this level depends on maintenance of current staffing levels.

In FY-82 (July 1, 1981 to June 30, 1982), about 6 miles of mains will be replaced, 5.8 due to condition and 0.2 miles because of freeway construction or expansion.

EBMUD conducts a vigorous benefit/cost analysis before replacing pipe. Repair costs are compared with numerous benefits including reduced annual repair costs, elimination or reduction of property damage liabilities, reduced rusty water calls, increased hydraulic capacity, better fire flow which could result in lower insurance premiums, and even improved public relations.

Detection and Prevention

The EBMUD leak detection program was initiated in the mid-1970's long before the idea caught on in other parts of the country. The leak detection program was initiated in February 1974 as a result of concern over the unaccounted for water percentage level (8-10%). The EBMUD program coincided with the start of two of the worst drought years in the history of Northern California (1975-76 and 1976-77).

The District program involves a systematic coverage of the entire distribution, utilizing Heath Son-i-Kit equipment. During the drought years, two or three crews (3-6 persons) were devoted to "prospecting" for leaks.

Current level of effort is two persons. One man performs prospecting/surveying--detecting leaks using the sonic probes. A second man works with crews in locating hard-to-find leaks.

In June 1978, one complete survey of the District's then 3300-mile distribution system was completed. A total of 5855 leaks were located, and 5531 were repaired; the difference (about 1% of leaks) could not be found by repair crews.

EBMUD estimates savings or benefits at $1,209,902. This figure is based on the assumption that the water lost through leaks would have been sold at the rate of $0.29 per 100 cubic feet.

Annual cost of the program amounts to $157,000. Dividing the annual savings by the annual costs yields a benefit/cost ratio of 7.7.

The District is currently considering the purchase of more sophisticated (and expensive) equipment. Even with the increased costs of the equipment (about $50,000), officials believe they can increase the benefit/cost ratio in the future.

FINANCIAL

The purpose of this report section is to provide information on 1) how the District pays for main extensions and replacements and 2) comparative bid data for both A/C and PVC.

In FY-81, the District installed 14 miles of pipe using its own work forces. The material, equipment, and labor cost were paid for using revenues. No financing was necessary. These pipe purchases and installation are part of the operating budget.

The remaining 34 miles were installed and paid for by developers. In the past, EBMUD did not require a 100% contribution by developers. However, there is increasing pressure by the public to have developers pay all costs of installation. Since there are always numerous applications pending, the District is struggling with the questions of equity or "when do we make the shift from a 70% to a 100% contribution level." It is safe to assume that developers will pay 100% of installation costs in the future.

Comparative bid data were obtained for both A/C and PVC. In larger quantities, EBMUD has found PVC prices to be competitive with A/C. Inspection of recent bids (July 22, 1981 for A/C and Oct. 7, 1981 for PVC) shows A/C and PVC to be virtually equal in cost per linear foot. A comparison of the two bids is shown below:

Item	Winning Bid	Terms of Winning Bid
20,000 linear feet, 6" PVC Class 150 pressure pipe	$2.42 lin. ft. $48,400.00	2% 25th prox., after deducting freight
85,500 ft., 6" AC pipe, 13' lengths, with couplings and rubber rings installed	$2.45 lin. ft. $209,475.00	2% 10th prox., net 30th prox.

CAPCO JEN 0023574

In 8-inch diameter pipe, A/C is 11.5% lower in cost.

Item	Winning Bid	Terms of Winning Bid
54,000 ft., 8" AC pipe, 13' lengths, with couplings and rubber rings installed, Class 150	$3.65 lin. ft. $197,100.00	2% 25th prox., net 30th prox.
13,000 linear feet, 8" PVC Class 150 pressure pipe	$4.07 lin. ft. $52,910.00	2% 25th prox., after deducting freight

In calculating life cycle costs, storage costs must be included. EBMUD's purchasing department adds 17% of purchase price to the unit price to account for storage costs of inventory.

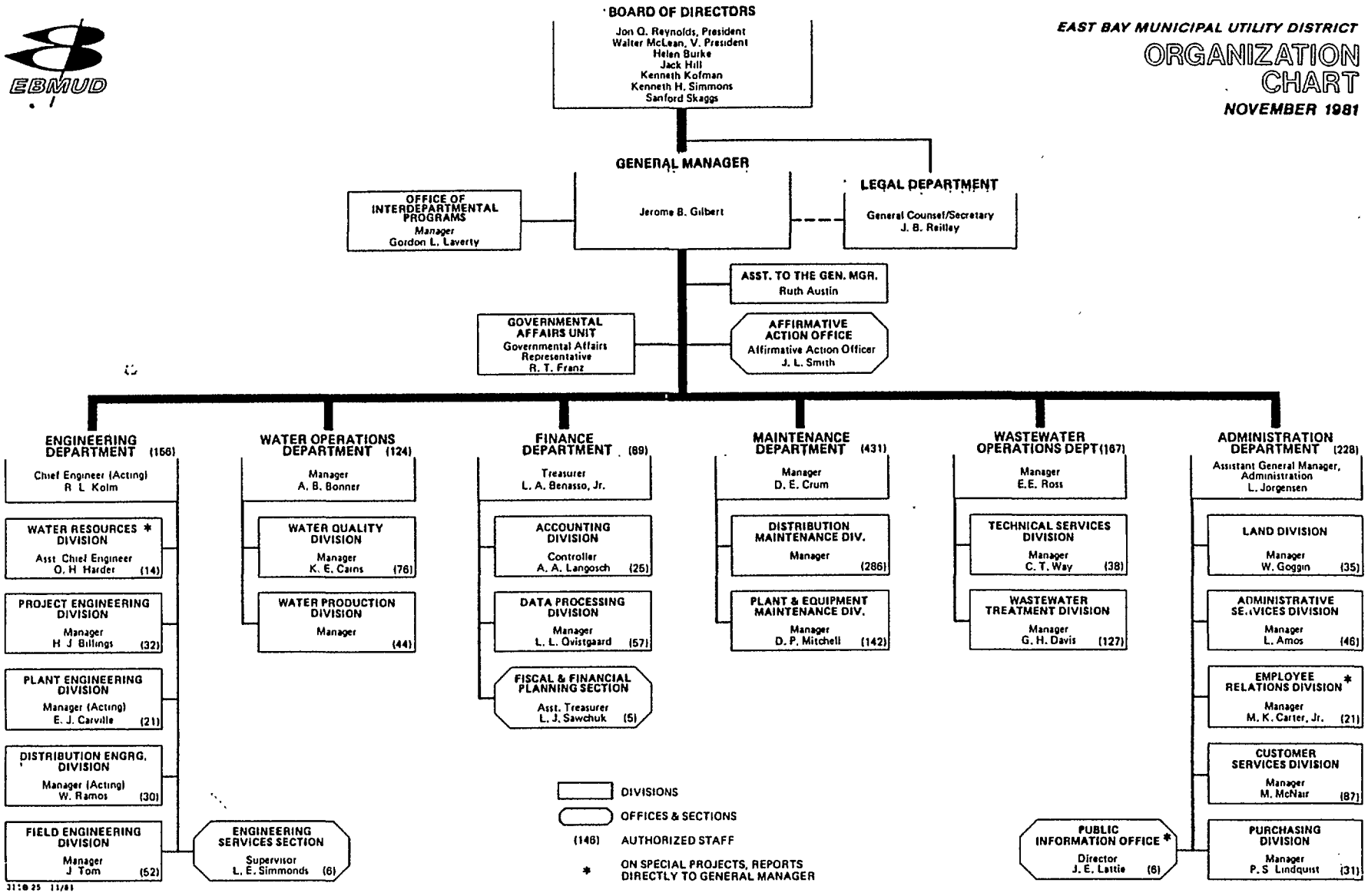
A/C pipe is depreciated on a 50-year schedule, though this would seem to be low. Cast iron has an expected life of 75 years as does steel. Plastic pipe's expected life also is estimated at 50 years.

SUMMARY AND CONCLUSIONS

A/C pipe is the "bread and butter" pipe of EBMUD. An annual purchase of 25-35 miles of A/C can be expected to continue in the future.

There is one cause for concern, however, and that is the trend of PVC. The annual purchase has been tripled in 1982 from 20,000 to 60,000 feet.

With regard to performance, East Bay officials are quite pleased with A/C. Most mainbreaks are attributed to poor installation, contractor damage when making repairs to other utility services, differential settlement, and some snap breaks. EBMUD feels imposition of constraints on where A/C can be used allows them to minimize problems while maximizing benefits.



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