INDUSTRIAL WASTE SURVEY

CENTRAL SCREW COMPANY
Keene, New Hampshire

September 26 - 27, 1972

At the request of the Enforcement Branch, and with the permission of Mr. L. W. Hewitt, Plant Manager, U. S. Environmental Protection Agency Region I personnel collected samples of the plating operation waste water discharge of Central Screw Company, Mill Brook, and the Ashuelot River on September 26 and 27, 1972. The main objective of this survey was to study the effect of the waste water discharge upon the receiving water and the Ashuelot River for a possible enforcement action against the company under Section 13 of the River and Harbor Act of 1899 (USC 33 §§ 407).

Central Screw Company

Personnel from the Environmental Protection Agency, Region I, interviewed Mr. L. W. Hewitt, Plant Manager of Central Screw Company, on two occassions: June 29, 1972 during a reconnaissance survey conducted by personnel of the Enforcement Branch, and September 26, 1972, the date of the sampling survey. These discussions concerned the nature of the production process and the waste water discharge to Mill Brook.

Central Screw Company produces metal screws and special fasteners made of steel, stainless steel, and copper-base alloys. The plant operates twenty hours per day, five days per week, and employs about 200 persons. Steel is used at the rate of approximately 14,000 pounds per day.

A wax-base lubricating oil is used in the screw-making process to reduce wear on the machine. This oil is recycled until it becomes too dirty for reuse.

The spent oil is stored in a 2,000 gallon tank until it is hauled by truck to the municipal sanitary landfill.

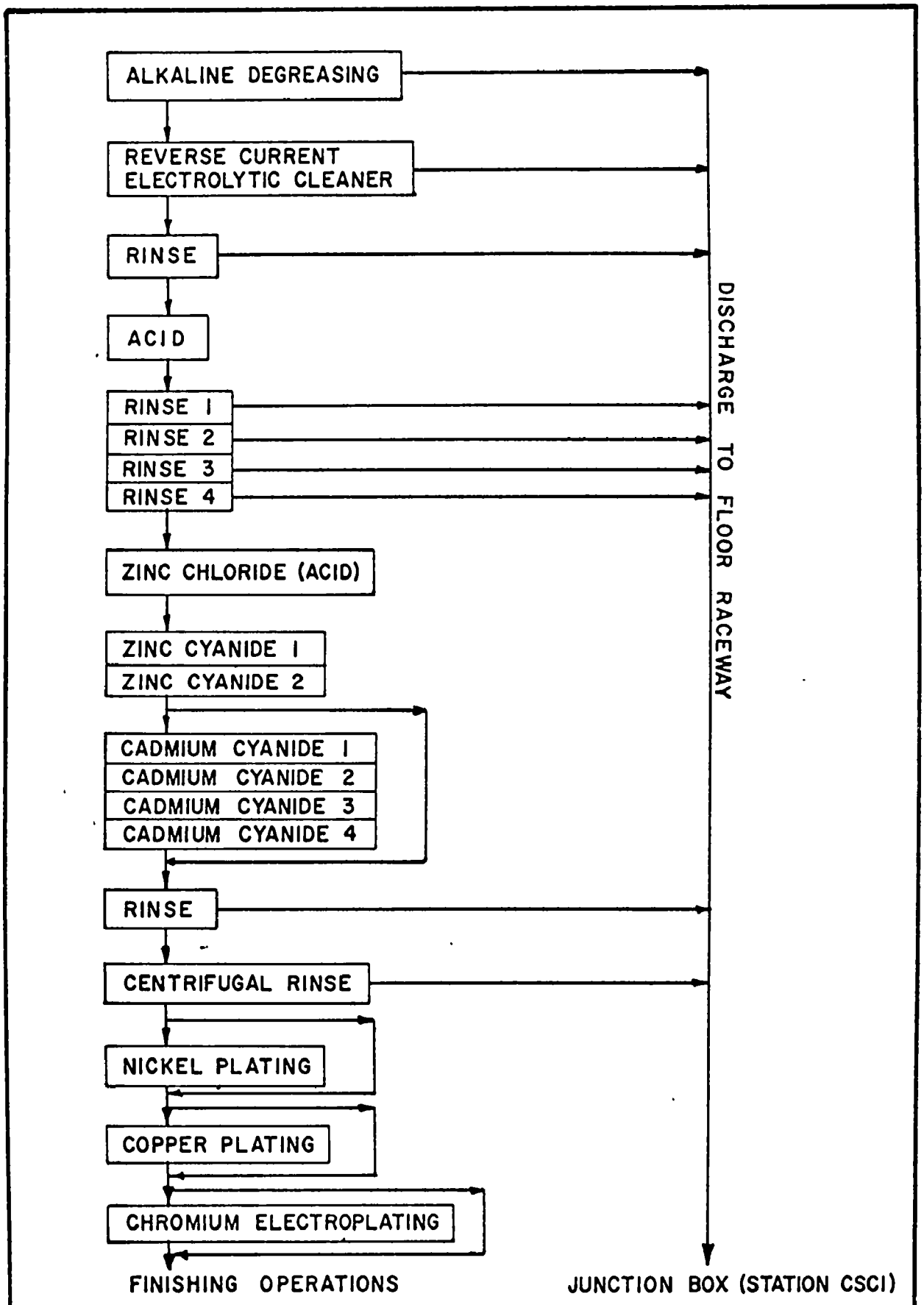
Most of the waste comes from the plating process operation which consists of cleaning, zinc and cadmium baths, and nickel, copper and chromium plating. There are six constant over-flow water-rinse baths plus a centrifugal water rinse all of which produce a constant waste water flow and two alkaline degreasing baths which are dumped periodically (approximately every two weeks). Figure 1 shows a schematic diagram of the plating process operation.

Dye studies performed on September 27, 1972 revealed that waste water from the various baths is collected in floor raceways and transmitted via a clay pipe for approximately 1,000 feet to Mill Brook. Neither the town nor Mr. Hewitt know of any other tie-ins to this pipe.

A possible air pollution problem is produced by the heat treating carbonitriding and case hardening operation. This finishing process consists of a recycled quench which is kept cool by circulating water through cooling coils. The water leaving the heat exchanger is discharged uncontaminated to the plating rinse baths at about 80°F. However, this process, also known as "gas cyaniding" may have toxic emissions to the atmosphere. The cyanide salts carried over from the plating operation decompose into carbonates. If these carbonates are carried into the atmosphere, they can combine with atmospheric moisture to form toxic compounds. Heat treat furnances are major sources of cyanide, nitrogen oxides, carbon monoxide, and metallic oxide emissions.

Sampling Information

Only the waste water from the plating room was sampled. This sampling point, Station CSC1, was located inside the building at a junction box before



CENTRAL SCREW COMPANY
PLATING PROCESS FLOW DIAGRAM

FIGURE 1

the waste entered the clay pipe. Approximately 400 gallons per day of boiler water enters this pipe between the junction box and the outfall to Mill Brook; this boiler water was not sampled. Samples were collected at Station CSC1 approximately every one-half hour for four hours and composited proportionate to flow. The effluent flow rate was calculated on the basis of measurements taken in the junction box. Grab samples were also collected at this location. In addition, grab samples were collected in Mill Brook upstream (MBO 1) and downstream (MBO 2) from the outfall, and in the Ashuelot River upstream (ASR 1) and downstream (ASR 2) from its confluence with Mill Brook. Table 1 describes the sampling stations. Figure 2 is a sketch of the general area showing all sampling locations.

All samples were collected, preserved, and analyzed according to "EPA Methods for Chemical Analysis of Water and Wastes, 1971."

The EPA Region I chain of custody record system was used to insure the integrity of the samples. Analyses were performed at the New England Regional Laboratory in Needham, Massachusetts.

Results

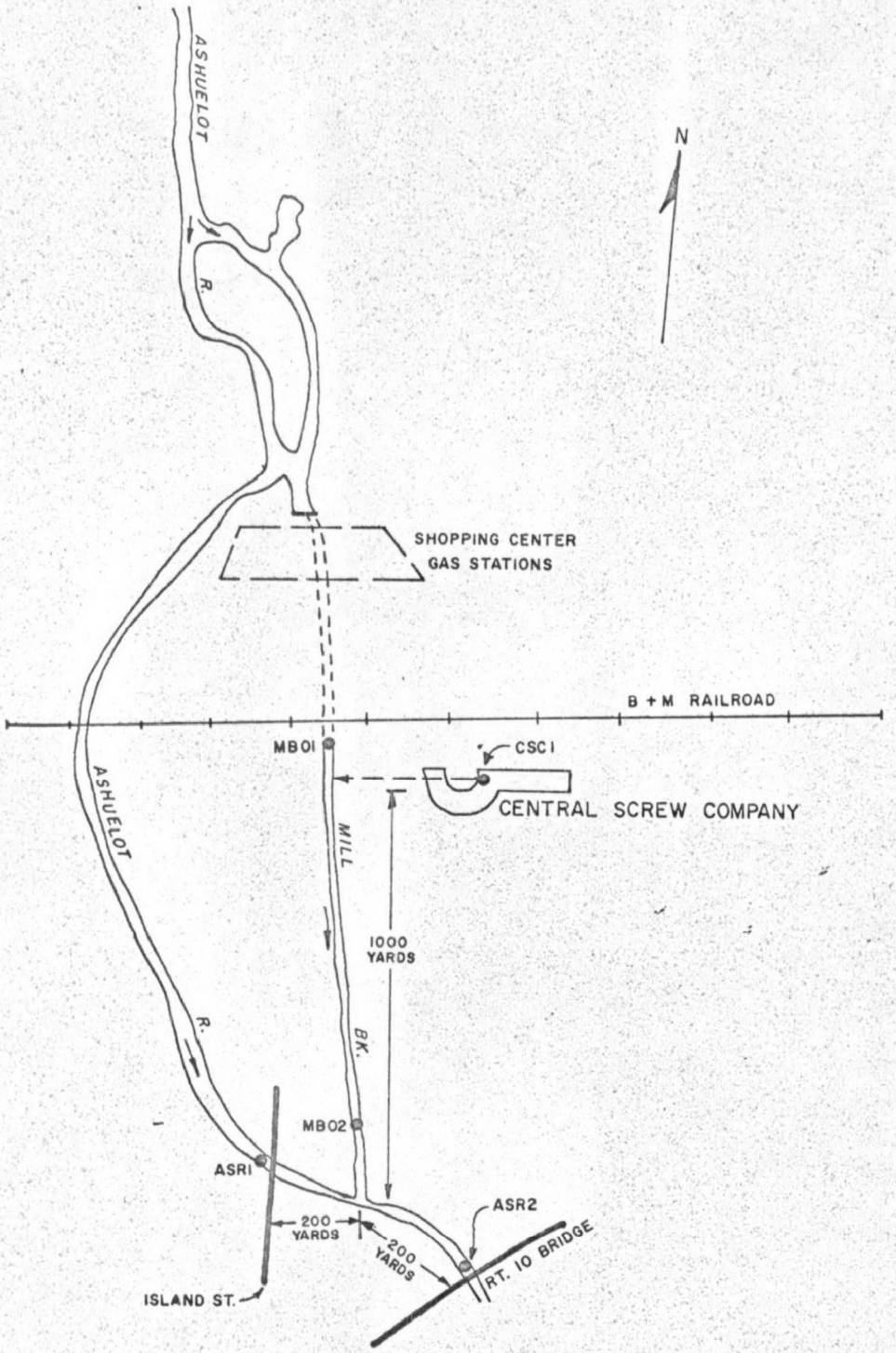
Table 2 summarizes the results of the laboratory analyses. Some dilution of the plating room effluent by boiler water occurs in the clay pipe which lowers the concentrations of this effluent as it enters the river. However, the quantity of pollutants discharged by the company remains the same.

Based upon measurements made at the time of sampling, the average plating room discharge rate was in excess of 229,000 gpd (gallons per twenty hour operating day); this is more than twice the rate reported in the Army Corps of Engineer's Refuse Act Permit Application.

TABLE 1

SAMPLING STATION IDENTIFICATION

STATION	LATITUDE ° ' "	LONGITUDE ° ' "	
CSC1	42 55 49	72 17 02	Plating room discharge-inside building
MBO1	42 55 48	72 17 16	Mill Brook-10 yards upstream of outfall
MBO2	42 55 43	72 17 14	Mill Brook-50 yards upstream of confluence with Ashuelot River
ASR1	42 55 40	72 171 20	Ashuelot River-upstream of Mill Brook
ASR2	42 55 37	72 17 14	Ashuelot River-downstream of Mill Brook



CENTRAL SCREW COMPANY
KEENE, N.H.

FIGURE 2

The components of the plating room waste water were present in concentrations so as to create the following pollutional load on Mill Brook:

Parameter	River Loading Indicated by Grab Samples Analyses (Pounds/20 hour day)	River Loading Indicated by Composite Sample Analyses (Pounds/20 hour day)
Cyanide	117	J 70
Oil and Grease	73	-
Suspended Solids	52	55.5
Total Phosphorus	3.5	12.0

Code: J indicates an estimated value

Six gallons of muriatic acid were dumped at 1755 hours. Between 1515 hour to 1755 hours, the pH of the effluent (Station CSC 1) varied from 9.0 to 1.4 S. U. The composited sample had a pH of 3.0 S. U. The wide range in pH is indicative of the variable nature of the waste water.

The total waste from all operations, including sink wash water possibly containing phosphates and boiler water should create greater pollutional loadings than those tabulated above. Heavy metals analyses of samples collected from the plating room effluent, Mill Brook, and the Ashuelot River, when completed, will be incorporated as an addendum.

Impact on Receiving Water (Mill Brook) and the Ashuelot River

Between Stations MB01 and MB02, Mill Brook showed a marked increase in total phosphorus, oil and grease, and cyanide concentrations. This is the reach into which Central Screw Company discharges its wastes. The Ashuelot River showed similar increases between the Island Street bridge (Station

ASR 1) and the Route 10 bridge (Station ASR 2). Mill Brook forms its confluence with the Ashuelot River in this reach.

Based upon analysis of the composite sample collected at Station CSC 1, Central Screw Company discharges approximately 70 pounds of cyanide per operating day to Mill Brook increasing the cyanide concentration from an average 0.089 milligrams per liter (mg/l) upstream at Station MB01 to an average 12.4 mg/l downstream at Station MB02. In the Ashuelot River, the cyanide concentration increases from almost negible (.002 mg/l average) above its confluence with Mill Brook (ASR 1) to an average 1.83 mg/l below its confluence (ASR 2).

The cyanide concentrations found in the discharge and both rivers downstream from Central Screw Company are lethal to fish and other aquatic life and may be lethal to humans. A twenty-four hour TLm (mean tolerance limit) for perch is reported to be 0.069 mg/l, while the death of all perch occurred at 0.10 mg/l of cyanide. Concentrations of 0.10 to 0.15 mg/l of cyanide are toxic to trout. The maximum safe total ingestion by humans has been estimated at something less than 18 mg/day, part of which would come from the normal environment.

Cyanide is a true protoplasmic poison, combining in the tissues and thereby preventing cellular oxidation and causing death through asphyxia. The toxicity of hydrogen cyanide (most cyanide in water is in the form of hydrogen cyanide) is increased in a low pH environment, such as the plating room effluent. Certain metals, such as zinc and cadmium, may complex with cyanide to increase toxicity. There is presumptive evidence indicating the presence of both metals.

Central Screw Company also discharges twelve pounds of phosphorus per operating day (based on composite sample analyses) increasing the phosphorus concentration in Mill Brook from an average 0.26 mg/l upstream of the discharge

(MB01) to an average 1.56 mg/l downstream of the discharge (MB0 2). The phosphorus concentration on the Ashuelot River similarly increases from an average 0.05 mg/l above its confluence with Mill Brook to 0.15 mg/l below its confluence. Phosphorus is an essential nutrient for the growth of aquatic organisms including algae. An overabundance or imbalance of this nutrient can lead to eutrophication of water bodies.

More than 70 pounds per day of oil and grease is also discharged by Central Screw Company. While collecting sediment samples, the sampling crew noted that an oily sludge layer approximately three feet thick exists in Mill Brook. A similar layer, approximately one foot thick, exists in the Ashuelot River below its confluence with Mill Brook. Other discharges containing oil and grease are suspected in Mill Brook upstream of the Central Screw Company discharge. Also, whereas various types of weed growth were observed in the Ashuelot River upstream of its confluence with Mill Brook, a complete absence of aquatic growth was noted below the confluence.

The Central Screw Company discharge also produces a suspended solids loading rate, based on composite sample analysis, of 55.5 pounds per twenty hour operating day. Because of the plating room suspended solids discharge, fish propagation may be diminished. Suspended solids are inimical to aquatic life by causing abrasive injuries; by clogging the gills; and by blanketing the bottom which smothers spawning beds, eggs, young, and food organisms. Fish may be so weakened that the abrasive and clogging action of suspended solids become more effective and dangerous, and even lethal in the presence of even flow concentrations of toxic substances, such as cyanide.

SAMPLE ANALYSES

ABBREVIATIONS & UNITS OF MEASURE

Analysis Reported	Description	Units of Measure
Temp	temperature	degrees Centigrade (°C)
pH	hydrogen ion concentration	standard units (S.U.)
Probe D.O.	dissolved oxygen	milligrams/liter(mg/l)
Total NFR	total suspended solids	mg/l
Turbidity		Jackson Turbidity Units(J.T.U.)
Total P	total phosphorus	mg/l as phosphorus
Oil and Grease		mg/l as Hexane extractables
Cyanide		mg/l as CN
Total Coliforms	total coliform bacteria	per 100 Milliliters
Fecal Coliforms	fecal coliform bacteria	per 100 Milliliters

TAB 2
CENTRAL SCREW COMPANY
SEPTEMBER 26, 1972

LABORATORY ANALYSES

STATION	TIME	LAB CODE	DEPTH (Ft)	TEMP (°C)	PROBE D.O. (mg/l)	Field pH (S.U.)	Total NFR (mg/l)	TURBIDITY (J.T.U)	Total P (mg/l)	OIL & GREASE (mg/l)	CYANIDE (mg/l)
						DISCHARGE					
CSC1	Composite*	35843	1.0	-	-	3.0[1]	29.1	8.3	6.30	-	J36.6
	1420	35840	1.0	19.5	-	5.0	28.1	18.0	1.34	33.8	71.3
	1530	35841	1.0	20	-	6.5	43.5	21.0	3.20	38.2	-
	1700	35842	1.0	20	-	7.5	11.2	7.2	0.96	42.8	51.8
						MILL BROOK					
MBO1	1445	35844	1.0	19.5	5.4	7.0	20.6	28.0	0.16	30.2	.013
	1600	35845	1.0	17.0	6.6	6.0	26.4	27.0	0.18	36.3	-
	1715	35846	1.0	18.5	5.6	6.0	46.3	36.0	0.44	38.5	.165
MBO2	1455	35847	0.6	21.5	5.4	7.2	15.4	12	1.40	42.5	10.4
	1610	35848	0.5	21.5	5.2	9.1	10.9	13	2.20	50.7	-
	1740	35849	0.5	22.5	-	7.8	14.0	16.0	1.08	44.9	14.4
						ASHUELOT RIVER					
ASR1	1510	35850	1.0	15.0	8.8	6.4	1.6	2.1	0.06	41.5	.004
	1630	35851	1.0	15.0	9.2	5.9	1.5	2.3	0.04	44.0	-
	1755	35852	1.0	15.5	-	5.9	1.9	2.3	0.04	37.2	.000
ASR2	1420	35853	1.0	15.5	9.1	6.2	16.2	5.5	0.18	36.9	1.72
	1545	35854	1.0	15.5	9.3	6.3	2.4	3.4	0.14	28.6	-
	1715	35855	1.0	15.5	-	6.1	2.8	4.4	0.12	59.4	1.94

*Composite from 1420-1755 hours

1)pH ranged from 9.0 @ 1515 hours to 1.4 @ 1755 hours

Code: J-estimated value

ENVIRONMENTAL PROTECTION AGENCY

TO
ATTN OF: LAS

DATE: November 20, 1972

SUBJECT: Addendum to Central Screw Company
Industrial Waste Survey, September 26 - 27, 1972

TO: Thomas W. Devine, Chief
Technical Operations Section

Enclosed is the addendum to our Central Screw Company survey sent to your office on November 13, 1972. Metals analyses indicates a more substantial menace exists toward aquatic life and to other animals than that postulated in the original report.

D. H. Stonefield

Enclosure

ADDENDUM

INDUSTRIAL WASTE SURVEY
CENTRAL SCREW COMPANY
KEENE, NEW HAMPSHIRE
SEPTEMBER 26 - 27, 1972

Water and sediment samples were collected for metals analyses (copper, cadmium, zinc, chromium and nickel) from the Central Screw Company plating room effluent, Mill Brook, and the Ashuelot River. The results of the laboratory analyses are given in Table 1 and the calculated waste loadings are given in Table 2.

The plant effluent significantly increased the copper, cadmium, zinc and nickel concentrations in Mill Brook which in turn significantly increased the concentration in the Ashuelot River. The sediment heavy metals concentrations in the Ashuelot River similarly increased from upstream of its confluence with Mill Brook to downstream of it.

The metals analyses of water samples indicate that a more significant health hazard exists toward aquatic life as well as humans than that postulated in the original report. For example, toxicity increases because zinc, copper and cadmium act synergistically with each other and cyanide to form complex cyanide salts.

Concentrations of zinc as low as 100 micrograms per liter (ug/l) have been reported lethal toward fish. The zinc concentration in the Ashuelot River downstream of the confluence with Mill Brook (Station ASR2) averaged 363 ug/l. Copper and cadmium in concentrations less than those found in the Ashuelot River (ASR2), either acting alone or through interaction with each other and zinc, are also toxic toward fish; the threshold concentration for fish of copper is 20 ug/l and that of cadmium is 30 ug/l. Each of the heavy metals found in the effluent from Central Screw Company produces a substantial menace to aquatic life and to humans as well.

Analysis of the Ashuelot River sediments indicates that the Central Screw waste metals are settling out in the river. The sediment metals are toxic to benthic organisms which are food for higher aquatic animals such as fish. These sediments can be resuspended during high flow periods.

TABLE 1

METALS ANALYSES
WATER SAMPLES

Station	Time	Lab Code	Depth (Feet)	Copper (ug/l)	Cadimum (ug/l)	Chromium (ug/l)	Zinc (ug/l)	Nickel (ug/l)
CSC1	Composite	35843	1.0	1070	10500	1500	17300	4900
	1420	35840	1.0	1010	23750	78	6500	1500
	1530	35841	1.0	630	3180	4500	308	21500
	1700	35842	1.0	1070	18000	660	6100	920
MBO1	1445	35844	1.0	10	44	79	336	0
	1600	35845	1.0	34	24	328	322	10
	1715	35846	1.0	58	220	388	432	36
MBO2	1445	35847	0.6	430	1980	29	3350	1850
	1610	35848	0.5	610	3360	40.4	332	600
	1740	35849	0.5	340	2200	30	3920	2100
ASR1	1510	35850	1.0	0	0	4.6	12.6	0
	1630	35851	1.0	0	0	4.6	10.6	0
	1755	35852	1.0	2	0	6	21.4	5
ASR2	1420	35853	1.0	33	220	4.6	334	94
	1545	35854	1.0	37	172	68	394	120
	1715	35855	1.0	23	154	13.6	328	60

SEDIMENT SAMPLES

				Copper (ug/g)	Cadmium (ug/g)	Chromium (ug/g)	Zinc (ug/g)	Nickel (ug/g)
ASR1	1510	35850	Seidment	13.47	2.2	5.99	42.9	10.96
ASR2	1420	35853	Sediment	39.90	99.76	96.76	389.0	42.90

TABLE 2

LOADING RATES
CENTRAL SCREW COMPANY EFFLUENT

	Mean Grab Sample Loading (Pounds per day)	Composite Sample Loading (Pounds per day)
Copper	1.7	2.0
Cadmium	28.6	20.1
Chromium	3.3	2.9
Zinc	8.2	33.0
Nickel	15.2	9.4

Basis: Calculated mean effluent flow rate = 229,000 gallons per 20 hour operating day