

INTERIM REPORT FOR
CHEMICAL WASTE TREATMENT PLANT STUDY
STRATFORD ARMY ENGINE PLANT
CONNECTICUT

PRESENTED TO
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT
CORPS OF ENGINEERS
NANEN-MA FY 82 SP #1

BY
ROY F. WESTON

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INTRODUCTION

This Interim Report is presented as part of the overall study to evaluate the existing Chemical Waste Treatment Plant (CWTP) at AVCO Lycoming, Stratford Army Engine Plant. Its purpose is to present options for handling future wastewater flows and associated sludge volumes from all metal finishing operations. Having evaluated these options, the report presents a preliminary selection of a preferred alternative for purposes of discussion and evaluation. The report is divided into three sections:

Section 1 - highlights projections for plating process facility renovation and expansion, existing CWTP operating problems, and projected process area flows (with supporting methodologies and background data in Appendix A).

Section 2 - outlines the most feasible plan based upon preliminary investigations. This plan is subject to revision in the Final Concept Design Report submittal.

Section 3 - presents topics which require discussion with AVCO Lycoming personnel to ensure the selection of the most effective options.

The Final Concept Design Report will incorporate additional studies involving groundwater monitoring, soils borings, site surveys, and geologic investigations for the purpose of modifying the interim plan, if necessary, and selecting a sludge management plan for existing impounded sludge and future sludges to be generated from the proposed wastewater treatment facility.

SECTION 1

BACKGROUND

1.1 Process Facilities Renovation and Expansion

By the end of 1981, renovations to the main plating area in Building 2 of AVCO Lycoming, Stratford, Connecticut electroplating facility (Figure 1-1) will be completed and in operation. This expanded area will replace all previous metal finishing operations with the exception of the anodizing, HAE, plasma spray and materials lab. The renovated plating operation is expected to operate at three times the current production rates. Concurrently, cleaning lines for renovated parts in the Engine Overhaul Area are being moved to Building 3. Water conservation measures will be employed to optimize performance and reduce waste flow in both these areas. As a result of increased production and water conservation, a more highly-concentrated waste stream with reduced flow rate will be discharged for treatment at the Chemical Waste Treatment Plant (CWTP).

1.2 Existing CWTP Operations

The existing 23-year old CWTP operation discharges an effluent stream which is in conformance with National Pollution Discharge Eliminations System (NPDES) requirements for metal removal, but historically has had problems meeting pH discharge limits. The facility and treatment process itself, however, is one which is obsolete, potentially unsafe, in violation of Resource Conservation and Recovery Act (RCRA) regulations, potentially in violation of State of Connecticut ground and surface water discharge criteria, and contains overflows which, if utilized, would violate NPDES requirements.

LEGEND OF PROCESS WASTE SOURCE LOCATIONS

- 1 - PLATING AREA
- 2 - ANODIZING AREA
- 3 - HAE AREA
- 4 - BARREL-FINISHING AREA
- 5 - WASH TUB OPERATION
- 6 - WET AIR SCRUBBERS
- 7 - PLATE COILS
- 8 - QUALITY ASSURANCE LAB
- 9 - PLASMA SPRAY BOOTH AREA
- 10 - ENGINE OVERHAUL AREA
- 11 - MATERIALS LAB

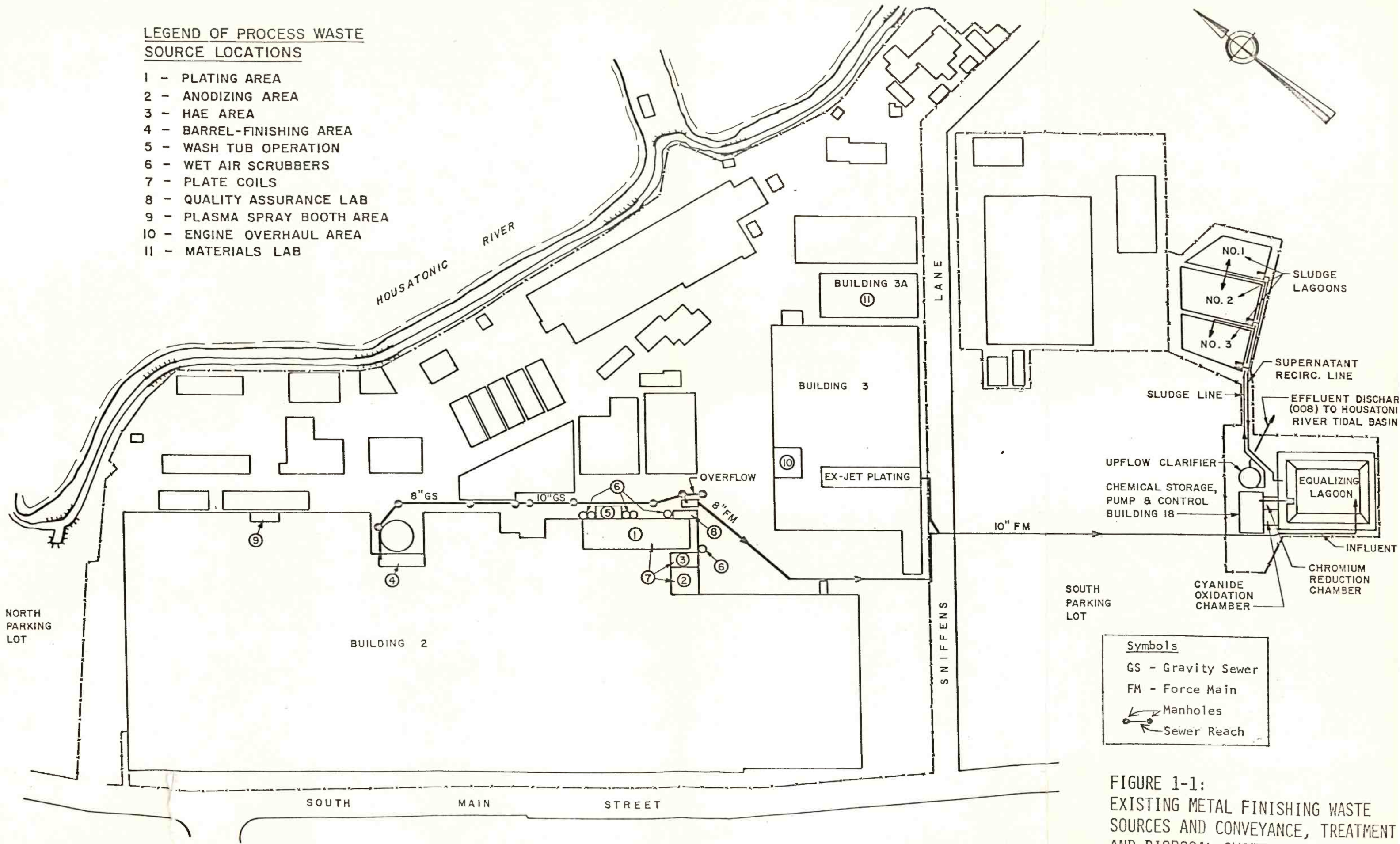


FIGURE 1-1:
EXISTING METAL FINISHING WASTE
SOURCES AND CONVEYANCE, TREATMENT
AND DISPOSAL SYSTEMS

The existing facility utilizes a combined series-treatment approach for electroplating wastes, in which waste streams from all plating operations are combined prior to treatment for removal of various waste constituents in a series of step processes. This sequence of treatment operations is rarely used in modern installations. One important reason for this is that this type of treatment can lead to the unsafe mixing of incompatible waste streams capable of generating hydrogen cyanide gases. HCN

Sludge generated in the wastewater and during treatment is presently deposited in three locations: (1) the equalization lagoon, (2) the CWTP reactors, and (3) the sludge lagoons. Precipitation of solids in the cyanide oxidation reactor is due to improper mixing. Disposal of sludge, classified as hazardous under RCRA regulations, in the existing sludge lagoons is considered unsatisfactory under new RCRA regulations. Precipitation and settling of sludges in the equalization lagoon classifies the equalization lagoon as a hazardous waste surface impoundment, and is in need of upgrading.

Other problems include: the introduction of approximately 150 gpm of potable water in the CWTP which represents 40% of the treated effluent flow (400 gpm) for use in pump seal water and chemical feed slurries; the deterioration of plant equipment and machinery; replacement parts becoming harder to procure; and, escalating operating and maintenance costs (manpower, chemical and power).

$400 \times 60 \times 8 = 192,000 \text{ GPD}$

excess water at CWTP

1.3 Projected Process Area Flowrates

Both existing and future flowrates to be discharged to the CWTP were unavailable. To establish projected plans, an intensive research and data collection effort was required, which involved a review of AVCO Lycoming operation and maintenance documents and a broad-based interfacing with plant personnel in numerous process operation areas.

Table 1-1 identifies eleven projected sources of waste flow which will discharge to the CWTP. New sources of flow are still under investigation. Flows presented in Table 1-1 are separated by location (building) and process area.

Figure 1-1 displays the location of each waste source, following the number system listed in Table 1-1 and used throughout this study. Projected combined waste flow to the CWTP is estimated to be approximately 109,000 gpd.

The total projected flows from all discharges to the CWTP, as presented in Table 1-2, are divided into three main waste stream categories: chromium waste; cyanide waste; and other wastes. This breakdown was provided to estimate the total amount of wastewater which would be included under segregated treatment requirements. From this table, chromium containing waste will comprise a significant amount, or 71%, of the total flow generated daily from the process facility, while only 1% of the total flows will be cyanide related. The remaining 28% will be comprised of acids, alkalies, chelates, metals, and steam condensate.

All data bases, assumptions, and calculations utilized for flow projections can be found in Appendix A.

TABLE 1-1
PROJECTED FLOW TO CWTP FROM ALL SOURCES

LOCATION I.D. NO.	FLOW SOURCES (By Process Area & Operation)	PRODUCTION RATE ¹	OPERATION SCHEDULE	PEAK FLOWRATE ²	AVERAGE DAILY FLOW ⁶	
		(ft ² Metal/Day)	(Hrs/Day)	(GPH)	(GPD)	(% Total)
1	(A) FROM BUILDING #2					
	Plating Area: ³	<i>current rate</i>				
	- Copper Plating Rinses	480	20	1.5	1,820	2
	- Nickel Plating Rinses	45	20	.2	260	--
	- Chromium Plating Rinses	9	24	<.1	30	--
	- Cadmium Plating Rinses	3	1	.3	20	--
	- Passivation Rinses	300	16	.1	100	--
	- Mn & Zn Phosphating Rinses	30	12	<.1	70	--
	- Black Oxide Rinses	30	16	.2	170	--
	- Clean Before Heat Treat Rinses	300	8	1.1	520	--
- Bath Dumps For Above Operations	--	8	1.2 ⁴	80	--	
				3070		
2	Anodizing Area: ⁵					
	- Anodizing on Aluminium Rinses	60	18	18.8	20,250	19
	- Chromate Conversion Rinses	3	6	9.4	3,370	3
	- Bath Dumps For Above Operations	--	8	1.1 ⁴	130	--
				23,750		
3	HAE Area: ⁵					
	- Anodizing on Magnesium Rinses	180	24	25.0	36,000	33
	- Bath Dump For Above Operation	--	8	1.1 ⁴	10	--
				36010		
4	Barrel-Finishing Area:					
- Tumbling Machine Dumps	--	24	2.8	4,050	4	
5	Wash Tub Operation:					
- Tote Box Cleaning	--	8	3.8	1,800	2	
6	Wet Air Scrubbers:					
- Recirculation Water Discharge	--	24	18.8	27,000	25	
7	Plate Coils:					
- Hot Tank Steam Condensate	--	24	4.8	6,840	6	
8	Quality Assurance Lab:					
- Glassware Cleaning Sinks	--	8	<.1	30	--	
9	Plasma Spray Booth Area:					
- Wet Collector Discharges	--	15	6.3	5,620	5	
				108110		
10	(B) FROM BUILDING #3					
	Engine Overhaul Area: ³					
	- Cleaning of Renovated Parts Rinses	900	24	.5	700	1
- Bath Dumps For Above Operation	--	8	1.5 ⁴	40	--	
11	(C) FROM BUILDING #3A					
	Materials Lab:					
- Research Plating Dumps	--	.25	10.0	150	--	
	FLOW SUBTOTAL FOR RINSES	--	--	93.9	108,650	100
	FLOW SUBTOTAL FOR BATHS	--	--	14.9	410	--
	TOTAL PROCESS FLOWS	--	--	108.8	109,060	100

¹Projection of 3 times current production rate used.

²Flow rates during 8-hour main work shift.

³Area to be employing water conservation measures. *1 good*

⁴Peak flow rate for bath dumps equivalent to largest bath bled to waste over an 8-hour period.

⁵Areas not projecting immediate employment of water conservation measures.

⁶All average daily flows rounded to nearest 10 gpd; safety factors applied, refer to Table A-5, Appendix A

TABLE 1-2
SEGREGATED PROCESS FLOWS TO CWTP¹

FLOW CHARACTERIZATION	FLOWS TO CWTP						% TOTAL
	CONTINUOUS RINSES (DILUTE)		BATH DUMPS (CONCENTRATED)		COMBINED		
	PEAK (GPM)	AVG. (GPD) ⁴	PEAK (GPM) ²	AVG. (GPD) ³	PEAK (GPM)	AVG. (GPD)	
1. CHROMIUM WASTES	61.6	77,142	3.4	101	65.0	77,244	71
2. CYANIDE WASTES	4.1	861	1.2	18	5.3	879	1
3. OTHER WASTES (i.e. metals, chelates, acids, alkalies)	28.2	30,647	10.3	291	38.5	30,937	28
TOTALS	93.9	108,650	14.9	410	108.8	109,060	100

¹From Tables A-3 and A-6.

²Assume one dump tank from each process area, bled to waste within 8 hours.

³Total annual bath dump volume divided by 365 days.

⁴Total flow quantity over 24 hour period.

SECTION 2

SELECTED PLAN

Introduction

Several alternative solutions to AVCO Lycoming waste treatment/disposal problems are available and were examined. The selected alternative was divided into four major components: ① process, ② conveyance, ③ treatment, and ④ disposal. The process component includes all activities or presently planned modifications associated with the manufacturing/plating operations; the conveyance component includes all activities or modifications associated with transporting waste streams; the treatment component includes all activities associated with existing or modified chemical treatment of the waste streams; and the sludge disposal includes existing or modified sludge disposal activities. In addition, recycling of various waste streams for in-plant reuse are included under a separate resource recovery plan component.

This interim report explains both the reasons for discounting the continued utilization of the current treatment system (No Action Alternative) and the major components of the selected alternative that deal with the problems created by the current system.

2.1 No Action Alternative ?

The No Action Alternative consists of implementing the renovations now under construction in the plating area, transporting the waste products via the same drainage conduits now in use, and continuing to use the existing treatment facilities for cyanide destruction, chromium reduction, and metals precipitation. The No Action Alternative does not address existing or projected problems. The four components of the No Action Alternative and its corresponding problem areas are listed in Figure 2-1. The reasons for discounting continued utilization are presented in the following sections.

maximum use of existing facilities & conveyances will reduce costs

2-2

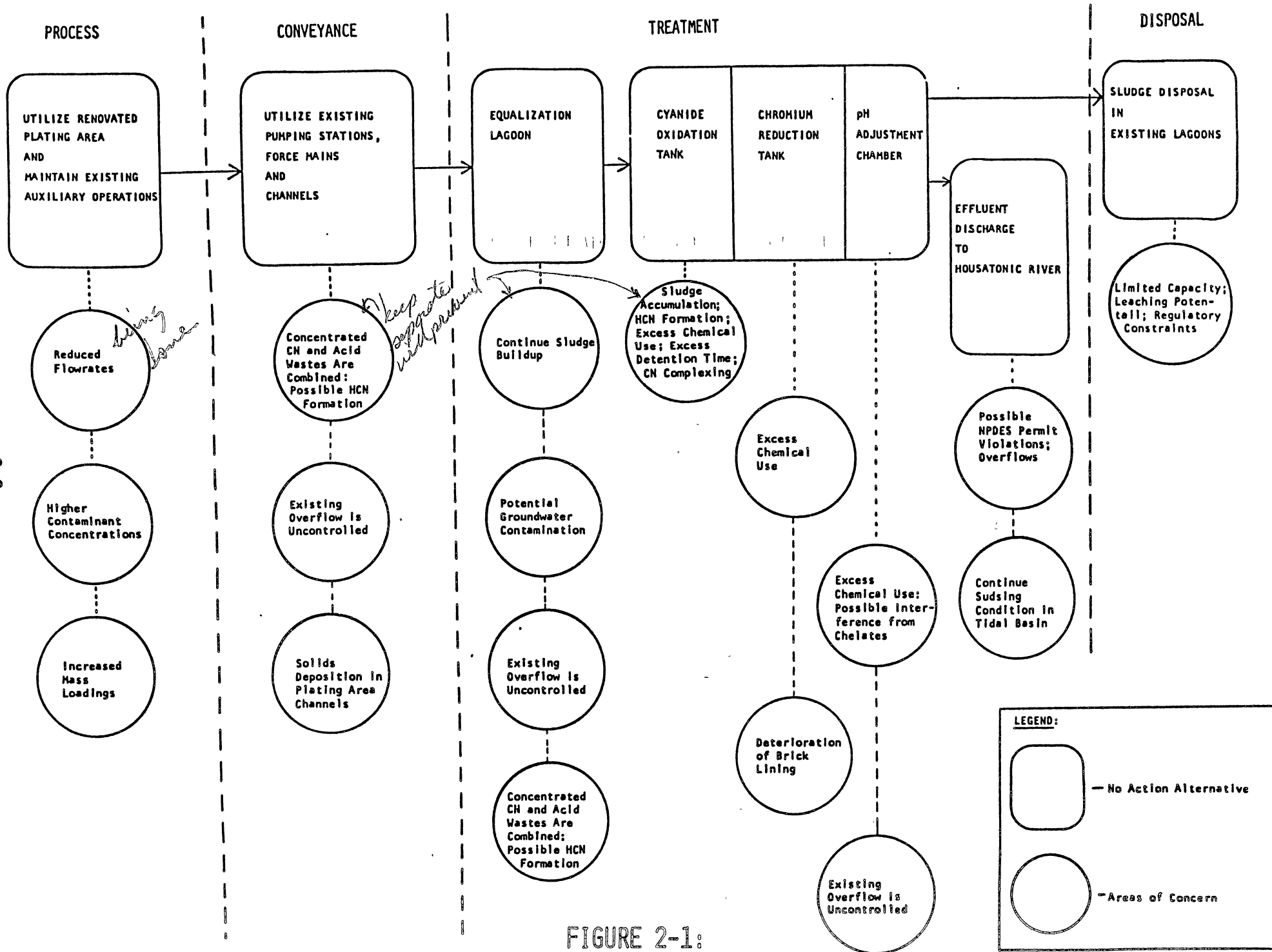


FIGURE 2-1:
NO ACTION ALTERNATIVE

2.1.1 Process

Under this component, the projected plating area now under construction, including plating baths, rinse tanks, scrubbers, condensate discharges, wash tub operations, and laboratory flows, would be the No Action process conditions. This would result in a threefold increase in plating production rates over the rates before construction, and a flow reduction through the use of water conservation measures in rinse tank operations. This new operation differs from the original waste flows for which the Chemical Waste Treatment Plant was designed. The areas of concern created by this change in operating conditions, depicted in Figure 2-1, are as follows:

- Reduced Flows - New plating operations will result in a reduced volume of wastewater which will prolong the detention time of the waste in the treatment system. This will result in conveyance and treatment problems discussed in Sections 2.1.2 and 2.1.3. *True*
- Higher Concentrations - The use of counter-current rinse tanks and flow restrictors will result in a rinse tank effluent with a higher concentration of dragout chemicals than was produced by the previous continuous rinse system. Without the buffering effects of excess water, greater fluctuations in pH can be expected. The sensitivity of the present chemical feed system at the CWTP may not be adequate to accommodate quick variations in pH and chemical constituents.
- Increased Mass Loadings - Dragout from the rinse tanks is directly related to the amount of area plated. Because production is to be increased by a factor of three, the dragout chemicals (contaminants) and, hence, the mass loadings to the plant, in pounds per day, can also be expected to increase by a factor of three. The amount of chemicals needed to effectively treat and remove these contaminants will increase proportionately. The ability of the existing treatment chemical feed systems to supply those chemicals may not be adequate.

2.1.2 Conveyance

This component includes the continuing use of the main pumping station, force main, and treatment process pumps and channels. Several problems exist with this option. Primary among these is the fact that the existing system is in need of extensive rehabilitation. An existing overflow at the main pump station may be discharging substantial quantities of chemical waste to the storm water system without monitoring. Because of the higher waste stream concentrations described earlier, waste streams will be more corrosive, further damaging the 23-year old system. Another problem can be traced to the present practice of combining all waste streams before they leave the plating area sump. Concentrated cyanide and chromic acid rinses will mix, with the possibility of toxic hydrogen cyanide (HCN) gas being formed and released either in the wet well prior to pumping or downstream in the equalization basin. Last, reduced flows will result in solids deposition in process area channels.

HCN

2.1.3 Treatment

The treatment component of the No Action Alternative encompasses equalization, cyanide destruction, chrome reduction, pH adjustment, and metal hydroxide precipitation. Projected problems anticipated with the continued use of these processes are the age of the equipment, the increased detention time (i.e. solids settling at various locations) and the ability of the system to treat the new waste streams. Specific consequences of this alternative are as follows:

- Equalization Lagoon - Sludge is accumulating and will continue to build up, further reducing the volume available for equalization. Increased detention times and higher contaminant concentrations will accelerate the rate of sludge accumulation. If breaks exist in the existing bentonite liner, the liner will continue to deteriorate, contaminating groundwater with untreated wastes. (1) Existing overflow at the effluent end of the lagoon is uncontrolled and should be eliminated. In addition, the combined wastes mixing in the lagoon are generating cyanide gas when the pH falls below 7.0. Increased concentrations would increase cyanide generation rates.

} HCN

- Cyanide Treatment - Because of increased detention and the lack of mixing, sludge will continue to build up in the cyanide oxidation tank. Concentrated flows increase the possibility of hydrogen cyanide (toxic gas) formation. Because all wastes have been combined into one stream, pH adjustment for cyanide oxidation requires much greater quantities of chemical dosing than would be necessary if the cyanide stream was segregated from the remaining chemical waste stream. Section 1 identifies cyanide bearing flows as 1% of the total flow to the treatment plant. Therefore, 99% of the wastes will unnecessarily be subjected to alkaline chlorination. Finally, mixing the cyanide radical with other wastes such as nickel, iron, or cobalt, forms metal cyanide complexes that are not amenable to treatment and will remain complexed in future generated sludge. This will result in the presence of cyanide in either the plant effluent or the sludge. NB
- Chromium Reduction - To reduce chromium from the hexavalent to trivalent state prior to precipitation, sodium metabisulfite is added in an acid (pH = 2.5) environment. Because chromic acid wastes are combined with alkaline cleaners prior to treatment, the pH of the influent wastewater is nearly neutral. As a result, more sulfuric acid is necessary to acidify the waste than if chromic acid were treated separately. Other problems associated with this phase of treatment include the deterioration of the brick lining in the existing tank and the age and adequacy of the existing chemical feed system.
- pH Adjustment, Precipitation, and Effluent Discharge - Subsequent to chromium reduction, lime is added to the wastewater to form insoluble metal hydroxides. The sensitivity of the existing lime feed and mixing equipment may be inadequate to respond to greater pH fluctuations resulting from water conservation measures used in rinse tanks. Clarifier overflow rates will decrease in response

to reduced flows; this will serve to improve performance. However, the ability of the clarifier to settle heavy metals may be impaired if chelates used to increase the solubility of metals interfere with the formation of metal hydroxides. Another problem with the clarifier is the presence of an uncontrolled overflow pipe permitting discharge of unmonitored wastewater. This violates present discharge requirements. Monitored effluent is discharged to a tidal basin on the Housatonic River. The existing plant is also exhibiting an uncontrolled foaming problem which is not being treated by the current plant and is not currently part of NPDES requirements for discharge. Overall, the changes in plating area flows and subsequent impacts to waste treatment described throughout this section increase the potential for future effluent violations.

no visible foam?

2.1.4 Disposal

Currently, sludge from the clarifier is disposed in one of three on-site lagoons. The sludge is presently classified as a hazardous waste under RCRA Part 261.31, May 19, 1980. Water from initial sludge deposits percolated through this layer, dewatering the sludge. Metal hydroxide sludge is impermeable, however, and subsequent sludge deposits are unable to drain. As a result, sludge water usually fills the lagoon until it reaches the elevation of the overflow box, where it empties via the supernatant return line to the head of the plant. In this way the area acts as a sludge lagoon, dewatering sludge by settling, evaporation and decanting. The area does not fulfill the requirements of a hazardous waste disposal area. The state regulatory agency (Department of Environmental Protection) is aware of this problem⁽²⁾ and has requested that the site conform at a minimum to the requirements of the State Groundwater Discharge Criteria, or provide safe leachate control.

*It is
Not
H.W.D. A.*

*leaching out of lagoons and total
leachate control*

2.2 Selected Plan

The No Action Alternative as previously described presents problems which require resolution by future action. A study of several alternatives resulted in the formulation of a recommended plan which requires isolation of five or six waste streams (the final number is subject to a cost-effective analysis) with conveyance, treatment, and disposal systems to be designed accordingly. Effluent wastewater and steam condensate reuse is provided. The plan utilizes new equipment, considers rehabilitating old equipment, and makes utilization of existing equipment wherever practical.

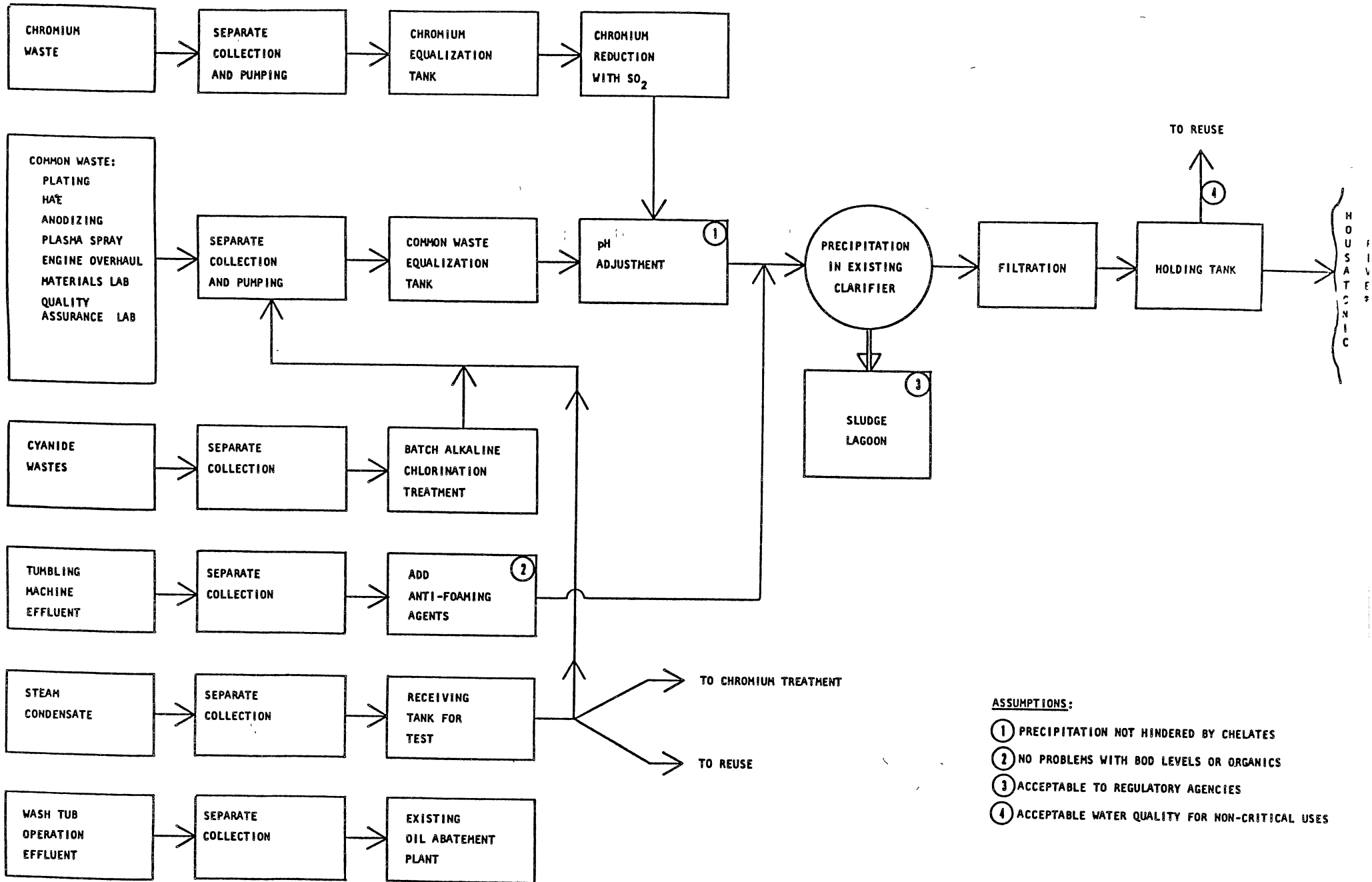
Figure 2-2 presents a schematic of the plan. The major elements of the plan, defined in the following section, are listed in an abbreviated form in Table 2-1.

see both next pages

2.2.1 Process

Projected wastewater flow rates from the new plating areas, as well as existing flows from unmodified plating areas, air scrubbers, wash tub operations, tumbling machines and condensed steam, presented in Section 1, are the basis for design. Therefore, no major changes in process operations are considered in the implementation of the proposed design. The following modifications are presented here as recommended actions to reduce operating costs but have not been taken into consideration for purposes of the design:

- Water Conservation Techniques should be used in the HAE and anodizing areas, which will contribute over half the projected flow to the chemical waste treatment plant. Conductivity meters to regulate rinse rates would be the simplest retrofitting operation. Single rinse tanks should be converted to counter current tanks. This will depend on the structural condition of the tanks and space limitations. Typically, reduction in rinse flow rates of 80% to 90% have been realized from such measures. This would reduce



ASSUMPTIONS:

- ① PRECIPITATION NOT HINDERED BY CHELATES
- ② NO PROBLEMS WITH BOD LEVELS OR ORGANICS
- ③ ACCEPTABLE TO REGULATORY AGENCIES
- ④ ACCEPTABLE WATER QUALITY FOR NON-CRITICAL USES

FIGURE 2-2:

SELECTED PLAN - PROCESS SCHEMATIC

TABLE 2-1: SELECTED PLAN

PROCESS	CONVEYANCE	TREATMENT	DISPOSAL
<p>(1) Maintain water conservation techniques in renovated main plating and engine overhaul areas, including:</p> <ul style="list-style-type: none"> - periodic adjustment of conductivity meters - minimizing or eliminating process bath dumps - keep spills to a minimum - minimize overflows by periodic supervision of influent foot pedal operation or overflow alarm system <p>(2) Investigate the use of water conservation in the following process areas (HAE, anodizing, and lab areas):</p> <ul style="list-style-type: none"> - conductivity meters in rinse tanks to control rinse ratio - spring loaded valves on process bath water supply lines - retrofitting single and series rinse tanks to create double counter current tanks <p>(3) Restrict the use of chelates in process baths. These organic compounds can seriously hinder the removal of heavy metals and render the treatment process ineffective.</p> <p>(4) The use of any new chemical that will eventually reach the CWTP must be evaluated for its compatibility with treatment operations.</p>	<p>(1) Provide a separate collection system for cyanide wastes consisting of drip pans beneath CN bath and rinse tanks, troughs to collect rinses and spills and a sump for wastes to collect before being pumped to treatment.</p> <p>(2) Provide a separate system of troughs and drip pans to collect chromium wastes and transport to a chromium pump in the main pump station and from there via a force main to the CWTP.</p> <p>(3) Provide a system of troughs to collect all other metal finishing rinse waters and convey to the new main pump station and force main. In-plant spills from these sources would be collected by the existing floor drain system which would be periodically flushed.</p> <p>(4) Provide separate collection and transportation to individual treatment schemes for the following waste streams:</p> <ul style="list-style-type: none"> - wash tub operation - tumbling machines - plate coils 	<p>(1) Provide a batch alkaline chlorination treatment system for cyanide wastewaters.</p> <p>(2) Provide a continuous sulfur dioxide system for chromium reduction. Preliminary plans call for renovating the existing reactor for chromium treatment only.</p> <p>(3) Replace the existing equalization lagoon (after removal of sludge accumulations and contaminated liner) with a concrete equalization tank with separate compartments for chromium and for all other (including cyanide) metal finishing wastes. Detention time provided for both waste streams will be 7 days each. Tanks will be corrosion resistant, and mixing will be provided to avoid sludge accumulations.</p> <p>(4) Effluent from the wash tub operation should not enter the CWTP but rather will be directed to the oil abatement plant.</p> <p>(5) Effluent streams from the tumbling machine operation will be analyzed to ascertain the typical constituents. If after mixing with CWTP effluent, BOD is reduced below 30 ppm and trace organics are not a problem (depending on constituents) final treatment will consist of adding anti-foaming agents and discharging to the river with CWTP effluents. If test results reveal that contaminant removal is warranted, carbon adsorption will be piloted as a treatment process. If successful and isotherms are developed, an operating carbon adsorption unit will be incorporated.</p> <p>(6) Steam condensate will be directed to a holding tank and tested. If it is clean, it will be used as bath makeup water, rinse water or boiler feed. Its use as a boiler feed provides energy conservation benefits as well.</p> <p>(7) Pending a chemical analysis, air scrubber blowdown will be used as a feed to chromate cleaner rinse tanks or as Cr plating bath makeup.</p> <p>(8) The existing upflow clarifier will be evaluated for structural integrity and maintained to provide settling for insoluble metal hydroxides.</p> <p>(9) Subsequent to final treatment in a pressurized sand filter, CWTP effluent will be directed to a holding tank. The contents of the tank will be tested and, if acceptable, will be reused as a source of water for plant air scrubbers, wash tub operations, tumbling machines, plasma spray and certain treatment chemical dilution water. It is estimated that approximately 1/3 to 1/2 of the CWTP effluent will be reused in this manner. The remainder will be discharged to the Housatonic River, constituting a blowdown of the system.</p>	<p>Depending on the results of an EP Toxicity test and a regulatory review, sludge will be classified as either hazardous or non-hazardous material. Disposal options address either condition.</p> <p><u>Scenario I: Non-Hazardous Material Disposal</u></p> <p>Option A: On-Site Disposal in the three existing lagoons. The lagoons will be rehabilitated, including excavation, regrading and repair of supernatant return.</p> <p>Option B: On-Site Disposal in a sanitary landfill, constructed on the site of one of the existing lagoons. Dewatering will be provided in a building adjacent to the treatment area and the sludge trucked to the fill.</p> <p>Option C: Off-site Disposal in an approved sanitary landfill.</p> <p><u>Scenario II: Hazardous Material Disposal</u></p> <p>Option A: On-Site Disposal in a secure pond (surface impoundment), including leachate and supernatant return system, impervious liners, flood protection and covers.</p> <p>Option B: On-Site Disposal in a secure landfill, includes dewatering sludge and placement in a hazardous waste landfill, including a leachate return system, impermeable liner, flood protection and covers.</p> <p>Option C: Off-Site Disposal to an approved hazardous waste facility.</p> <p><u>RESOURCE RECOVERY</u></p> <p>Provide holding tanks, transmission lines and distribution systems for the following water reuse systems:</p> <ul style="list-style-type: none"> (1) CWTP Effluent Reuse (2) Steam Condensate Return (3) Scrubber Blowdown Reuse

restriction of

overall flow to the treatment plant by 40%. Spring operated valves on all process tank clean water inflow lines should be installed to avoid process bath washouts. Because a timetable for these modifications does not exist, existing flows will be used for design.

- Quality Assurance and Materials Laboratories - Flows from these areas are small and the capacity in the treatment system reserved for them was sized accordingly. Unregulated overflows and washouts from the lab, however, can hydraulically overload the treatment system. For this reason, the installation of conductivity meters and spring loaded water supply valves in the labs is recommended.

2.2.2 Conveyance

Providing separate transport for individual waste streams is the major element of this plan. This would be accomplished in the plating areas by retrofitting the existing drainage system through the installation of fiberglass troughs in the underdeck galleries presently used to collect wastewater. These troughs would be enclosed pipes used to intercept rinse tank overflows.

Waste streams were segregated based on the type of treatment required. A maximum of six separate streams, three major and three minor streams, were identified. There is a possibility that only five streams may be necessary since one sub-option of this plan could mix common wastes with chromium wastes. The selection of five versus six waste streams will be determined by a cost-effective analysis to compare the operating cost of additional chemicals required to treat a combined stream versus the capital outlay of a separate chromium collection system. Pending the final resolution of this analysis, it was assumed that economics will dictate that separate chromium and common waste treatment should be incorporated into the selected plan. As such, three major and three minor collection systems are proposed and are described below.

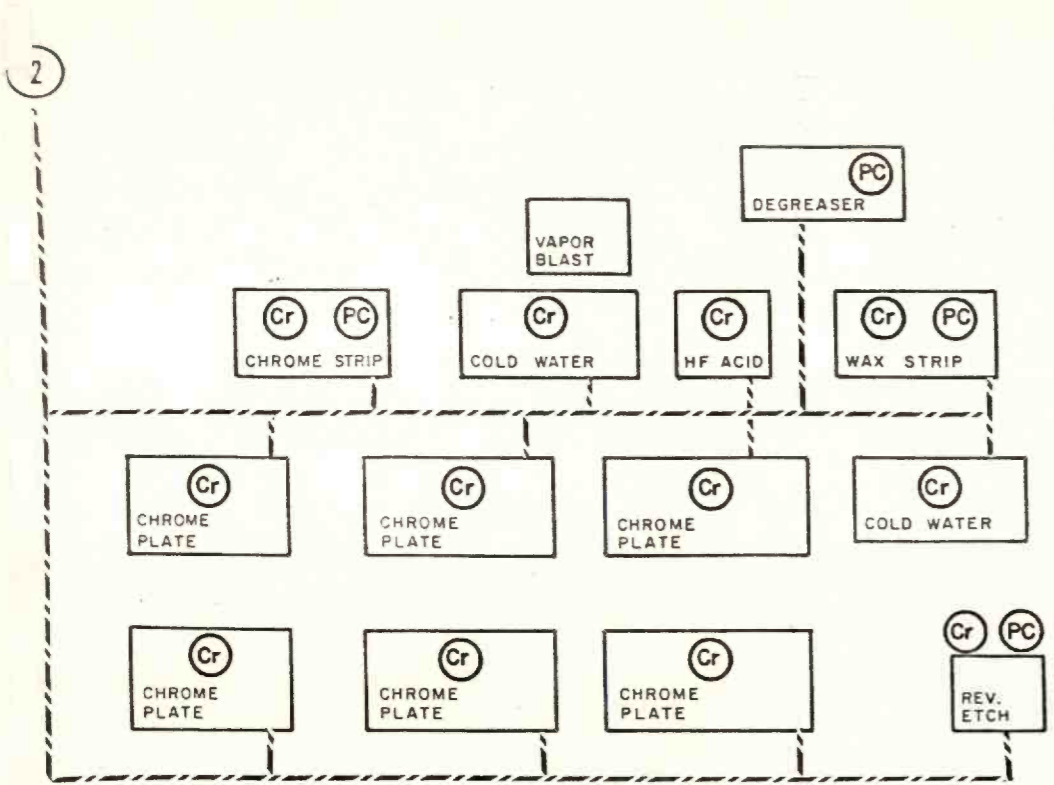
- (1) Cyanide Wastes (Table 1-2, 879 gpd) are generated throughout the main plating area. Process baths and rinse tanks containing cyanide (Figure 2-3) would be connected to a separate cyanide collection system (sewer). Drip pans would be installed beneath those tanks to collect dragout spills and direct them to the cyanide sewer. Waste would flow by gravity to a sump either in the main plating room or in the proposed cyanide treatment area, defined in *CN says* Section 2.2.3.

Materials Lab (Table 1-1) could contribute up to 52 gpd of cyanide wastes, depending on the type of research being conducted. Because the lab is located in Building 3, a separate pipeline or a transportable holding tank must be provided from the building to the cyanide treatment area.

- (2) Chromium Waste (Table 1-2, 77,244 GPD) located in the plating, HAE, anodizing and materials lab areas, will be conveyed in a separate collection system similar to that used for cyanide (Figures 2-3 and 2-4): fiberglass troughs, drain pans, and pipelines from the plasma spray and materials lab areas. Because the proposed chromium reduction operation is located in the area of the Chemical Waste Treatment Plant, a separate force main and pump must be provided.

Wet Air Scrubber Flows (Table 1-1) from six units, a major source of chromium waste, discharge approximately 3,600 gpd each, or 21,600 gpd. These flows would be sent to the chromium pump station.

The chromium waste pump station will direct flows to a chromium equalization basin prior to treatment.



LEGEND:

- (Cr) - CHROMIUM WASTE - - - - -
- (CN) - CYANIDE WASTE ······
- (PC) - PLATE COIL
- COMMON WASTE - - - - -

① - TO COMMON WET WELL, MAIN PUMP STATION

② - TO CHROMIUM WET WELL, MAIN PUMP STATION

③ - TO BATCH CN TREATMENT

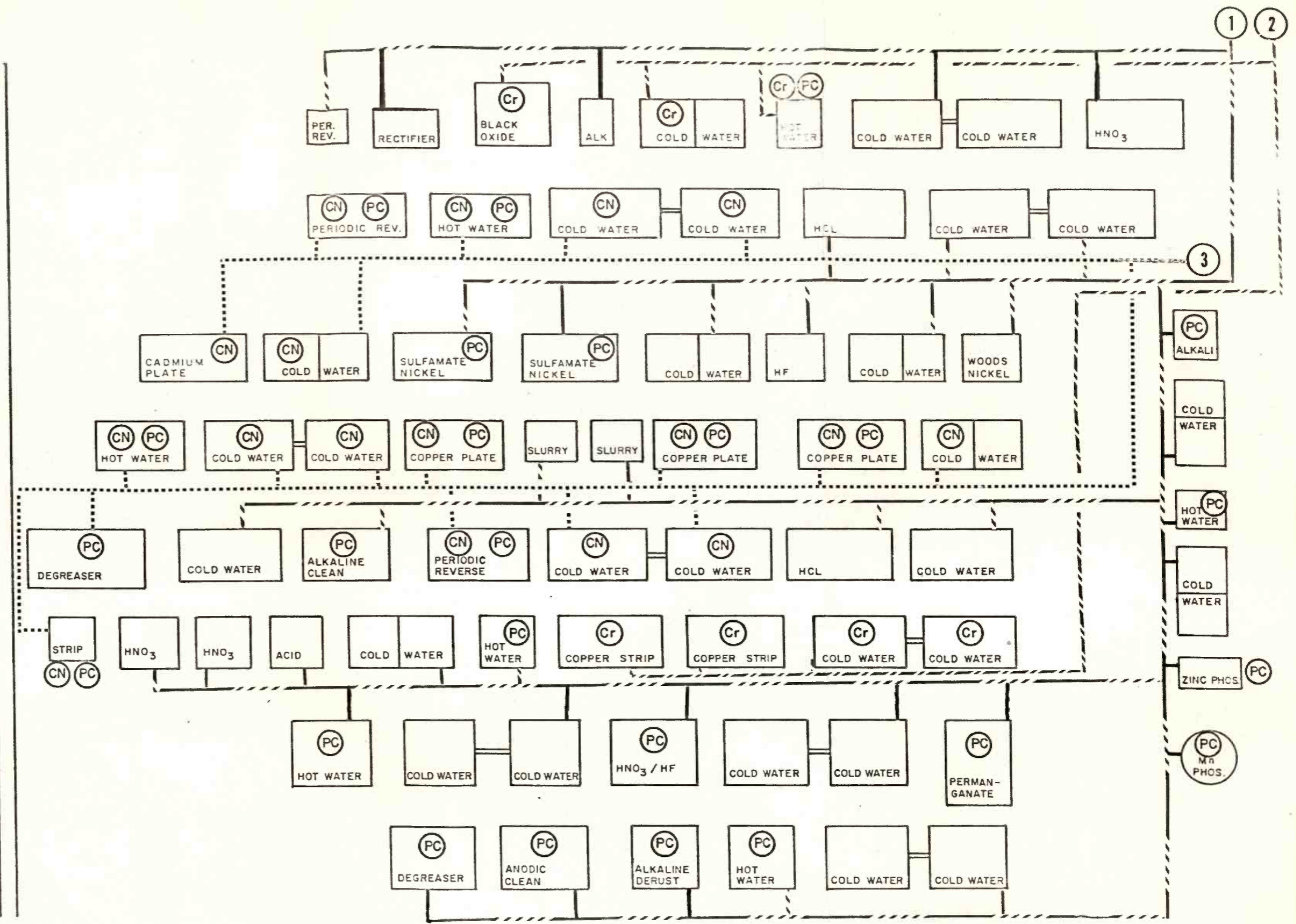


FIGURE 2-3:
SEGREGATED WASTEWATER
COLLECTION: MAIN
PLATING AREA

re-doing of all pipes with 2007

- (3) Common Wastes (Table 1-2, 30,937 gpd) consist of all other metal plating wastes. They will be directed to a third set of pipes in the gallery and subsequently to the wet well of the existing pump station. Troughs are needed because, although spills may be washed from the galleries on a daily basis, it is anticipated that the flow of the rinse water in the galleries will be too small to flush the solids contained in the flow. Similar water conservation renovations for electroplating operations have resulted in significant (4"-8") sludge accumulations in the open channels used for drainage. (3)

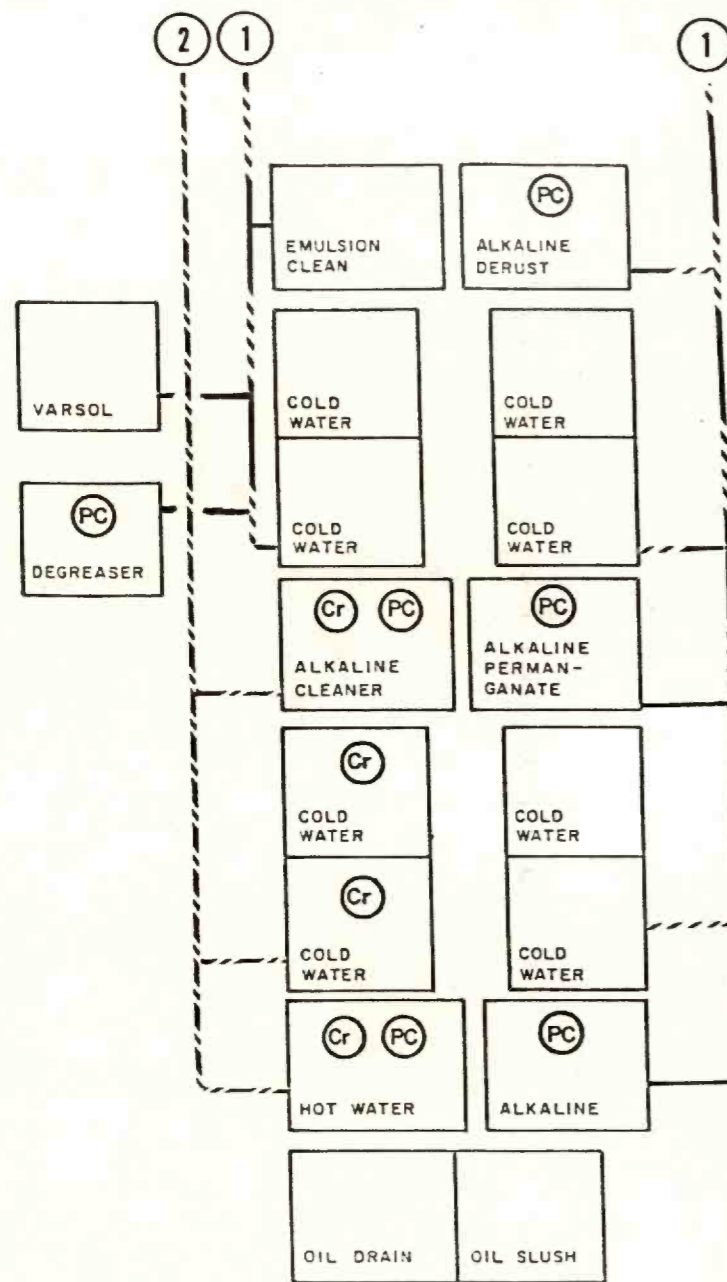
There are three other point sources of wastewater flow that require separate piping. They are: effluent from the tumbling machines in the west side of Building 2 (ID #4); rinse water from the wash tub operation (ID #5); and condensed steam from the process bath plate coils (ID #7). The first two sources have a single discharge point and would only require enough piping to connect with the main pump station wet well. A sump pump would be used if enough head does not exist to permit gravity flow. The last source, steam condensate, would require the transport of the steam piping discharge from approximately 50 plate coils (Figures 2-3 and 2-4) to a common header, and from there to a receiving tank on site. Figure 2-5 depicts the overall conveyance scheme of the Selected Plan.

2.2.3 Treatment

The collection system described above will result in six separate waste stream categories:

- 1 • Cyanide Wastes 1%
- 2 • Chromium Wastes 71%
- 3 • Other Plating Wastes 11%
- 4 • Tumbling Machine Effluents 4%
- 5 • Wash Tub Operation Rinse Water 1.7%
- 6 • Steam Condensate 11.3% ?

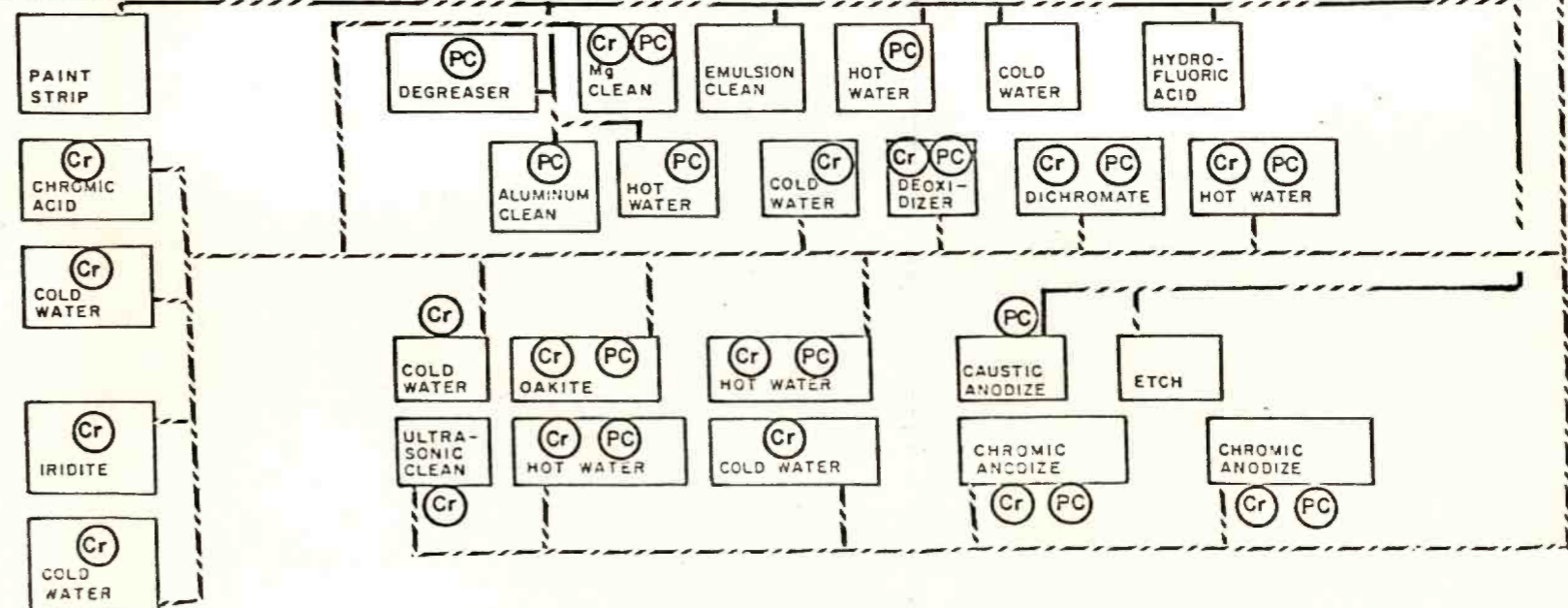
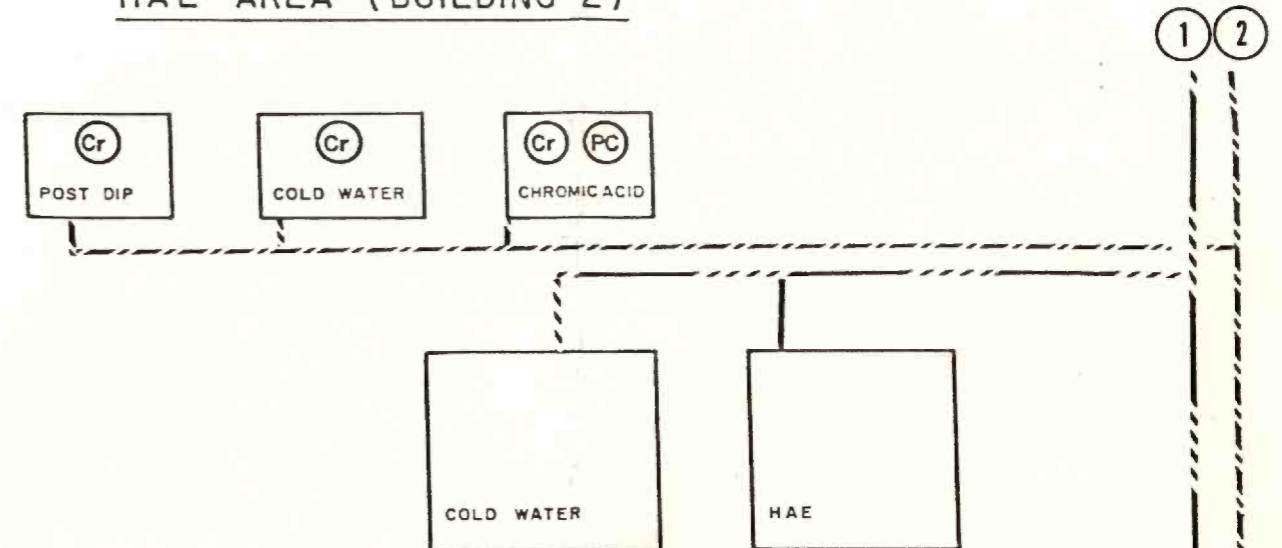
ENGINE OVERHAUL AREA
(BUILDING 3)



LEGEND:

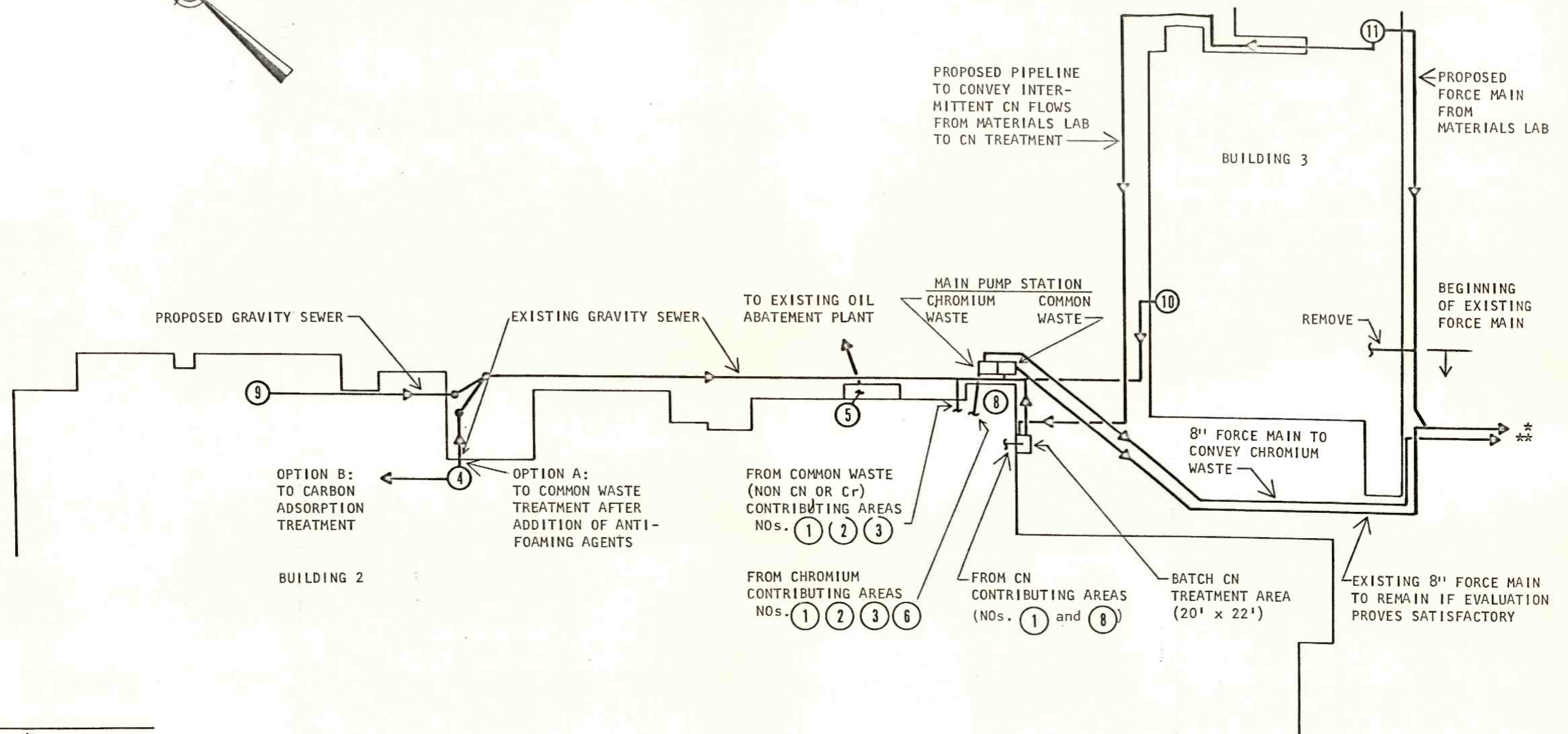
- (Cr) - CHROMIUM WASTE
- (PC) - PLATE COIL
- COMMON WASTE
- (1) - TO COMMON WET WELL, MAIN PUMP STATION
- (2) - TO CHROMIUM WET WELL, MAIN PUMP STATION

HAE AREA (BUILDING 2)



ANODIZING AREA (BUILDING 2)

FIGURE 2-4:
SEGREGATED WASTEWATER
COLLECTION: OTHER
PROCESS AREAS

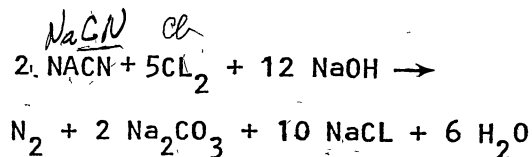


* TO COMMON WASTE EQUALIZATION TANKS
 ** TO CHROMIUM EQUALIZATION TANKS
 ○ DENOTES WASTE STREAM I.D. NO., REFER TO TABLE 1-1

FIGURE 2-5:
 SELECTED PLAN
 CONVEYANCE SYSTEM

Treatment systems have been designed to address the particular constituents and flow rate from each waste category.

- Cyanide Bearing Wastes will be reduced to a flow rate of 879 gpd by water conservation methods and will be directed to a batch treatment system located adjacent to the main plating area using the alkaline chlorination process to convert cyanide to carbon dioxide and nitrogen:



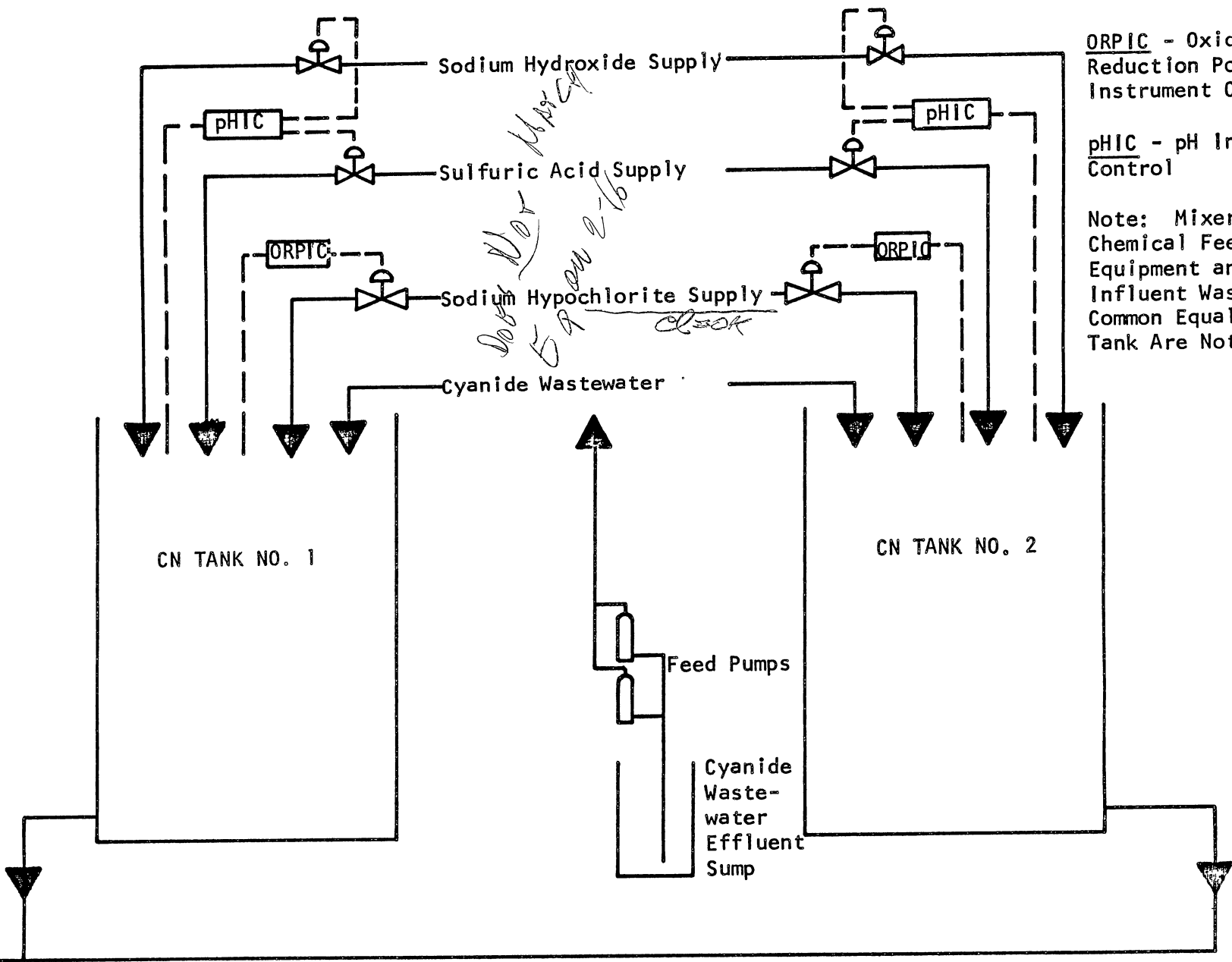
See 2-17

Three tanks, each holding $2\frac{1}{2}$ days storage capacity, will be provided as reaction vessels. Operation will consist of filling the first tank over the course of a day, testing for cyanide content, adding hypochlorite, raising the pH to a range between 9 and 11.5, and mixing until the reaction to cyanate is complete. Further treatment for complete destruction to carbon dioxide and nitrogen gas will be accomplished by continuing the reaction at pH 7.5 to 8.0.⁽⁴⁾ The operation will be programmed using level control devices and oxidation-reduction potential and pH analyzer indicator controllers to monitor automatic chemical feed equipment. The treatment cycle is estimated to run approximately two hours, during which time the process will begin again with the filling of the second tank. The third tank provides standby storage capacity. Effluent is directed to the wet well of the main pump station. The process is shown schematically in Figure 2-6.

- Chromium Wastes represent over 70% of all flows and contain up to 50 ppm of hexavalent chromium. To reduce the valence of hexavalent chromium to the trivalent state prior to settling, a continuous chrome reduction treatment system using sulfur dioxide (SO₂) gas is proposed. It is anticipated that the present cyanide/chromium reactor vessel will be retrofitted to form the proposed chromium

while flow rate is small continuous treatment might be less of a problem than batch (eg. less attention)

2-17



ORPIC - Oxidation
Reduction Potential
Instrument Control

pHIC - pH Instrument
Control

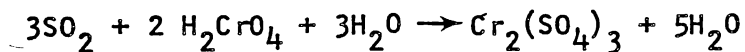
Note: Mixers,
Chemical Feed
Equipment and
Influent Waste From
Common Equalization
Tank Are Not Shown

FIGURE 2-6:
BATCH CN TREATMENT

Discharge
To
Common
Waste
Wet Well

reduction system, as shown in Figure 2-7. The chromium equalization tank referred to in the figure is to be a separate, concrete tank with continuous mixing to keep solids in suspension. To provide seven days of detention at a total flow rate of 77,244 gpd, would require a storage volume of 72,300 C.F. (Table 1-2). *7 days OK*

After equalization, the pH of the waste stream will be reduced to approximately 2.5 by the controlled addition of sulfuric acid. A polyelectrolyte will be added to enhance the sulfur dioxide, hexavalent chromium reaction. At this point, sulfur dioxide gas will be metered into the stream. The following equation represents the reduction of hexavalent chromium to its trivalent state:



Sensors that measure ORP and pH will control sulfur dioxide and sulfuric acid feed systems.

The effluent would then be sent to the pH adjustment chamber where it would be mixed with the common waste stream prior to precipitation.

- Common Wastes - This category includes the following waste streams:

<u>I.D. #</u>	<u>Description</u>	<u>Flow Rate (GPD)</u>
1,2,3	Non Cr & CN Plating, HAE & Anodizing Processes	11,707
9	Plasma Spray	5,620
10	Engine Overhaul	740
11	Materials Lab	150
8	Quality Assurance Lab	<u>30</u>
	Total:	18,247

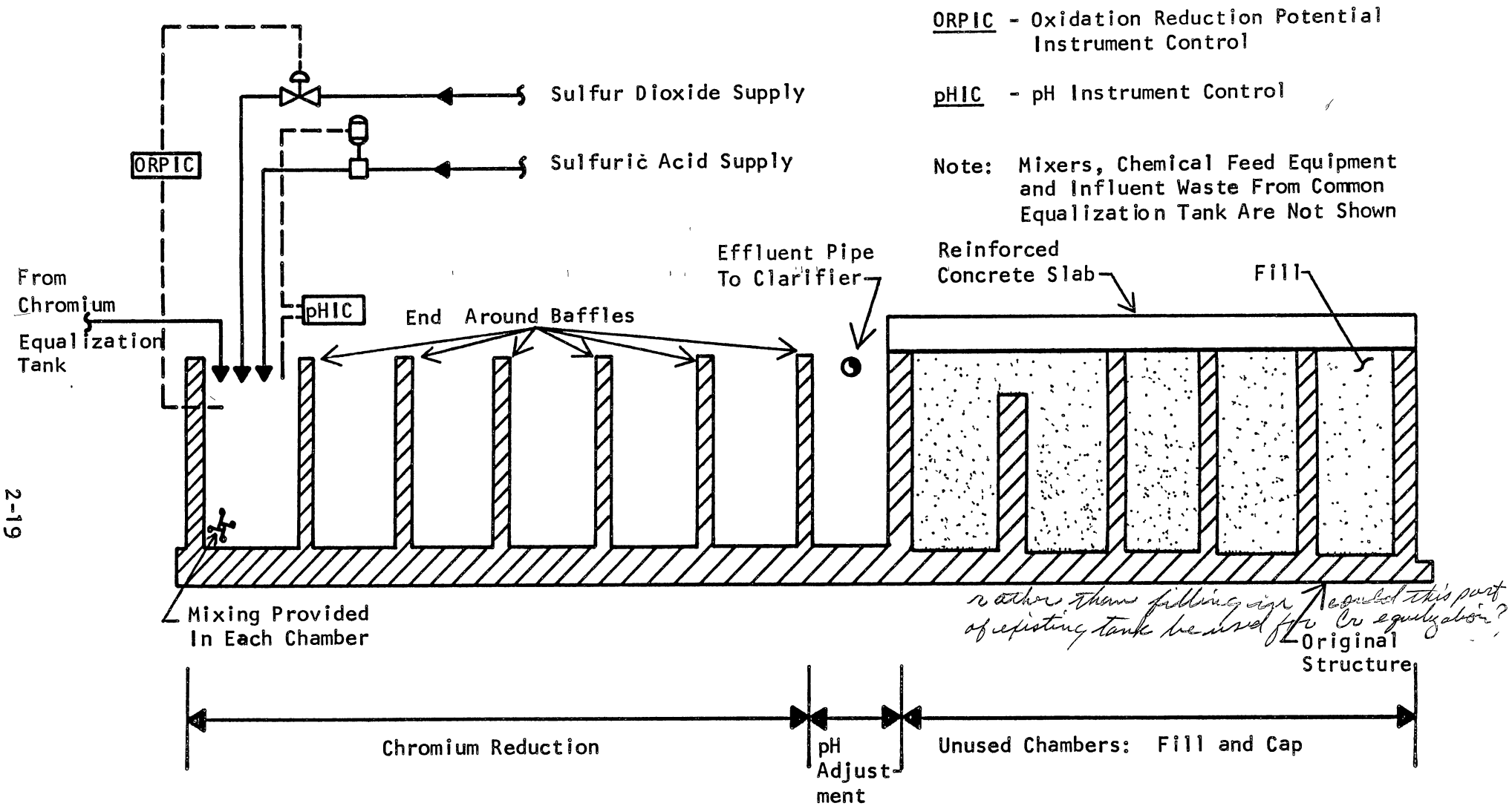


FIGURE 2-7:
EXISTING REACTOR CONVERTED
TO CHROMIUM REDUCTION

These wastes would be combined with treated cyanide effluent (879 gpd, Table 1-2), and conveyed via the main pump station to the main equalization tank, which will be adjacent to the chromium equalization area. The volume of the main equalization tank which will provide seven days of detention for the combined waste stream (19,126 gpd) would be 17,900 C.F.

A portion of this flow contains chelated rinse waters. Chelates are organic compounds in which the metal is contained as an integral part of a ring structure. The strong metal/chelate bond does not permit the metal to precipitate in a high pH (hydroxide) solution. (5) AVCO Lycoming uses chelating agents in a number of processes to keep bath metals in solution. They enter rinse water as dragout from plating baths and can interfere with subsequent metals removal treatment by hydroxide precipitation. Because their effect is dependent on concentration and actual waste conditions at the plant, the impact of chelates cannot be determined at the present time. To account for potential chelating agent interferences, two options have been developed. Option A assumes the chelates to have no significant effect on metal removal with lime. Option B presents a treatment scheme to overcome the problems resulting from chelate use. Final resolution will require a treatability study of the wastes once the plating facility is on-line:

Option A

Wastewater would be pumped from the equalization basin to the existing pH adjustment chamber where lime would be added with a new chemical feed and instrumentation system. At this point, the waste stream would be mixed with treated chromium waste. With a pH around 9.0, the mixed stream would feed to the existing upflow clarifier for settling. Effluent would be discharged to the Housatonic River. Sludge disposal will be discussed in the following section.

why not caustic?

Option B

After equalization, wastewater would be removed from the equalization basin and mixed with reduced chromium wastes. If pilot scale settling tests identify interference with metal hydroxide precipitation by chelates, the combined stream would be further acidified to destroy the chelates. Lime would then be added in a subsequent chamber and metal hydroxides precipitated in the existing upflow clarifier. Effluent would be discharged to the Housatonic River.

Historically, the Stratford Plant has had problems meeting the allowable pH discharge range of 6.0 to 9.5. More concentrated rinses resulting from plating area renovations may result in even wider fluctuations in effluent pH. Neutralization with automatic controls to add sulfuric acid or ^{caustic} lime must be considered. Therefore, CWTP effluent will be neutralized with sulfuric acid or lime prior to discharge in the effluent reuse holding tank (to be discussed in Section 2.2.5).

- Tumbling Machine Effluents - Effluent from these metal cleaning machines (ID #4, 4050 gpd, Table 1-1) consists primarily of detergents. This flow is currently directed to the chemical waste treatment plant. CWTP processes were not designed to treat detergents. Therefore, these processes are ineffective in eliminating these detergents; they continue to cause a foaming problem at the CWTP discharge point. Although sampling and analysis of this effluent stream will be necessary to confirm actual constituents before a method of treatment can be implemented, preliminary investigations indicate three potential options:

Option A

If the waste stream is biodegradable with a low oxygen demand and soluble metals, cyanides, and other NPDES parameters are absent, then the major problem is the visual impact of foaming. This can be eliminated using anti-foaming chemicals prior to discharge to the main equalization tank of the CWTP. Direct discharge to the river is possible but would require a separate NPDES permit. *permit would not be a problem if discharge is "clean"*

Option B

If problematic trace organics or high BOD concentrations are found to be a problem, filtration and carbon adsorption treatment may be bench-tested and, if successful, used as either a pretreatment before the CWTP or as a final treatment prior to river discharge.

Option C

While this is an "easy out" it would leave the plant wide open to criticism and/or scrutiny by the towns!

This option would direct this stream to the sanitary sewer and eventually to the Stratford Municipal Wastewater Treatment Facility. The wastes must conform to all regulations promulgated by the locality (Stratford) governing the type of waste that may be discharged to the sewer.

- Wash Tub Operation Rinse Water (ID #5, 1,800 gpd) Tote boxes used to transport metal parts from one process operation to another are washed clean in this operation, resulting in an effluent containing oil, grease, and solvents. The flow is presently sent to the CWTP. None of the processes at the CWTP are capable of altering or removing this material. For this reason, it is planned that this waste stream would be rerouted to the Oil Abatement Plant. The plant has adequate capacity to handle the flow and air flotation equipment to remove floatable organics. *good!*

- Steam Condensate Once-through steam flow, which heats the plating baths, generates a waste flow of 6,840 gpd. Problems arise when plate coils are defective and allow contaminated process water to enter the condensate return. [To address this, the condensed steam will be directed to a holding tank (7,000 gallons), tested for contamination, and discharged to common, cyanide or chromium collection and treatment if contaminants are found and to a storm water sewer if the water is acceptable. *sounds good*] Drain taps from each plate coil discharge would allow testing to locate the defective element.

A site plan of the proposed treatment units is provided in Figure 2-8.

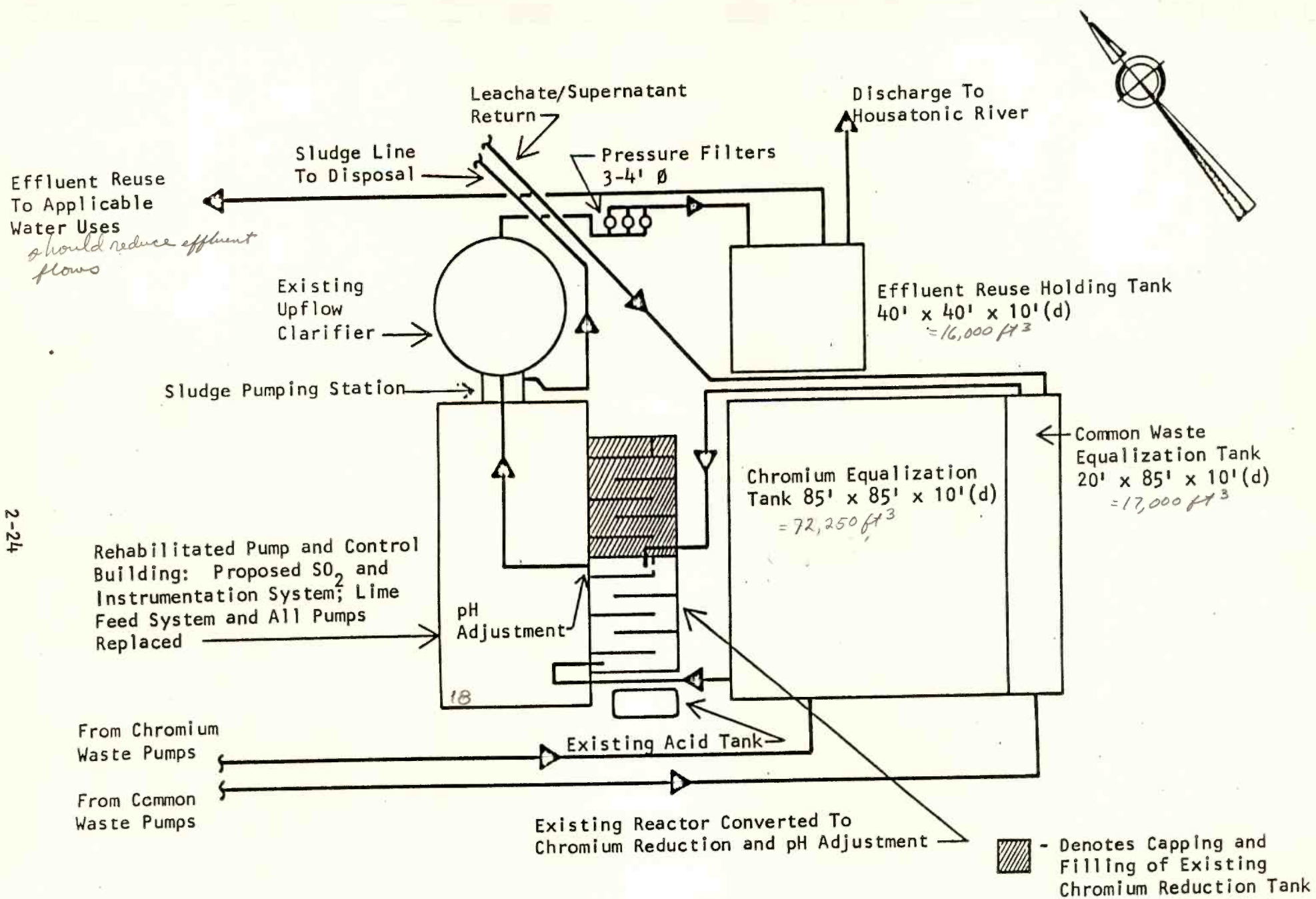
2.2.4 Sludge Disposal

Preliminary extraction testing on the sludge disposed in the sludge lagoon have yielded results which show high concentrations of cyanide in the sludge. It is possible that batch cyanide treatment, chromium reduction, adequate equalization capacity, and automatic instrumentation and chemical feed systems will produce a non-hazardous sludge. The outcome is dependent on future delisting procedures (i.e. sampling and submission of application to EPA to remove sludge from hazardous waste listings). The waste may prove to be a hazardous or non-hazardous material. To address either condition, the disposal plan was developed for two scenarios:

Scenario I: Solid Waste Management If Sludge Is Classified As Non-Hazardous

Scenario II: Solid Waste Management If Sludge Is Classified As Hazardous

Within each scenario, a number of options are available. The choice of which option to implement will be based upon a cost comparison within each scenario. The overall decision process is outlined in Figure 2-9.



2-24

FIGURE 2-8:
SELECTED PLAN
TREATMENT AREA

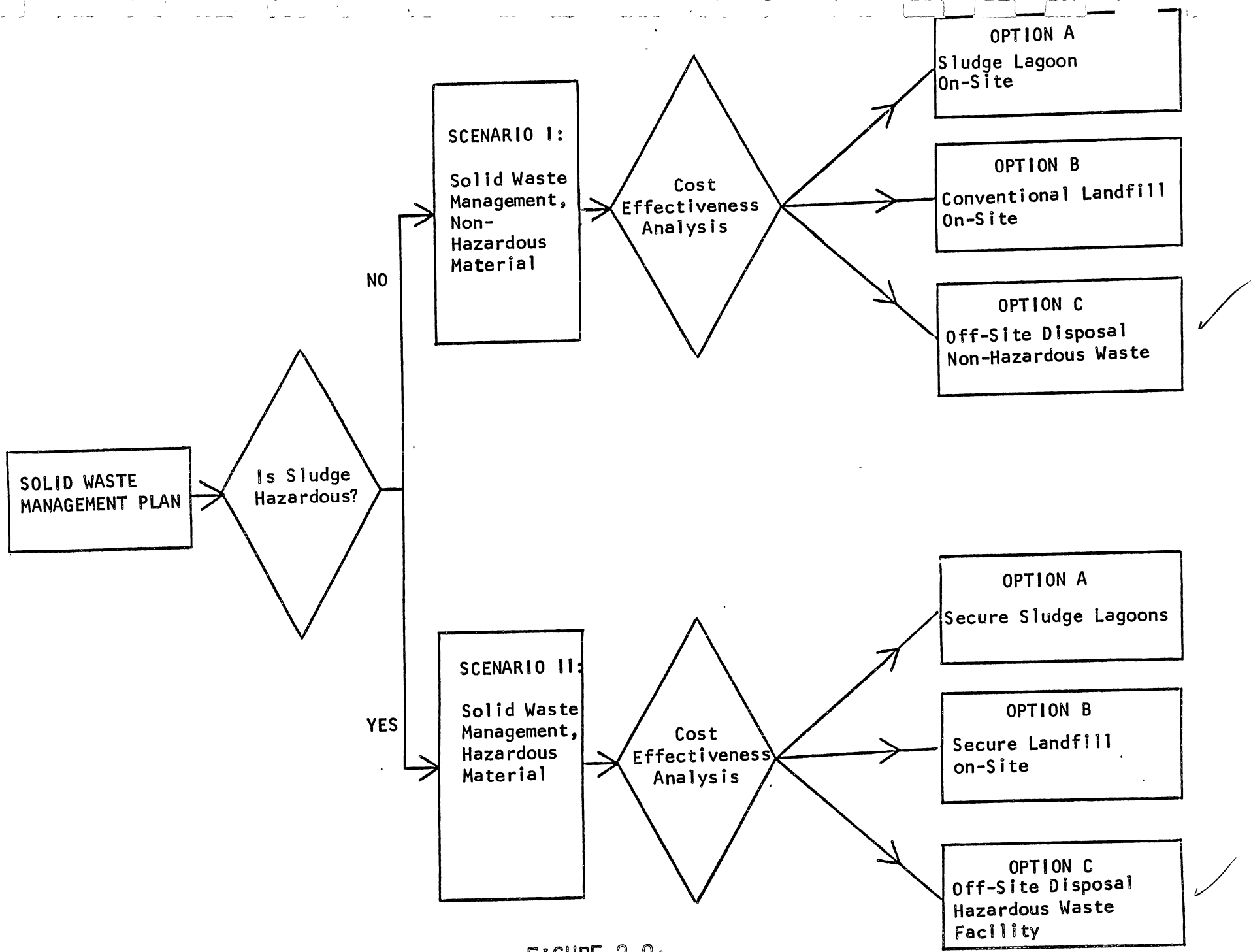


FIGURE 2-9:
SOLID WASTE MANAGEMENT DEVELOPMENT PLAN

Scenario I: Non-Hazardous Material Disposal

If the waste is classified as a non-hazardous material, on-site disposal must conform to requirements for a sanitary landfill or surface impoundment. The waste may also be disposed of at off-site facilities that fulfill the same requirements. Of these three options, described in more detail below, the least costly will be incorporated into the selected plan.

Option A: On-Site Disposal (Lagoons)

Sludge will be pumped to the three existing lagoons. The lagoons will be rehabilitated, including excavation and disposal off-site of enough of the existing material to provide storage for twenty years sludge disposal, regrading, and repair of the supernatant return system. *if lagoons must be kept (I don't like them!) an underdrain system should be installed to return liquid to CWP -*

Option B: On-Site Disposal (Landfill)

Sludge will be dewatered and trucked to a landfill on-site. The landfill will be located at the site of one of the existing lagoons. Material presently in the lagoon will be removed. Items common to sanitary landfills such as daily fill cover, sand liners and walls, and unit cell construction, will be used to provide stability.

For both Option A and B, a survey of the soil below the disposal area is necessary to determine its bearing capacity.

Option C: Off-Site Disposal

Sludge will be thickened and stored for disposal in an approved off-site disposal area.

Site development under the non-hazardous waste management options is shown in Figure 2-10.

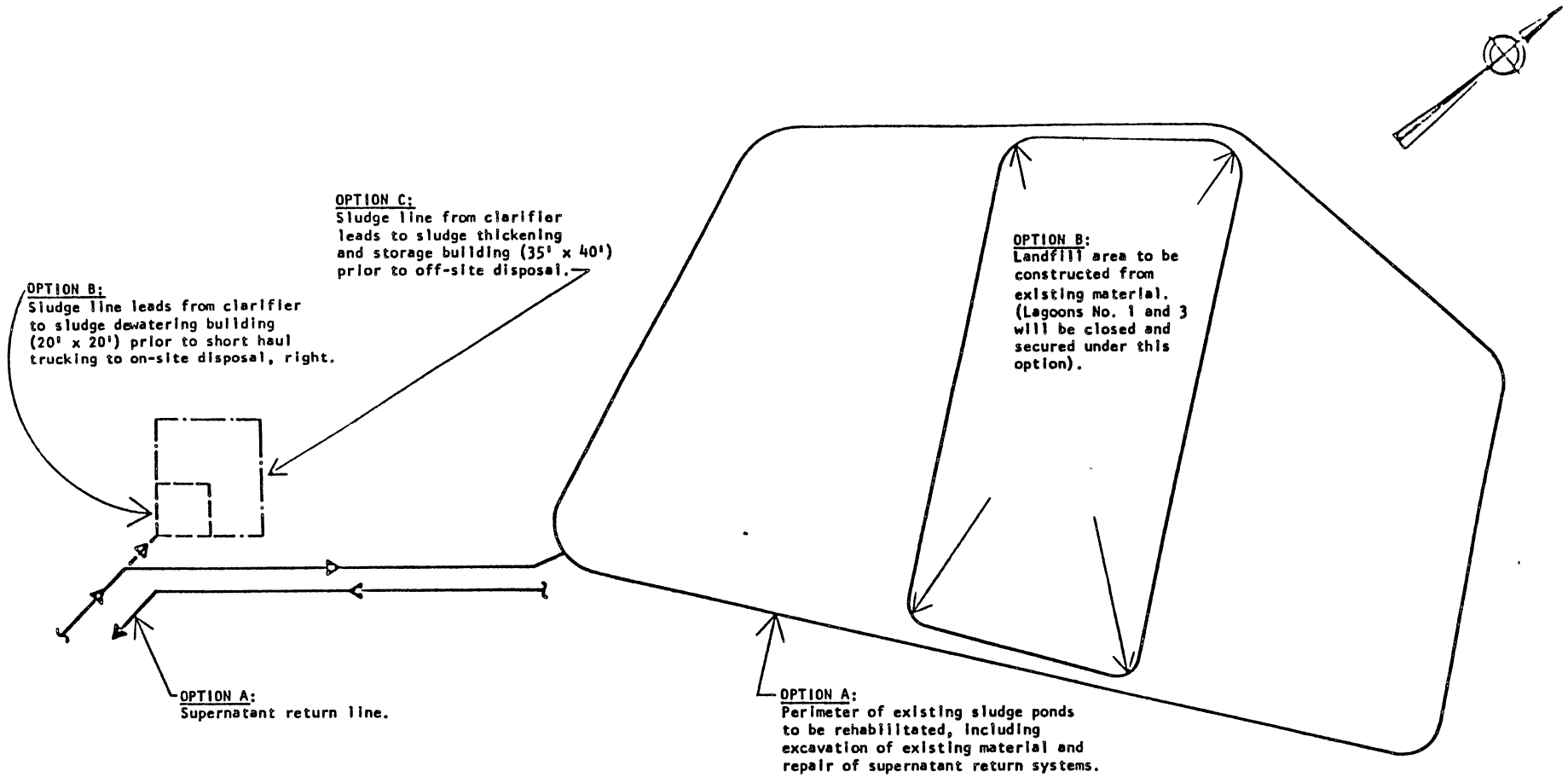


FIGURE 2-10:
DISPOSAL OPTIONS - SELECTED PLAN
SCENARIO I: NON-HAZARDOUS MATERIAL

Scenario II: Hazardous Material Disposal

If the waste is classified as hazardous, disposal must conform to the applicable regulations outlined in the Resource Conservation and Recovery Act (RCRA). Options developed under Scenario II, shown in Figure 2-11, address these regulatory requirements. A cost-effective analysis will determine which of the following options will become part of the selected plan.

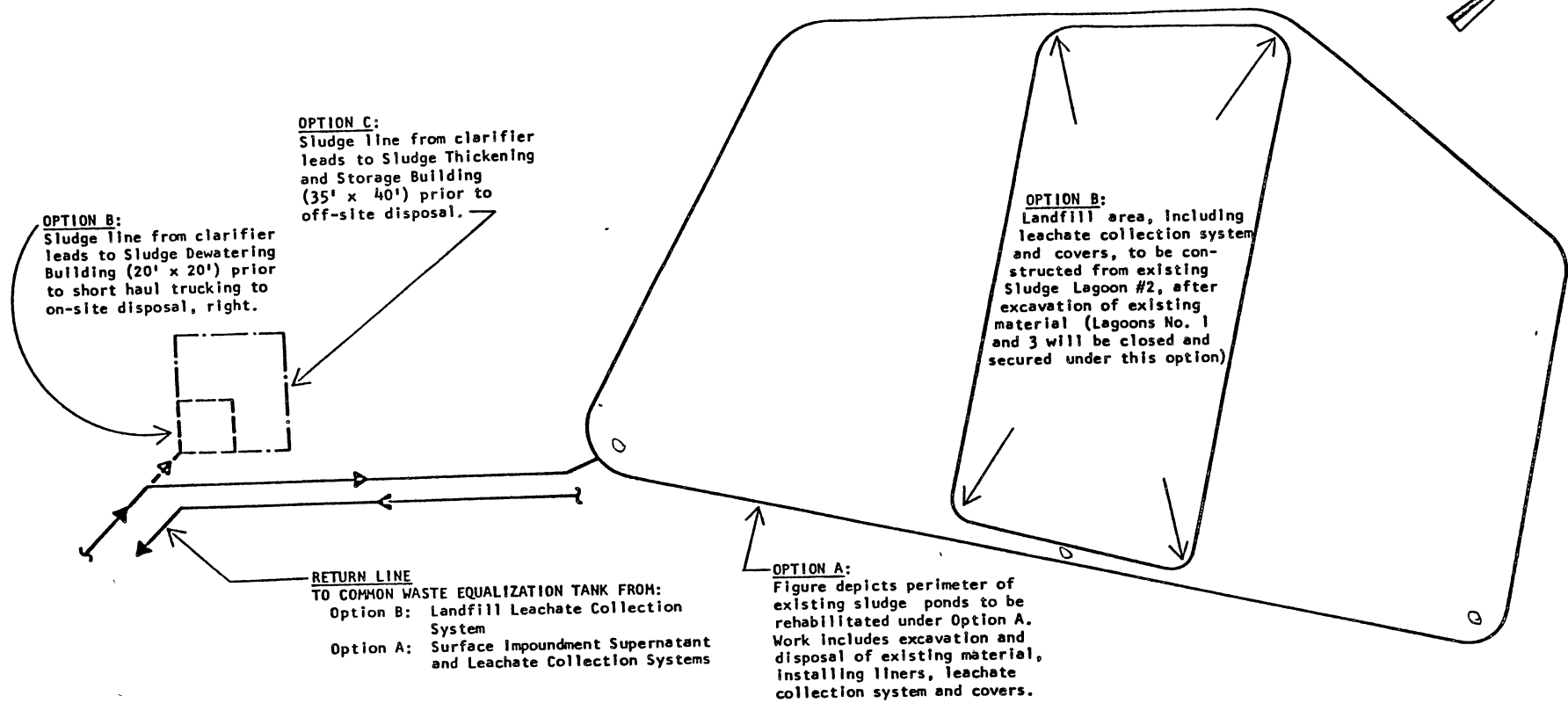
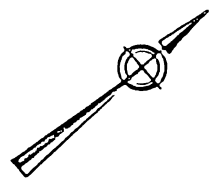
Option A: On-Site Disposal (Secure Sludge Lagoon)

Sludge measuring 2%-3% solids will be pumped from the clarifier to the three existing lagoon areas. Material presently in the lagoon will be either completely removed or removed to an elevation sufficient to allow construction of a secure system. The secure lagoon consists of a sand layer containing piping to return leachate, an impermeable liner below that, flood protection, and a supernatant (overflow) return system.

Option B: On-Site Disposal (Secure Landfill)

Existing sludge lagoon material will be either completely removed to an elevation sufficient to allow construction of a secure landfill. Leachate return, liners and flood protection will be included. Solids content of the sludge will be increased by pumping sludge from the clarifier to a dewatering building on site. The dewatered solids will be trucked to the proposed landfill. Sufficient moisture must be left in the material to prevent wind erosion.

The disposal site covers approximately 0.8 acres. (6) Rainfall in the area averages 44 inches per year. Precipitation would, therefore, contribute 2,600 gpd to either a pond overflow or landfill leachate return. To eliminate this flow and to prevent metal ions from reentering solution due to the acid nature of rainfall in this area, it is proposed that on-site disposal include an open air fiberglass cover.



2-29

FIGURE 2-11:
DISPOSAL OPTIONS - SELECTED PLAN
SCENARIO II: HAZARDOUS MATERIAL

Option C: Off-Site Disposal

Under this alternative, clarifier sludge would be directed to a gravity thickener to increase solids concentrations to about 7%. From there it would be directed to a holding tank prior to removal by private carters to an off-site disposal area. The existing on-site lagoons would be rehabilitated and closed in conformance with regulatory requirements.

2.2.5 Resource Recovery

Resource recovery schemes are not part of the process, treatment, and disposal categories used in discussing the proposed concept design. Rather, they are an interplay of all three. For this reason, they are presented as independent options. Their advantages and disadvantages are discussed in relation to their effect on plating operations, subsequent treatment, and disposal.

Metal Recovery

Although plating metals represent a major materials cost, recovery of these chemicals in either a marketable form or in a condition to be reused would require a significant capital outlay for recovery equipment as well as an operation and maintenance budget for energy and labor. These costs must be equal to or less than the value of the metals recovered. Based on materials losses from bath dumps (Appendix A, Table A-3) and dragout in rinse waters (Appendix A, Table A-2), and assuming an 80% recovery of materials, it would require close to twenty years to recover capital expenditures alone, based on EPA estimates for evaporative recovery.⁽⁷⁾ A further review of recovery processes disclosed that space requirements for these units may not be available at the AVCO facility. These factors, together with operational problems inherent in recovery units (e.g. solids buildup, advanced treatment requirements, rising energy costs) eliminated them from consideration in the selected plan.

Water Reuse

Water is a valuable and increasingly costly resource. Its recovery, or reuse, is to be encouraged for its economic advantages as well as for its conservation benefits. Three effluent streams have been identified as potential sources of process feedwater: steam condensate; CWTP effluent; and, air scrubber blowdown. The mechanics of reuse, from collection - to testing - to reuse, or treatment, are shown for each stream in Figure 2-12 and are discussed below.

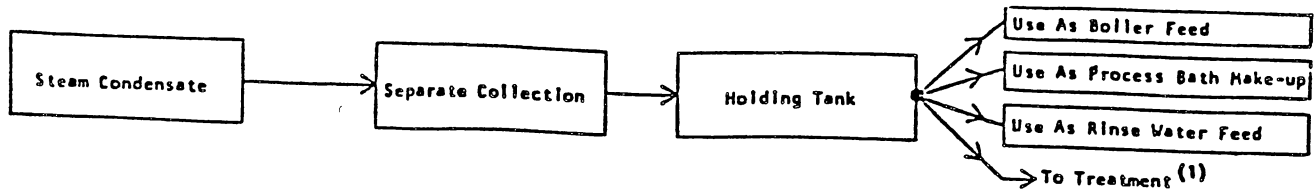
- Steam Condensate Return - Unless contaminated by defective plate coils, condensed steam from heated process tanks is clean (distilled) water. Reuse of this water would serve several purposes, depending upon its destination (Figure 2-12a).

Return To Boiler Feed - Using condensed steam as feedwater to a boiler serves a four-fold purpose: heat is recovered; fresh water intake is reduced; the solids free condensate would keep boiler and water treatment blowdown to a minimum; and, hydraulic loading to CWTP is reduced.

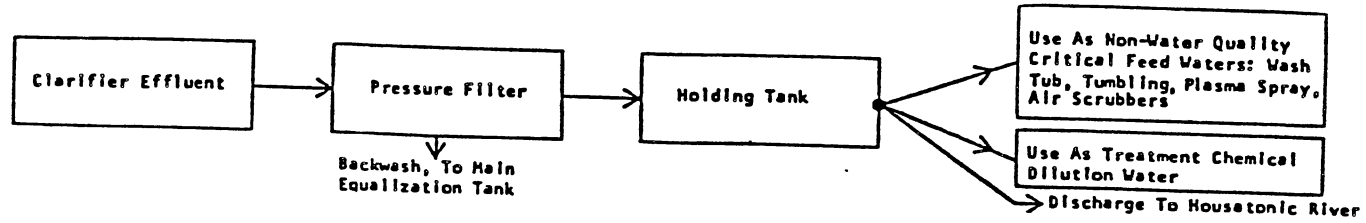
Use As Process Bath Make-Up Solvent - Dissolved solids present in all potable waters remain in process bath water and continue to build up in concentration as evaporation reduces volume. Using condensate would relieve this situation and may eliminate the expensive dumping of process batch water because of solids buildup.

Use As Rinse Water - To maintain a final rinse tank TDS concentration of 10 to 37 mg/l, a satisfactory rinse rate must be maintained. Condensate would reduce that rate and, therefore, lower the hydraulic loading to the CWTP. The use of condensate as either process bath make-up or as rinse water would reduce process use of potable water.

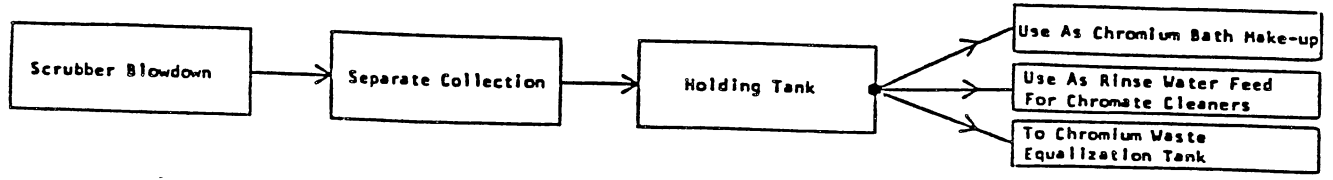
*could keep all 3 options open?
although rinse water seems best*



(A) CONDENSATE RETURN



(B) EFFLUENT REUSE



(C) SCRUBBER BLOWDOWN REUSE

LEGEND:
 → Waste Stream
 ● Decision Point
 (1) Denotes Cyanide Destruction, Chromium Reduction Or Precipitation, Depending On Waste Constituents

FIGURE 2-12:
 RESOURCE RECOVERY: WATER REUSE

Weston report on H₂O handling

P 1-1 P 1-2. How are we in violation of PCRT?

Steam condensate stream from
plate coils

P 2-16 - Equation does not match
the verbage.

Same page: - $\frac{879 \text{ gpc}}{\text{hr}}$ - how about $\frac{881}{\text{hr}}$?

P 2-18 Equation & words don't match.

P 2-22 Option C is unacceptable and
should be discarded. Reopen the
plant open to too many problems.

P 2-23 Steam Condensate:

How much more effort would be
required to have "on-line" testing
of the condensate at each
plate coil discharge? This would
allow returning the "clean"
condensate to the boiler. (?)

P 2-26 Option C is the only acceptable one.

How would thickening be done?

Additive (No!) or Deaerating (Yes!)

P 2-28 Option B - type of?

P 2-33 - Units(?)

Prior to use of any kind, condensate would be collected in a holding tank (7,000 gallons) and tested for contamination. If contamination is discovered, flow can be directed to cyanide destruction, chromium reduction, or precipitation, depending on the type of waste present. Drain taps from each plate coil discharge would allow testing to locate the defective element.

- CWTP Effluent Rinse ^{Reuse} - To meet the NPDES effluent concentration limits at the Stratford COE Plant, values of 1.5 mg/l or less must be reported for all metals. Water of this quality is acceptable for use in several process and treatment operations. For this reason, reuse of the CWTP effluent is included as a resource recovery application. *several lower than this*

Under this option, effluent from the clarifier would be further treated by passing through a pressure filter. Backwash will be returned to the head of the CWTP and mixed with non-cyanide, non-chromium streams. Filtered water is pumped to a holding basin. The basin, a concrete tank, will have provisions to remove sludge, since additional hydroxide settling may occur. The basin outflow will have two destinations: the first stream will be sent to a plant distribution system for reuse; the second will be discharged to the Housatonic River (Figure 2-12B). This latter stream represents a system "blowdown" wherein the concentration of dissolved salts is kept to a minimum. Make-up water, estimated to comprise 2/3 to 1/2 total daily water demand, will be from the existing potable water source. The effect of dissolved solids is further minimized by limiting application to streams where feed water quality control is not critical, such as air scrubber intake (ID #6, 27,000 gpd), CWTP plant water (estimated 48,000 TPD), wash tub operations (ID #5, 1,800 TPD), and plasma spray (ID #9, 5,620). *1,510,000 gpd*

all can use almost any water

31,000 gpd (?)
(Reuse ?)

The monitoring and reporting of effluent concentrations under the terms of the plant's NPDES permit, will also afford quality control of the reused water. If treatment plant performance is temporarily upset, the holding tank will serve to reduce those impacts by dilution and effluent reuse would be temporarily suspended to avoid adverse process effects.

Overall, effluent reuse has been shown to reduce water bills for electroplating operations similar to Stratford by almost \$60,000 per year per 100,000 gpd capacity. ⁽⁸⁾

*presently at 192,000 gpd
this equals \$115,000 per year*

- Scrubber Blowdown Reuse - Six wet scrubber units at the manufacturing plant are used to remove chromic acid as the major toxic component discharged to the ventilating system. Blowoff from these units is estimated at a flow rate of 27,000 gpd. This wastewater is typically considered to have a chromic acid concentration of up to 50 mg/l, together with minor components. Diverting this flow to a holding tank and using it for chromic acid make-up solution would reduce chromium losses, reduce hydraulic loadings to the chemical waste treatment plant, and lessen the need for neutralization and chromium reduction chemicals. Scrubber effluent can also be used for chromic acid rinse water, since concentrations of the last rinse tank can reach 750 mg/l and still be effective. These modifications should be attempted on a trial basis, and incorporated if they are not detrimental to plating performance (Figure 2-12C).

Of the three water reuse schemes presented, the first two, steam condensate return and CWTP effluent rinse, are considered the most feasible and have been incorporated into the selected plan (Figure 2-2). The third, scrubber blowdown reuse, requires definite characterization of the waste and a pilot program to assure that the practice does not interfere with plating quality.

SECTION 3

TOPICS FOR FUTURE EVALUATION

Several elements of the selected plan require input from the personnel at AVCO Lycoming prior to implementation in the final design. It is the intention of this section to present topics which must be properly addressed following submission of this report. Primary among these concerns are factors which affect and are affected by plating operations. It is Weston's intent to coordinate production and waste treatment so that treatment processes and water conservation techniques do not impair plating production and conversely, plating operations do not interfere with treatment. This section is intended to outline these areas of concern:

must

(1) Location of Treatment Processes

Figure 3-1 provides a location plan showing treatment processes, conveyance systems and disposal areas tentatively proposed under the selected plan. AVCO should review the plan to ensure that the proposed location of each unit does not interfere with present operations. The plan includes the following items:

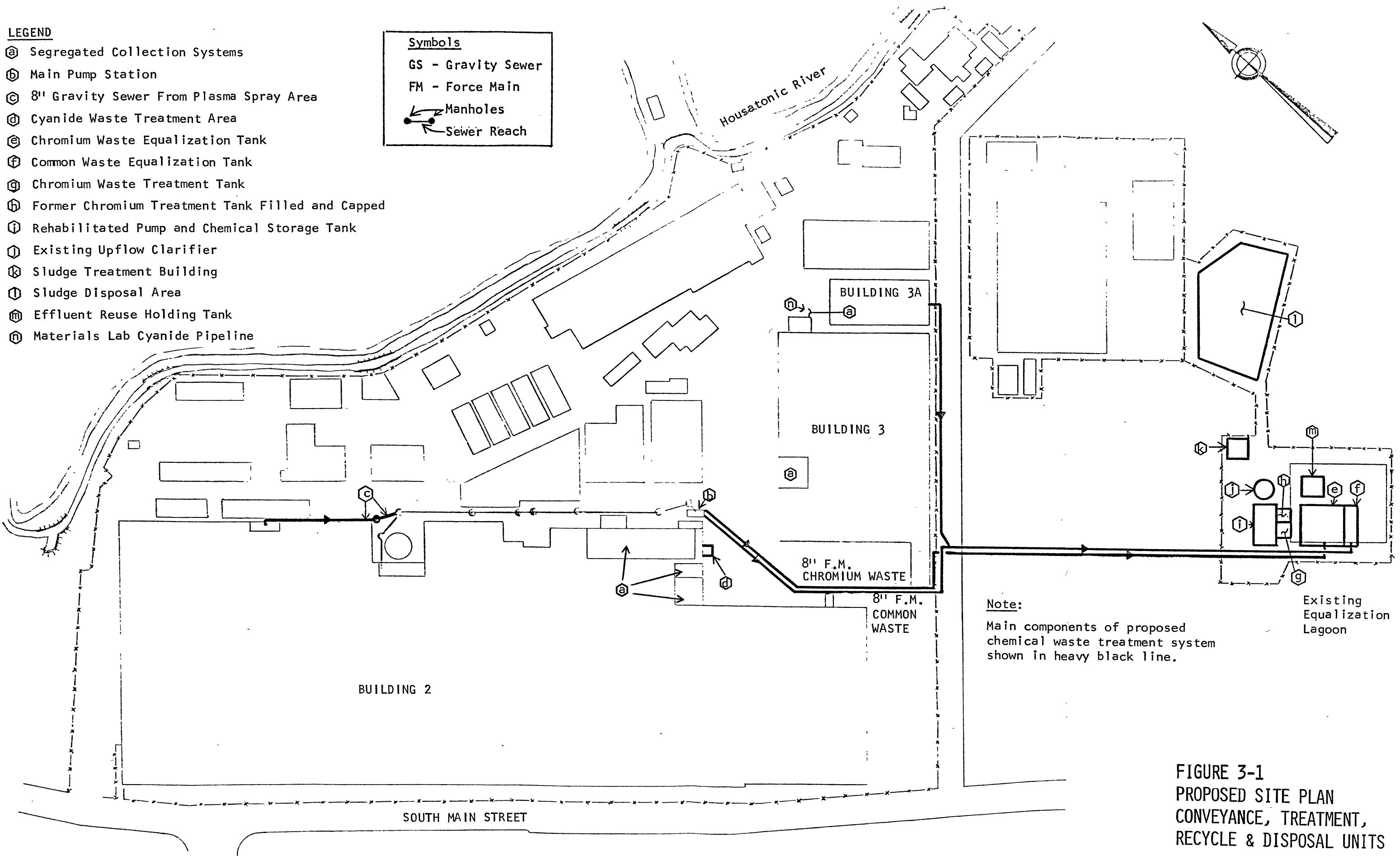
- A. Segregated Collection Systems - (Cyanide Wastes; Chromium Wastes; Common Wastes; and Steam Condensate)
Piping for each waste stream is to be installed in the main plating area, HAE, anodizing and engine overhaul area. The quality assurance and materials labs will have separate piping to either cyanide or common treatment.
- B. Main Pump Station and Force Mains - The existing pump station adjacent to Building 2 will be rehabilitated and two force mains installed to the treatment area to provide waste transport for chromium and common waste.
- C. Gravity Sewer - To convey plasma spray area waste to main pump station common waste wet well.
- D. Cyanide Treatment Building - Adjacent to Building 2 (east side).

LEGEND

- Ⓐ Segregated Collection Systems
- Ⓜ Main Pump Station
- Ⓒ 8" Gravity Sewer From Plasma Spray Area
- Ⓓ Cyanide Waste Treatment Area
- Ⓔ Chromium Waste Equalization Tank
- Ⓜ Common Waste Equalization Tank
- Ⓕ Chromium Waste Treatment Tank
- Ⓜ Former Chromium Treatment Tank Filled and Capped
- Ⓜ Rehabilitated Pump and Chemical Storage Tank
- Ⓜ Existing Upflow Clarifier
- Ⓜ Sludge Treatment Building
- Ⓜ Sludge Disposal Area
- Ⓜ Effluent Reuse Holding Tank
- Ⓜ Materials Lab Cyanide Pipeline

Symbols

- GS - Gravity Sewer
- FM - Force Main
- ↔ Manholes
- ↔ Sewer Reach



Note:
Main components of proposed chemical waste treatment system shown in heavy black line.

FIGURE 3-1
PROPOSED SITE PLAN
CONVEYANCE, TREATMENT,
RECYCLE & DISPOSAL UNITS

- E. Chromium Waste Equalization Tank - At site of existing equalization lagoon. Requires complete removal of material in existing lagoon. *permit to transport*
- F. Common Waste Equalization Tank - Abutting chromium equalization tank in area of existing equalization lagoon.
- G. Chromium Reduction Tank - To be constructed from existing cyanide treatment tank.
- H. Existing Chromium Reduction Tank - Fill and cap.
- I. Existing Chemical Storage, Pump and Control Building - To be rehabilitated.
- J. Existing Upflow Clarifier - To be retained. *(need rehab?)*
- K. Sludge Treatment Building - For Scenarios I and II (Hazardous or Non-Hazardous Material Classification), structure is required for either Option B - dewatering building for on-site landfill, or Option C - sludge thickening and storage prior to off-site disposal. Size will vary.
- L. Disposal Area - For Scenarios I and II (Hazardous or Non-Hazardous Material Classification), and will be developed as either a lagoon (Option A) or landfill (Option B).
- M. Effluent Reuse Holding Tank - For testing prior to wastewater recycling.

(2) Variations In Waste Stream Constituents

Changes in the type of chemicals used in plating and cleaning operations cause a direct change in the chemical constituents of the resulting wastewater. New chemicals should not be used as substitutions in the process unless their waste discharge is amenable to treatment. It must be emphasized that a metal finishing chemical treatment plant may be designed with some flexibility but the replacement of chemicals with other compounds to effect better or more efficient plating can cause contaminant removal processes to malfunction.

*remember
not all purpose*

Of primary concern is the use of chelates. A list of chelating agents presently being used is given in Appendix B. They are a major problem in metal precipitation technology since their primary function is to keep metals in suspension. The selected plan includes a treatability study to determine whether or not metal precipitation is hindered by chelate activity. If it is, AVCO must decide whether to implement a chelate treatment operation or to replace the chelating agent; that is, limit or eliminate their use in the baths themselves.

*apparently not
all present*

An inventory of chemical usage revealed that primary chelate use at the Stratford facility is associated with alkaline cleaners. Substitution with compounds that have a less adverse affect on precipitation is feasible.

evaluate

(3) Effluent Reuse

The proposed plan includes facilities to reuse the chemical waste treatment plant effluent for treatment plant water and certain non-critical process area water uses (i.e. air scrubber make-up, plasma spray, tumbling machine, and wash tub feed water, etc.). The following scheme is involved: a holding tank and water distribution system; monitoring to assure water quality (already required by the existing NPDES permit). This plan is not an integral part of treatment, however, and is included based on its anticipated cost benefits and because it ensures the plant of a major portion of its water supply needs.

*many non-critical uses
can reduce both intake & effluent*

(4) Steam Condensate Return

Reuse of steam condensate has been avoided at the AVCO Stratford facility because of valid fears that defective plate coils can damage boilers and process baths. The proposed plan calls for condensed steam to be collected in a holding tank and tested. A short duration color test may allow reuse of hot water, saving both energy and water. The plan has potential impact on both operations and equipment and, therefore, requires a review by AVCO before implementation.

(5) Scrubber Blowdown Reuse *probably not*

This element of the plan presents the most problems to implementation: blowdown constituents vary and the use of additives to improve performance, although not a current practice, would prohibit reuse. AVCO must review the option and decide on its applicability to the Stratford facility.

(6) Existing Sewer System Evaluation

According to AVCO personnel, the existing sewer system is inspected and maintained by a private contractor. If reports recording the condition and layout of the sewer system at AVCO's Stratford facility are available, two major areas relevant to Weston's final design must be resolved; these are:

- A. The extent of sewer system rehabilitation required. The maintenance contractor should be aware of leaky joints, blockages, excess settlement and other problems that should be addressed in the final design. The condition of the existing force main affects treatment choices; if it must be replaced, the cost-effective balance towards separate chromium and common waste treatment increases. *↳ would not like common treatment*
- B. The layout of the existing sewer system. Comprehensive maps of the industrial waste sewer system at AVCO have not been available. Questions exist regarding the ultimate destination of wash tub and materials lab effluents. The existing sewer system must be defined before additions are planned.

dye-testing!

(7) Combined Cyanide and Chromium Contaminants

Weston's review of process conditions revealed that cyanide and chromium are not used in the same process tanks in any area of the Stratford plant. If this is not true, treated cyanide wastes must be discharged to the chromium waste wet well.

?

REFERENCES

- 1 Closure Of Hazardous Waste Surface Impoundments
September 1980
Municipal Environmental Research Laboratory
USEPA
SW-873
- 2 Correspondence, AVCO Lycoming Plant Utilities and
State of Connecticut Department of Environmental Protection,
May 5 and 15, 1981
- 3 Concept Engineering Report For Plating Wastewater Treatment,
Gould, Inc., by Roy F. Weston, June 1981
p. 3-1
- 4 Concept Engineering Report, Wastewater Treatment Facility,
Martin Marietta Aerospace
Roy F. Weston, 1978
p. A-12
- 5 Development Document For Existing Source Pretreatment Standards
For The Electroplating Point Source Category
Final, August 1979, EPA 440/1-79-003
- 6 RCRA Hazardous Waste Management Plan
AVCO Lycoming, prepared by Industrial Pollution Control
p. IX-11
- 7 Summary Report: Control Technology For The Metal
Finishing Industry - Evaporators
EPA 625/8-79-002, June 1979
- 8 Wastewater Treatment and Reuse In A Metal Finishing Shop
EPA 670/R-74-042

APPENDICES

APPENDIX A

METHODOLOGY FOR ESTIMATING PROCESS FLOWS TO CWTP

(Summary of Results shown in Table 1)

TABLE A-1: METHODOLOGY FOR ESTIMATES OF PROCESS AREA RINSE TANK FLOWS

A. BASIS

Formula^{1,2} used in expected water conservation areas only (ie in Main Plating Area - location ID #1)

$$\text{Rinse Rate (gpd)} = \frac{(C_p/C_n)^{1/n}}{E} \times \left[\text{Dragout Rate} \times \text{Metal Production Rate} \right]$$

where:

C_p = Plating bath concentration (mg/l total solids)

C_n = Concentration of nth rinse tank (mg/l total solids)

n = number of rinse tanks

E = Rinse tank efficiency

Dragout Rate = Gallons bath solution removed/1000 ft² metal² plated

Metal Production Rate = Projection future conditions in ft² metal/day

B. ASSUMPTIONS:

- For C_p: Special Process Procedure (SPP) sheets used for tank constituencies. Factors of: 1oz/Gal = 7500 mg/l and 1% volume = 10,000 mg/l used to convert concentrations for formula calculations
- For C_n: Concentrations² of 750 mg/l for cleaning rinses and 37 mg/l for plating rinses used (from EPA text)³
- For n: Double counter-current rinses considered in all cases; variation of formula with multiple of n was used where cold water rinses were followed by hot water rinse.
- For E: 70% assumed.
- For Dragout Rate: 5 gal/1000 ft² used (this rate is typically applied to complex metal parts)
- For Metal Production Rate: Instructed by AVCO Lycoming to assume a factor of 3 times current production rates displayed in Table A-2.
- Rinse Rate Formula: Only applicable where water conservation measures will be definitely employed (ie. Renovated Plating Area of Bldg. 2 - Location ID #1 and in Engine Overall Area of Bldg. 3 - Location ID #10).
- For other metal finishing operations (ie. Anodizing & HAE Areas of Bldg. 2 - Location ID #'s 2 and 3), existing rinse tank flowrates⁴ were utilized as modified for projected tripling of production rates.
- In renovated process areas (ie. Plating) production increases will be met by expanded work area while operating hours remain constant.
- In non-renovated process areas (ie. Anodizing & HAE) production increases will be met by extending operating hours since work area is constant.

1 Derived from EPA document: Control Technology for the Metal Finishing Industry - EPA 625/8-79-002, pp 8

2 Reference correspondence to Bob Carr; Chief, Building Design and Construction, AVCO Lycoming Division - July 1, 1981

3 Development Document for Interim Final Effluent Limitation Guidelines and Proposed New Source Performance Standards for the Common and Precious Metals Segment of the Electroplating Point Source Category, by USEPA, April 1975, EPA-440/1-75/040, pp 125

4 EPA Electroplating Information Request - Data Collection Portfolio - Submitted by Peter Bonitatebus, Chief of Plant Utilities, AVCO Lycoming Division - Aug. 21, 1978

TABLE A-2: ESTIMATES & BACKGROUND DATA FOR PROCESS AREA RINSE TANK FLOWS

#/yr

LOCATION I.D. NO.	PROCESS OPERATION & TANK DESCRIPTION	PRODUCTION RATES (Ft ² Metal/Day)		OPERATING SCHEDULE (Hours/Day)		WATER CONSERVATION MEASURES	PROCESS BATH CHEMICAL INGREDIENT	RINSE CONCENTRATION (mg/l)	PROCESS BATH CONCENTRATION		SEPARATE TANK FLOWS (GPD)	TOTAL OPERATION FLOWS (GPD)	
		PRESENT	FUTURE	PRESENT	FUTURE				Oz/Gal	mg/l			
1	PLATING AREA Copper Plating: - Anodic Clean - Periodic Reverse Clean - Hydrochloric Acid Dip - Copper Plate	160 27.6	480	20	20	Yes						#/0	
							Steel Cleaner	750	10.00	75,000	34.3	5.7 x 10 ⁻³	6.7
							Cleaner	750	32.00				
							Sodium Cyanide		16.00				
									48.00	360,000	75.1	1.2 x 10 ⁻²	3.7
							HCl - Full Strength	750	133.48	1,000,000	125.2	2.07 x 10 ⁻²	6.3
							Copper Cyanide	37	6.00				
							Sodium Cyanide		7.75				
							Potassium Hydroxide		2.50				
							Metex (1%)		16.25				
	Rocheltex (6%)		1.33										
			8.00										
			25.58	191,850	493.8	4.02 x 10 ⁻³	1.2						
						728.4							
	Nickel Plating: 2 - Hydrofluoric Acid Dip - Woods Nickel Strike - Sulfamate Nickel (2 Tanks)	15 ³ 2.6%	45	20	20	Yes							
							HF (60% Strength) @33% Volume	750	26.7	199,800	5.2	9.7 x 10 ⁻⁴	0.3
							Nickel Chloride	37	32.00				
							HCl Acid (12.5%)		16.67				
							Maintain 12% Nickel	37	51.00	382,500	65.0	2.6 x 10 ⁻⁴	0.08
						5.3 x 10 ⁻⁴	0.2						
						104.0							
	Chromium Plating: - Reverse Etch - Chrome Plate - Chrome Strip	3 0.5%	9	24	24	Yes							
							Chromic Acid	750	32.00				
							Sulfuric Acid		32				
									32.32	242,400	1.2	2 x 10 ⁻⁴	0.06
							Unichrome CR-110	37	30.67				
							Sulfates		19				
	Silicon Fluoride		33										
			31.19	233,900	5.1	4.2 x 10 ⁻⁵	0.01						
			32.00	340,000	5.2	4.2 x 10 ⁻⁵	0.01						
					11.5								

A-2

TABLE A-2. ESTIMATES & BACKGROUND DATA FOR PROCESS AREA RINSE TANK FLOWS

#/R

LOCATION I.D. NO.	PROCESS OPERATION & TANK DESCRIPTION	PRODUCTION RATES (Ft ² Metal/Day)		OPERATING SCHEDULE (Hours/Day)		WASTE CONSERVATION MEASURES	PROCESS BATH CHEMICAL INGREDIENT	RINSE CONCENTRATION (mg/l)	PROCESS BATH CONCENTRATION		SEPARATE TANK FLOWS (GPD)	TOTAL OPERATION FLOWS (GPD)
		PRESENT	FUTURE	PRESENT	FUTURE				Oz/Gal	mg/l		
	<u>Cadmium Plating</u> ⁴ (a) On Ferrous Alloys - Electro Clean - Periodic Reverse Clean - Hydrochloric Acid Dip - Cadmium Plate - Chromic Acid	0.2% .5	3 1.5	1 .5	1 .5	Yes						#/D 3.3x10 ⁻⁵ 0.0 8.3x10 ⁻⁵ 0.0 2.6x10 ⁻⁵ 2.9 1.5x10 ⁻⁵ 4.6 1.4x10 ⁻⁵ 4.3
	(b) On Vane Assembly Same as above, but with added Woods Nickel Strike - Woods Nickel Strike	.5	1.5	.5	.5						7.4	
	Passivation: - Alkaline Cleaner - Passivation (No Rinse)	100 17.2	300	16	16	Yes						
	Mn and Zn Phosphating - Alkaline Derust Clean - Manganese Phosphate ⁵ - Zinc Phosphate ⁵	10 1.7%	30	12	12	Yes	Turco 4181 Rust Shield #2 (Mn PO ₄) (Zn PO ₄)	750 37 37	48.00 7.34 7.34	360,000 55,000 55,000	9.4 8.3 8.3	1.6x10 ⁻³ 0.5 6.8x10 ⁻⁵ 0.02 6.8x10 ⁻⁵ 0.02 26.0
	Black Oxide: - Alkaline Clean - Hydrochloric Acid Dip - Black Oxide	10 1.2%	30	16	16	Yes	Steel Cleaner HCl Chromic Acid	750 750 37	10.00 133.33 6.00	75,000 1,000,000 45,000	2.1 7.8 59.7	3.5x10 ⁻⁴ 0.1 1.3x10 ⁻³ 0.4 4.9x10 ⁻⁴ 0.15 69.6
											Average =	8.2
							Ferrodex #8	750	8.00	60,000	38.3	8.3 38.3

A-3

TABLE A-2: ESTIMATES & BACKGROUND DATA FOR PROCESS AREA RINSE TANK FLOWS

#/yr

LOCATION I.D. NO.	PROCESS OPERATION & TANK DESCRIPTION	PRODUCTION RATES (Ft ² Metal/Day)		OPERATING SCHEDULE (Hours/Day)		WATER CONSERVATION MEASURES	PROCESS BATH CHEMICAL INGREDIENT	RINSE CONCENTRATION (mg/l)	PROCESS BATH CONCENTRATION		SEPARATE TANK FLOWS (GPD)	TOTAL OPERATION FLOWS (GPD)
		PRESENT ¹	FUTURE	PRESENT	FUTURE				Oz/Gal	mg/l		
	Clean Before Heat Treat: - Alkaline Permanganate Soak - HF/HNO ₃ Acid Dip - Alkaline Derust Soak	100 17.2%	300	8 ⁶	8 ⁶	Yes	Turco 4181	750	48.00	360,000	47.1	#D 7.8x10 ⁻³ 2.4
							Nitric Acid Hydrofluoric Acid	750	66.72 26.42	93.14 698,550	65.4	1.1x10 ⁻² 3.4
							Turco 1481	750	48.00	360,000	93.9	1.5x10 ⁻² 4.6
											206.5	
10	ENGINE OVERHAUL AREA Cleaning of Renovated Parts: - Emulsion Clean - Alkaline Clean - Alkaline Derust - Alkaline Permanganate - Alkaline Soak	100 ⁶ 12.2%	900 ⁷	8 ⁶	24 ⁷	Yes	Turco 3878 Turco 4215 Turco 4181 Turco 4181 Dubois Sprex	750	33.33 8.00 48.00 48.00 6.00	250,000 60,000 360,000 360,000 45,000	281.6	all 1200 gpd 281.6 4.6x10 ⁻² 14
2	HAE AREA Anodizing On Magnesium: - Alkaline Cleaner - Chromic Acid - HAE Tank - Post Dip (No Rinse)	60 10.3%	180	12	24 ⁹	No	Turco 4215 Ammonium Bifluoride and Sodium Dichromate	-- -- -- --	-- -- -- --	-- -- -- --	11,520 8,640 8,640 --	28,800 ¹⁰
3	ANODIZING AREA Anodizing On Aluminum: - Alkaline Cleaner - Deoxidizer - Chromic Acid Anodize (No Rinse)	20 3.4%	60	6	18 ⁹	No	Dubois Sprex A.C. Dubois D-Smut	-- --	-- --	-- --	8,100 --	16,200 ¹⁰
	Chromate Conversion: - Alkaline Cleaner - Chromate Conversion Coat	1 ³ 0.17% 580	3 99.6%	2	6 ⁹	No	Dubois Sprex A.C. Iridite 14-2	-- --	-- --	-- --	2,700 --	2,700 ¹⁰

4-A

1 - From EPA Electroplating Information Request - Data Collection Portfolio - Submitted by Peter Bonitatebus, Chief of Plant Utilities, AVCO Lycoming Division - August 21, 1978
Rates modified as required to current day based upon discussions with Mike Brancucio and George Michrina, Process Dept., AVCO Lycoming

2 - Process steps for nickel operation refer to plating before braze only, since this comprises 98% of all nickel plating performed.

3 - Existing production rate from footnote 1 adjusted per process personnel recommendations

4 - Fifty percent of cadmium plating is performed on ferrous alloys and fifty percent on vane assembly; calculate independently and average for this analysis

5 - Assume 50% of treatment done equally for Mn and Zn and that both concentrations are similar

6 - Assumed due to unavailability of future production data.

7 - High future production assumed for worst case projections.

8 - Alternate cleaners offered for different needs; applied cleaner with maximum concentration for flow calculations.

9 - Assumed to increase to meet projected production rates, since work area is not being expanded.

10 - Actual flow rates used, as presented in footnote 1, and adjusted for projected operating schedule increases. Flows reflect lack of water conservation measures.

#/D		D	N	O	S	A	J	J	M	A	M	F	J
AUG	<u>007</u>												
2.9×10^{-3}	phenol	2.6^{-3}	2.8^{-3}	2.6^{-3}	3^{-3}	2.9^{-3}	-	3.6^{-3}	3.6^{-3}	2.1^{-3}	-	-	-

008

4.2×10^{-4}	Cd	3^{-4}	2.7^{-4}	3.4^{-4}	4^{-4}	4.2^{-4}	4.1^{-4}	4^{-4}	4.2^{-4}	4.1^{-4}	4.2^{-4}	4.1^{-4}	4.2^{-4}
6.7×10^{-4}	Cr ⁶	3^{-4}	2.7^{-4}	3.7^{-3}	4^{-4}	4.2^{-4}	4.1^{-4}	4^{-4}	4.2^{-4}	4.1^{-4}	4.2^{-4}	4.1^{-4}	4.2^{-4}
6.3×10^{-3}	Cr ^T	1.2^{-2}	5.9^{-3}	9.4^{-3}	1.2^{-3}	3^{-3}	4.1^{-3}	6.3^{-3}	3.7^{-3}	4.1^{-3}	3.8^{-3}	1.6^{-2}	5.8^{-3}
2.1×10^{-2}	Cu	2.3^{-2}	1^{-2}	2.3^{-2}	1.9^{-2}	2.4^{-2}	1^{-2}	5.9^{-3}	9.1^{-3}	4.9^{-3}	4.2^{-2}	1.4^{-2}	7.5^{-3}
4.2×10^{-3}	FE	3.9^{-3}	2.2^{-3}	5.4^{-3}	4.8^{-3}	4.3^{-3}	6.9^{-3}	4.4^{-3}	2.9^{-3}	2.9^{-3}	6.7^{-3}	3.3^{-3}	2.1^{-3}
5.7×10^{-3}	Ni	6.1^{-3}	1.1^{-2}	4.4^{-3}	2.8^{-3}	5.1^{-3}	4.9^{-3}	3.6^{-3}	2.9^{-3}	4.9^{-3}	7.6^{-3}	6.6^{-3}	8.7^{-3}
3.8×10^{-3}	Zn	8.2^{-3}	2.7^{-3}	1.3^{-3}	5.2^{-3}	8.9^{-3}	1^{-2}	4^{-4}	5.8^{-3}	8.2^{-3}	8.4^{-4}	1.2^{-3}	8.3^{-4}
1.8×10^{-3}	CN	2.4^{-3}	5.4^{-4}	3.4^{-4}	4^{-3}	4.2^{-4}	8.1^{-4}	4^{-4}	4.1^{-3}	4.1^{-3}	4.2^{-4}	3.3^{-3}	4.2^{-4}

8.8×10^{-1} PHENOL

- 1.3×10^{-1} Cd
- 2×10^{-1} Cr⁶
- 1.9 Cr^T
- 6.4 Cu
- 1.3 FE
- 1.7 Ni
- 1.2 Zn
- 5.5×10^{-1} CN

#/YR DISCHARGED VIA 007 & 008

to change
m grams \rightarrow grams mult by 10^{-3}

grams \rightarrow lbs mult by 2.2×10^{-3}

\therefore
mg \rightarrow lbs mult by 2.2×10^{-6}

7.8×10^3

liters \rightarrow gals mult by 2.6×10^{-1}

$^{-5}$
3.5

$$\frac{\text{mg}}{\text{L}} \times 10^{-3} \frac{\text{g}}{\text{mg}} \times 2.2 \times 10^{-3} \frac{\#}{\text{g}} \times 2.6 \times 10^{-1} \frac{\text{L}}{\text{g}}$$

$$2.2 \times 10^{-7} \frac{\#}{\text{g}} = 1 \frac{\text{mg}}{\text{L}} \times$$

$$2.2 \times 10^{-7} \frac{\#}{\text{g}} \times \frac{\text{g}}{\text{d}} =$$

TABLE A-3

ESTIMATES AND BACKGROUND DATA FOR PROCESS AREA BATH DUMP¹ FLOWS

LOCATION ID #	PROCESS OPERATION & TANK DESCRIPTION	TANK VOL. (GAL)	NORMAL LIFE (MTHS) ²	FLOWS	
				ANNUAL (GPY)	AVERAGE (GPD)
1	<u>PLATING AREA</u>				
	- Copper Strip (2 tanks)	405	2	4,860	13
	- Periodic Reverse (2 tanks)	405	5	1,944	5
	- Copper Plate	405	2	2,430	7
	- Alkaline Derust	450	2	2,700	7
	- Anodic Clean	450	3	1,800	5
	- Hydrochloric Acid (2 tanks)	405	1	4,860	13
	- Woods Nickel	200	1	200	1
	- Permanganate	450	4	1,350	4
	- Passivating	360	1	4,320	12
	- Manganese Phosphate	200	6	400	1
2	<u>ANODIZING AREA</u>				
	- Hot Water Seal	405	0.25	19,440	53
	- Chromic Anodize	135	3	540	2
	- Dichromate	360	2	2,160	6
	- Emulsion Cleaner	420	2.5	2,016	6
	- Etch Tank	200	1	200	1
	- Acid Cleaner	360	3	1,440	4
	- Caustic Anodize	180	0.25	8,640	24
	- Ultrasonic Cleaner	134	2	804	2
	- Hydrofluoric Acid	200	2	1,200	3
	- Aluminum Cleaner	360	1	360	1
3	<u>HAE AREA</u>				
	- Chromic Acid	360	4	1,080	3
	- Post Dip	420	6	840	2
10	<u>ENGINE OVERHAUL AREA</u>				
	- Soak Cleaner	565	0.75	9,040	25
	- Alkaline Cleaner	405	3	1,620	4
11	<u>MATERIALS LAB</u>				
- Research Plating Tanks	120	1 day	43,200	120	
<u>TOTAL</u>				118,148	324

¹ Process dumps include both those tank solutions which are discharged periodically upon becoming contaminated as well as equivalent tank volumes which are often lost to drains due to overfilling mishaps.

² Information provided by Lab and Process personnel at AVCO Lycoming

TABLE A-4

ESTIMATES AND BACKGROUND DATA FOR OTHER PROCESS AREA FLOWS

<p><u>LOCATION ID #4</u> <u>BARREL FINISHING AREA</u></p>	<p>A. <u>BASIS:</u> (from discussions with William Lazara, Avco Lycoming)</p> <ul style="list-style-type: none"> - 12 Tumbling machines @ 25% utilization - Dumped 3 times/shift @ 30 gal/machine - Roto-Brite detergent by Rotofinish, Inc., used in solution <p>B. <u>ASSUMPTIONS:</u></p> <ul style="list-style-type: none"> - Maximum daily operation of 24 hours - 100% machine utilization under future conditions <p>C. <u>CALCULATIONS:</u></p> $12 \text{ machines} \times \frac{3 \text{ dumps}}{\text{shift}} \times \frac{30 \text{ gal}}{\text{dump}} \times \frac{3 \text{ shifts}}{\text{day}} = 3,240 \text{ gpd or } 2.25 \text{ gpm}$
<p><u>LOCATION ID #5</u> <u>WASH TUB OPERATION</u></p>	<p>A. <u>BASIS:</u> (from discussions with Jack O'Brien and Quinto Carloni, Avco Lycoming, and Bill Bridgette of Jensen Fabricating, Inc.)</p> <ul style="list-style-type: none"> - Used in washing tote boxes for transporting parts - Machine rinse tank has 3 gpm overflow discharge - Alkaline cleaner used - Identity unknown - Greases, oils, & solvents removed through washing operation - Operation Intermittent, based upon daily/weekly needs <p>B. <u>ASSUMPTIONS:</u></p> <ul style="list-style-type: none"> - Operation will be more consistent in future, @ 8 hrs/day max. use <p>C. <u>CALCULATIONS:</u></p> $3 \text{ gpm discharge} \times 8 \text{ hrs/day} \times 60 \text{ min/hr} = 1,440 \text{ gpd}$
<p><u>LOCATION ID #6</u> <u>WET SCRUBBERS</u></p>	<p>A. <u>BASIS:</u> (from discussions with Quinto Carloni of Avco Lycoming and Peter Kahn, equipment representative for Heil scrubbers)</p> <ul style="list-style-type: none"> - 6 scrubbers for removing exhaust fumes from process operations - 5 gpm Influent make-up water flow restrictors on each unit - $\frac{1}{2}$ of Influent make-up water gets discharged to drain, while other half goes up stack - operation is 24 hours/day; scrubber water use is 30-60 gpm each - discharge rate is 2.5 gpm per unit <p>B. <u>ASSUMPTIONS:</u></p> <ul style="list-style-type: none"> - Scrubber contaminant of most concern is chromic acid¹ - Chromic acid concentration in discharge is 50 mg/l max. <p>C. <u>CALCULATIONS:</u></p> $6 \text{ scrubbers} \times 2.5 \text{ gpm} \times \frac{24 \text{ hrs}}{\text{day}} \times 60 \text{ min/hr} = 21,600 \text{ gpd or } 15 \text{ gpm}$
<p><u>LOCATION ID #7</u> <u>PLATE COILS</u></p>	<p>A. <u>BASIS:</u> (from discussions with Jack O'Brien, Paul Segala, George Rogucki of Avco Lycoming and Jerry Stuber of Trantner Manufacturing, Inc., Plate Coil Division)</p> <ul style="list-style-type: none"> - Approximately 50 coils used to heat hot baths and rinse tanks to 120-190° F. - Hot steam condensate not recovered but discharged Intermittently to plating room waste pits - Steam production (lb/hr) = $\frac{Q^o}{h_{fg}} = \frac{A\mu\Delta T}{h_{fg}}$ where, Q^o = Heat transfer (Btu/hr)² A = Area of Surface (ft²) μ = overall heat transfer coefficient ($\frac{\text{Btu}}{\text{hr-ft}^2-\text{°F}}$) ΔT = Temperature differential between solid surface and bulk of fluid outside the convective film (°F) h_{fg} = Latent heat of vaporization or change in enthalpy between the saturated liquid and the saturated vapor ($\frac{\text{Btu}}{\text{lb}}$)³

¹ Air Pollution Engineering Manual (second edition) prepared by Los Angeles County Air Pollution Control District, for EPA, May 1973; Chapter 11 - Chemical Processing Equipment for the Electroplating Industry, pp 831.

² Based upon formula 21.6, pp 668, Engineering Thermodynamics, by Jones & Hawkins; John Wiley & Sons, 1960.

³ Engineering Thermodynamics, Jones & Hawkins; John Wiley & Sons, 1960; pp 126 and Table A-2, pp 694.

TABLE A-4 (continued)

ESTIMATES AND BACKGROUND DATA FOR OTHER PROCESS AREA FLOWS

<p><u>LOCATION ID #7</u> <u>PLATE COILS (continued)</u></p>	<p>B. ASSUMPTIONS:</p> <ul style="list-style-type: none"> - where, $A = 17.9 \text{ ft}^2/\text{plate coil}$ (assume 50 coils to be used throughout process areas with 26 in renovated plating area alone)⁴ $\mu = 140 \text{ Btu/hr} - \text{ft}^2 - ^\circ\text{F}$ $\Delta T = 90^\circ\text{F}$ (Differential between pressured steam @ 250°F & avg. heated tank temperature of 160°F.) $h_{fg} = 945.3 \text{ Btu/lb}$ (see Footnote³ - based upon average steam pressure in plate coils of 15 psi gauge or 30 psi absolute at steam temperature of 250°F.) - Assuming coils are heated continuously and not allowed to cool to ambient temperature. - Assuming 10% heat loss⁵ from surface of solution and sides of tank plus 5%⁶ for heat loss taken up by work passing through the tank. <p>C. CALCULATIONS:</p> $\text{Avg. Steam Production Rate/Plate Coil} = \frac{A\mu\Delta T}{h_{fg}} = \frac{17.9 \text{ ft}^2 \times 140 \frac{\text{Btu}}{\text{hr} - \text{ft}^2 - ^\circ\text{F}} \times 90^\circ\text{F}}{945.3 \text{ Btu/lb}} = 239 \text{ lb/coil}$ <p>and, Gal/hour of steam = $239 \text{ lb/coil} \times 0.01701 \frac{\text{ft}^3}{\text{lb}} \times 7.48 \frac{\text{gal}}{\text{ft}^3} = \frac{30.4 \text{ gph}}{\text{coil}}$</p> <p>where, $0.01701 = v_f = \text{specific volume}^2$</p> <p>and, Total daily condensate produced = $\frac{30.4 \text{ gph}}{\text{coil}} \times 50 \text{ coils} \times 15\% \text{ duration of operation} \times \frac{24 \text{ hrs}}{\text{day}} = 5,470 \text{ gpd}$</p> <p>This is equivalent to 4.6 gph/coil or 228 gph plant-wide.</p>
<p><u>LOCATION ID #8</u> <u>QUALITY ASSURANCE LAB</u></p>	<p>A. BASIS: (from discussions with Les Brockway of Avco Lycoming)</p> <ul style="list-style-type: none"> - 3 glassware cleaning sinks in lab - No floor drain discharges <p>B. ASSUMPTIONS:</p> <ul style="list-style-type: none"> - 25 gpd average daily water usage <p>C. CALCULATIONS:</p> $25 \text{ gpd} \times \frac{1 \text{ day}}{8 \text{ hrs}} \times \frac{1 \text{ hr}}{60 \text{ min}} = 0.05 \text{ gpm}$
<p><u>LOCATION ID #9</u> <u>PLASMA SPRAY BOOTH AREA</u></p>	<p>A. BASIS: (from discussions with Eli Zadeh of Avco Lycoming)</p> <ul style="list-style-type: none"> - 6 booths where overspray of plasma (heated metal) is removed by wet collectors - 50% of spray adheres to parts; 50% into collectors - 10% of material going to collectors is discharged to drains and 2 sumps (thus, 5% of total spray goes to drains) - Currently, operation is one shift/day - 15 lbs of metal sprayed per engine - Future production of 2250 lbs metal/month to be sprayed - Spraying rate is 5 lbs/hour max. - Wet collectors discharge 5 gpm during operation <p>B. ASSUMPTIONS:</p> <ul style="list-style-type: none"> - 7 day operating week - All other necessary calculation components derived above <p>C. CALCULATIONS:</p> $\text{No. of hours of daily operation} = \frac{2250 \text{ lbs metal/month}}{5 \text{ lbs/hr} \times 30 \text{ days/month}} = 15 \text{ hr/day (future projection)}$ $\text{Flowrate} = 15 \text{ hr/day} \times 5 \text{ gal/min} \times 60 \text{ min/hr} = 4,500 \text{ gpd}$

⁴ Typical Value for Plating Coils (see Jerry Stuber, Trantner Manufacturing, Inc., Plate Coil Division, Wichita Falls, TX

⁵ Metal Finishing Guidebook & Directory, Issue 1981, pp 800.

⁶ Arbitrary Figure assumed equal to half of all other heat losses.

ESTIMATES AND BACKGROUND DATA FOR OTHER PROCESS AREA FLOWS

<p><u>LOCATION ID #10</u> <u>ENGINE OVERHAUL AREA</u></p>	<p>- SEE TABLE A-2 FOR FLOW DERIVATIONS</p>
<p><u>LOCATION ID #11</u> <u>MATERIALS LAB</u></p>	<p>A. <u>BASIS:</u> (from discussions with George Reimer of Avco Lycoming)</p> <ul style="list-style-type: none"> - Research plating conducted in small scale process lines in Bldg 3A - Operations similar to those in main plating area but conducted in bath mode (i.e., Bath and rinse solution line set-up, plating performed, then all tanks dumped to waste.) - Total operation is approximately 2 hours per week. - Maximum waste discharge is approximately 15 minutes/day. - Plating solutions of similar concentration to those in main plating area, but waste discharge is much more concentrated since acid and plating baths are dumped after use. - No future production increase anticipated for this area. - Common drain to sump discharging to CWTP used for all operations. - Process line description and tank volumes as follows: <ul style="list-style-type: none"> (a) Vapor Blast followed by rinse (40 gal tank) (b) HCl Dip (30 gal tank) (c) Woods Nickel (d) Plating baths of either sulfamate nickel, chrome, cadmium, or copper (2 gal tank). (e) Cold water rinse (40 gal tank) <p>B. <u>ASSUMPTIONS:</u></p> <ul style="list-style-type: none"> - Assume any type of plating waste could be discharged on any given day - Maximum daily flow is 120 gal <p>C. <u>CALCULATIONS:</u></p> $\text{Peak flowrate} = \frac{120 \text{ gal/day}}{15 \text{ min/day}} = 8 \text{ gpm}$

SUMMARY OF ADJUSTED PROJECTED FLOW TO CWTB FROM ALL SOURCES

LOCATION I.D. NO.	FLOW SOURCES (By Process Area & Operation)	BASE FLOWS ¹		ADJUSTED FLOWS ³		OPERATION SCHEDULE (Hours/Day)
		AVG. (GPD)	PEAK (GPH)	AVG. (GPD)	PEAK (GPH)	
1	(A) FROM BUILDING #2					
	<u>Plating Area:</u> ²					
	- Copper Plating Rinses	1,457	1.21	1,821	1.52	20
	- Nickel Plating Rinses	208	.17	260	.21	20
	- Chromium Plating Rinses	24	.02	30	.03	24
	- Cadmium Plating Rinses	16	.27	20	.34	1
	- Passivation Rinses	76	.08	95	.10	16
	- Mn & Zn Phosphating Rinses	52	.07	65	.09	12
	- Black Oxide Rinses	139	.14	174	.18	16
	- Clean Before Heat Treat Rinses	414	.86	518	1.08	8
	- Bath Dumps For Above Operations	68	.94 ⁴	85	1.18 ⁴	8
				3068 x 1.25 =		
	2	<u>Anodizing Area:</u> ⁵				
- Anodizing on Aluminum Rinses		16,200	15.00	20,250	18.75	18
- Chromate Conversion Rinses		2,700	7.50	3,375	9.38	6
	- Bath Dumps For Above Operations	102	.88 ⁴	128	1.10 ⁴	8
3	<u>HAE Area:</u> ⁵					
	- Anodizing on Magnesium Rinses	28,800	20.00	36,000	25.00	24
	- Bath Dump For Above Operation	5	.88 ⁴	6	1.10 ⁴	8
4	<u>Barrel-Finishing Area:</u>					
- Tumbling Machine Dumps	3,240	2.25	4,050	2.81	24	
5	<u>Wash Tub Operation:</u>					
- Tote Box Cleaning	1,440	3.00	1,800	3.75	8	
6	<u>Wet Air Scrubbers:</u>					
- Recirculation Water Discharge	21,600	15.00	27,000	18.75	24	
7	<u>Plate Coils:</u>					
- Hot Tank Steam Condensate	5,470	3.80	6,838	4.75	24	
8	<u>Quality Assurance Lab:</u>					
- Glassware Cleaning Sinks	25	.05	31	.06	8	
9	<u>Plasma Spray Booth Area:</u>					
- Wet Collector Discharges	4,500	5.00	5,625	6.25	15	
10	(B) FROM BUILDING #3					
	<u>Engine Overhaul Area:</u> ²					
	- Cleaning of Renovated Parts Rinses	563	.39	704	.49	24
	- Bath Dumps For Above Operation	29	1.18 ⁴	36	1.48 ⁴	8
11	(C) FROM BUILDING #3A					
	<u>Materials Lab:</u>					
	- Research Plating Dumps	120	8.00	150	10.00	.25
FLOW SUBTOTAL FOR RINSES		86,924	74.81	108,655	93.51	--
FLOW SUBTOTAL FOR BATHS		324	11.98	405	14.85	--
TOTAL PROCESS FLOWS		87,248	86.69	109,060	108.36	--

¹As estimated in Tables A-2, B-1, C-1

²Area to be employing water conservation measures; rinse tank base flows developed in Table A-2 were doubled to account for spillage, emergency discharge, etc.

³All base flows adjusted by safety factor of 1.25

⁴Peak flow rate for bath dumps equivalent to largest bath bled to waste within 8 hours.

⁵Areas not projecting immediate employment of water conservation measures.

TABLE A-6

SUMMARY OF WASTE FLOWS REQUIRING CHROMIUM TREATMENT

LOCATION I.D. NO.	PROCESS OPERATION AND TANK DESCRIPTION	OPERATION SCHEDULE (Hrs./Day)	PEAK FLOWRATE (GPD)		AVERAGE DAILY FLOW (GPD)	
			BASE	ADJUSTED	BASE	ADJUSTED
1	<u>PLATING AREA</u>					
	(a) <u>Rinse Waste:</u>					
	- Reverse Etch	24	--	--	2.4	3.0
	- Chrome Plate	24	.01	.01	10.2	12.8
	- Chrome Strip	24	.01	.01	10.4	13.0
	- Copper Strip	20	.68	.85	806	1007.5
	- 5 Wet Scrubbers	24	12.50	15.63	18,000	22,500
(b) <u>Bath Dump Waste:</u>						
- Copper Strip (2 Tanks)	8	1.63(.84)	2.04(1.05) ¹	13	16.3	
2	<u>ANODIZING AREA</u>					
	(a) <u>Rinse Waste:</u>					
	- Chromic Anodize	18	7.50	9.38	8,100	10,125
	- Aluminum Deoxidizer	18	6.00	7.50	6,480	8,100
	- Iridite	6	.01	.01	5	6.3
	(b) <u>Bath Dump Waste</u>					
	- Hot Water Seal	8	.05(.84)	.06(1.05) ¹	53	66.3
- Chromic Anodize	8	--	--	2	2.5	
- Dichromate	8	.01	.01	6	7.5	
3	<u>HAE AREA</u>					
	(a) <u>Rinse Waste:</u>					
	- Chromic Acid Dip	24	6.00	7.50	8,640	10,800
	- Soak Cleaner	24	8.00	10.00	11,520	14,400
	- One Wet Scrubber	24	2.50	3.13	3,600	4,500
	(b) <u>Bath Dump Waste</u>					
	- Chromic Acid (HAE)	8	.01(.88)	.01(1.10) ¹	3	3.8
- Post Dip	8	--	--	2	2.5	
9	<u>PLASMA SPRAY BOOTH AREA</u>					
	- Wet Collector Discharges	15	5	6.25	4,500	5,625
11	<u>MATERIALS LAB</u>					
	(a) <u>Rinse Waste</u>					
	- Chrome Plate	.25	2.67	3.34	40	50
(b) <u>Bath Dump Waste</u>						
- Chrome Plate	.25	.13	(.16) ¹	2	2.50	
FLOW SUBTOTAL FOR RINSES		--	--	61.62	--	77142.4
FLOW SUBTOTAL FOR BATHS		--	--	(3.36) ¹	--	101.4
TOTAL FLOWS		--	--	(64.98) ²	--	77243.8

¹ Flowrate for largest dump tank within each process area, bled to waste in 8 hours (from Table B-1).

² Includes all rinse flowrates and flowrates of largest dump tanks within each process area, bled to waste on any given day.

TABLE A-7

SUMMARY OF WASTE FLOWS REQUIRING CYANIDE TREATMENT

LOCATION I.D. NO.	PROCESS OPERATION & TANK DESCRIPTION	OPERATION SCHEDULE (Hrs/Day)	PEAK FLOWRATE (GPM)		AVERAGE DAILY FLOW (GPD)	
			BASE	ADJUSTED	BASE	ADJUSTED
1	<u>PLATING AREA</u>					
	(a) <u>Rinse Waste</u>					
	- Periodic Reverse	1	.02	.02	1.0	1.3
	- Cadmium Plate	1	.06	.08	3.6	4.5
	- Periodic Reverse	20	.13	.16	150.2	187.8
	- Copper Plate	20	.41	.51	493.8	617.3
	(b) <u>Bath Dump Waste</u>					
- Periodic Reverse (2 Tanks)	8	.08(.84)	.01(1.05) ¹	5.0	6.3	
- Copper Plate	8	.01	.01	7.0	8.8	
11	<u>MATERIALS LAB</u>					
	(a) <u>Rinse Waste</u>					
	- Cadmium or Copper Plate	.75	2.67	3.33	40.0	50.0
<u>Bath Dump Waste</u>						
- Cadmium or Copper Plate	.25	.13	(.17) ¹	2.0	2.5	
FLOW SUB-TOTAL FOR RINSES		--	--	4.10	--	860.9
FLOW SUB-TOTAL FOR BATHS		--	--	(1.22) ¹	--	17.6
FLOW TOTAL		--	--	(5.32) ²	--	878.5

¹Flowrate for largest dump tank within each process area, bled to waste in 8 hours (from Table B-1).

²Includes all rinse flowrates and flowrates of largest dump tanks within each process area, bled to waste on any given day.

APPENDIX B

CHELATING AGENTS USED IN PLATING AND CLEANING PROCESSES

<u>Area of Use</u>	<u>Process Tank Description</u>	<u>Chemical Compound</u>	<u>Chelate Component</u>
Plating	Chromium Strip	M&T Unichrome Compounds 80 and 80X	Tetrapotassium Pyrophosphate
Plating	Copper Plate	Rocheltex	Sodium Potassium Tartrate (Rochelle Salt)
Anodizing	Alkaline Derust	Turco 4181	Sodium Gluconate
HAE	Post Dip	Ammonium Bi-Fluoride	Ammonium Bi-Fluoride