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Development Document for Final Effluent Limitations Guidelines and Standards for Commercial Hazardous Waste Combustors

DEVELOPMENT DOCUMENT
FOR
FINAL EFFLUENT LIMITATIONS
GUIDELINES AND STANDARDS
FOR THE
COMMERCIAL HAZARDOUS WASTE COMBUSTOR SUBCATEGORY
OF THE
WASTE COMBUSTORS POINT SOURCE CATEGORY

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Credit must also be given to the additional members of the CHWC project team (William Anderson, Charles White, Patricia Harrigan, and Richard Witt) for their professional manner, conscientious effort and contributions.

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LEGAL AUTHORITY

1.1 LEGAL AUTHORITY

Effluent limitations guidelines and standards for the Commercial Hazardous Waste Combustor Industry (formerly Industrial Waste Combustor Industry) are promulgated under the authority of Sections 301, 304, 306, 307, 308 and 501 of the Clean Water Act, 33 U.S.C. 1311, 1314, 1316, 1317, 1318, 1342, and 1361.

1.2 BACKGROUND

1.2.1 *Clean Water Act (CWA)*

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." (Section 101(a)). To implement the Act, EPA is to issue effluent limitations guidelines, pretreatment standards and new source performance standards for industrial discharges. These guidelines and standards are summarized briefly in the following sections.

1.2.1.1 Best Practicable Control Technology Currently Available (BPT) (Section 304(b)(1) of the CWA)

In the guidelines for an industry category, EPA defines BPT effluent limits for conventional, priority, and non-conventional pollutants. In specifying BPT, EPA looks at a number of factors. EPA first considers the cost of achieving effluent reductions in relation to the effluent reduction benefits. The Agency next considers: the age of the equipment and facilities; the processes employed and any required process changes; engineering aspects of the control technologies; non-water quality environmental impacts (including energy requirements); and such other factors as the Agency deems appropriate (CWA §304(b)(1)(B)).

Traditionally, EPA establishes BPT effluent limitations based on the average of the best performances of facilities within the industry of various ages, sizes, processes or other common characteristics. Where, however, existing performance within a category or subcategory is uniformly inadequate, EPA may require higher levels of control than currently in place in an industrial category (or subcategory) if the Agency determines that the technology can be practically applied.

1.2.1.2 Best Conventional Pollutant Control Technology (BCT) (Section 304(a)(4) of the CWA)

The 1977 amendments to the CWA required EPA to identify effluent reduction levels for conventional pollutants associated with BCT technology for discharges from existing industrial point sources. In addition to other factors specified in Section 304(b)(4)(B), the CWA requires that EPA establish BCT limitations after consideration of a two part "cost-reasonableness" test. EPA explained its methodology for the development of BCT limitations in the July 1986 Federal Register (51 FR 24974).

Section 304(a)(4) designates the following as conventional pollutants: five day biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform, pH, and any additional pollutants defined by the Administrator as conventional. The Administrator designated oil and grease as an additional conventional pollutant on July 30, 1979 (44 FR 44501).

1.2.1.3 Best Available Technology Economically Achievable (BAT) (Section 304(b)(2)(B) of the CWA)

In general, BAT effluent limitations guidelines represent the best economically achievable performance of plants in the industrial subcategory or category. The factors considered in assessing BAT include the cost of achieving BAT effluent reductions, the age of equipment and facilities involved, the process employed, potential process changes, and non-water quality environmental impacts, including energy requirements. The Agency retains considerable discretion in assigning the weight to be accorded these factors. Unlike BPT limitations, BAT limitations may be based on effluent reductions attainable through changes in a facility's processes and operations. As with BPT, where existing performance is uniformly inadequate, BAT may require a higher level of performance than is currently being achieved based on technology transferred from a different subcategory or category. BAT may be based upon process changes or internal controls, even when these technologies are not common industry practice.

1.2.1.4 New Source Performance Standards (NSPS) (Section 306 of the CWA)

NSPS reflect effluent reductions that are achievable based on the best available demonstrated control technology. New facilities have the opportunity to install the best and most efficient production processes and wastewater treatment technologies. As a result, NSPS should represent the most stringent controls attainable through the application of the best available control technology for all pollutants (i.e., conventional, non-conventional, and priority pollutants). In establishing NSPS, EPA is directed to take into consideration the cost of achieving the effluent reduction and any non-water quality environmental impacts and energy requirements.

1.2.1.5 Pretreatment Standards for Existing Sources (PSES) (Section 307(b) of the CWA)

PSES are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of publicly owned treatment works (POTW). The CWA authorized EPA to establish pretreatment standards for pollutants that pass through POTWs or interfere with treatment processes or sludge disposal methods at the POTW. Pretreatment standards are technology-based and analogous to BAT effluent limitations guidelines.

The general Pretreatment Regulations, which set forth the framework for the implementation of categorical pretreatment standards, are found in 40 CFR Part 403. Those regulations contain a definition of pass through that addresses localized rather than national instances of pass through and establish pretreatment standards that apply to all non-domestic dischargers (see 52 FR 1586, January 14, 1987).

1.2.1.6 Pretreatment Standards for New Sources (PSNS) (Section 307(b) of the CWA)

Like PSES, PSNS are designed to prevent the discharges of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTWs. PSNS are to be issued at the same time as NSPS. New indirect dischargers have the opportunity to incorporate into their plants the best available demonstrated technologies. The Agency considers the same factors in promulgating PSNS as it considers in promulgating NSPS.

1.2.2 *Section 304(m) Requirements*

Section 304(m) of the Act (33 U.S.C. 1314(m)), added by the Water Quality Act of 1987, requires EPA to establish schedules for (1) reviewing and revising existing effluent limitation guidelines and standards (“effluent guidelines”), and (2) promulgating new effluent guidelines. On January 2, 1990, EPA published an Effluent Guidelines Plan (55 FR 80), that included schedules for developing new and revised effluent guidelines for several industry categories. One of the industries for which the Agency established a schedule was the Hazardous Waste Treatment Industry.

The Natural Resources Defense Council (NRDC) and Public Citizen, Inc. filed suit against the Agency, alleging violation of Section 304(m) and other statutory authorities requiring promulgation of effluent guidelines (<u>NRDC et al. v. Reilly</u>, Civ. No. 89-2980 (D.D.C.)). Under the terms of the consent decree in that case, as amended, EPA agreed, among other things, to propose effluent guidelines for the ALandfills and Industrial Waste Combusters@ category by November 1997 and final action by November 1999. Although the Consent Decree lists "Landfills and Industrial Waste Combusters" as a single entry, EPA is publishing separate regulations for Industrial Waste Combusters and for Landfills.

In order to reflect accurately the segment of the combustion industry being regulated today, EPA has now changed the name for this final regulation from “Industrial Waste Combustor” to “Commercial Hazardous Waste Combustor” regulations.

SECTION 2

DATA COLLECTION

In 1986, the Agency initiated a study of waste treatment facilities which receive waste from off site for treatment, recovery, or disposal. The Agency looked at various segments of the waste management industry including combustors, centralized waste treatment facilities, landfills, fuel blending operations, and waste solidification/stabilization processes (Preliminary Data Summary for the Hazardous Waste Treatment Industry, EPA 440-1-89-100, September 1989).

Development of effluent limitations guidelines and standards for the Commercial Hazardous Waste Combustor (CHWC) (formerly Industrial Waste Combustor (IWC)) Subcategory began in 1993. EPA originally looked at RCRA hazardous waste incinerators, RCRA boilers and industrial furnaces (BIFs), and non-hazardous combustion units that treat industrial waste. Sewage sludge incinerators, municipal waste incinerators, and medical waste incinerators were not included in the 1989 study or in the initial data collection effort in 1993. EPA limited the proposed rulemaking to the development of regulations for industrial waste combustors. Based on comments received on the proposed rulemaking, EPA has limited the final rulemaking to regulations for Commercial Hazardous Waste Combustors.

EPA has gathered and evaluated technical and economic data from various sources in the course of developing the final effluent limitations guidelines and standards for the CHWC Industry. These data sources include:

- Responses to EPA's "1992 Waste Treatment Industry Phase II: Incinerators Screener Survey,"
- Responses to EPA's "1994 Waste Treatment Industry Phase II: Incinerators Questionnaire,"
- Responses to EPA's "1994 Detailed Monitoring Questionnaire,"
- EPA's 1993 - 1995 sampling of selected CHWC facilities,
- Literature data, and

- Facility NPDES and POTW wastewater discharge permit data.

EPA has used data from these sources to profile the industry with respect to: wastes received for treatment or recovery, treatment/recovery processes, geographical distribution, and wastewater and solid waste disposal practices. EPA then characterized the wastewater generated by treatment/recovery operations through an evaluation of water usage, type of discharge or disposal, and the occurrence of conventional, non-conventional and priority pollutants.

2.1 CLEAN WATER ACT SECTION 308 QUESTIONNAIRES AND SCREENER SURVEYS

2.1.1 *Development of Questionnaires and Screener Surveys*

A major source of information and data used in developing effluent limitations guidelines and standards is industry responses to questionnaires and screener surveys distributed by EPA under the Authority of Section 308 of the Clean Water Act (CWA). The questionnaires typically request information concerning treatment processes, wastes received for treatment, and disposal practices as well as wastewater treatment system performance data. Questionnaires also request financial and economic data for use in assessing economic impacts and the economic achievability of technology options. Screener surveys generally request less detailed information than the questionnaires regarding treatment processes, wastes received for treatment and disposal practices.

EPA used its experience with previous questionnaires to develop one screener survey (the 1992 Waste Treatment Industry Phase II: Incinerators Screener Survey) and two questionnaires (the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire and the Detailed Monitoring Questionnaire) for this project. The 1992 Waste Treatment Industry Phase II: Incinerators Screener Survey was designed to obtain general infomation on facility operations from a census of the industry. The 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire was designed to request 1992 technical, economic, and financial data to describe industrial operations adequately from a census of facilities in the industry that were operating commercially and from a sample of facilities in the industry that were not operating commercially. The Detailed Monitoring Questionnaire was designed to elicit daily analytical data from a limited number of facilities which would be selected after receipt and review of the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire responses.

For the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire, EPA wanted to minimize the burden to industrial waste combustor facilities. Thus, only a statistical sample of the non-commercial facilities meeting the preliminary scope qualifications received the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire. The questionnaire specifically requested information on:

- combustion processes,
- types of waste received for combustion,
- wastewater and solid waste disposal practices,
- ancillary waste management operations,
- summary analytical monitoring data,
- the degree of co-combustion (combustion of waste received from off-site with other on-site industrial waste),
- cost of waste combustion processes, and
- the extent of wastewater recycling or reuse at facilities.

In the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire, EPA requested summary monitoring data from all recipients, but summary information is not sufficient for determining limitations and industry variability. Therefore, the Detailed Monitoring Questionnaire was designed to collect daily analytical data from a limited number of facilities. Facilities were chosen to complete the Detailed Monitoring Questionnaire based on technical information submitted in the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire. The burden was minimized in the Detailed Monitoring Questionnaire by tailoring the questionnaire to the facility operations.

EPA sent draft screener surveys and questionnaires to industry trade associations, incinerator facilities who had expressed interest, and environmental groups for review and comment. A pre-test for both the 1992 Waste Treatment Industry Phase II: Incinerators Screener Survey and the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire was conducted at nine industrial waste combustor facilities to determine if the type of information necessary would be received from the questions posed as well as to determine if questions were designed to minimize the burden to facilities.

Based on comments from the reviewers, EPA modified the draft questionnaire.

As required by the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq*., EPA submitted the Questionnaire package (including the 1992 Waste Treatment Industry Phase II: Incinerators Screener Survey and the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire and the Detailed Monitoring Questionnaire) to the Office of Management and Budget (OMB) for review. EPA also redistributed the questionnaire package to industry trade associations, industrial waste combustor facilities, environmental groups, and to any others who requested a copy of the questionnaire package.

2.1.2 *Distribution of Screener Surveys and Questionnaires*

Under the authority of Section 308 of the Clean Water Act, EPA sent the 1992 Waste Treatment Industry Phase II: Incinerators Screener Survey (OMB Approval Number: 2040-0162, Expired: 08/31/96) in September 1993 to 606 facilities that the Agency had identified as possible industrial waste combustor facilities. EPA identified the 606 facilities as possible industrial waste combustor facilities from various sources; such as, companies listed in the 1992 Environmental Information (EI) Directory, companies that were listed as incinerators in the RCRIS National Oversight Database (November, 1992 and February, 1993 versions), companies that were listed as BIF Facilities by EPA (updated December, 1992), and incinerator facilities identified in the development of the Centralized Waste Treatment (CWT) effluent guidelines. Since industrial waste combustors were not represented by a SIC code at the time of the survey, identification of facilities was difficult. The screener survey requested summary information on: (1) the types of wastes accepted for combustion; (2) the types of combustion units at a facility; (3) the quantity, treatment, and disposal of wastewater generated from combustion operations; (4) available analytical monitoring data on wastewater treatment; and (5) the degree of co-treatment (treatment of CHWC wastewater with wastewater from other industrial operations at the facility). The responses from

564 facilities indicated that 357 facilities burned industrial waste in 1992. The remaining 207 did not burn industrial waste in 1992. Of the 357 facilities that burned industrial waste, 142 did not generate any wastewater from air pollution control systems or water used to quench flue gas or slag generated as a result of their combustion operations. Of the remaining 215 facilities that generated these types of wastewater, 59 operated commercially, and 156 only burned wastes generated on site, and/or only burned wastes generated from off-site facilities under the same corporate structure.

Following an analysis of the screener survey results, EPA sent the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire (OMB Approval Number: 2040-0167, Expired: 12/31/96) in March, 1994 to selected facilities which burned industrial waste and generated wastewater from air pollution control systems or water used to quench flue gas or slag generated as a result of their combustion operations. EPA sent the questionnaire to all 59 of the commercial facilities and all 16 of the non-commercial facilities that burned non-hazardous industrial waste. Further, EPA sent 32 of the remaining 140 non-commercial facilities a questionnaire. These thirty-two were selected based on a statistical random sample. The questionnaire specifically requested information on: (1) the type of wastes accepted for treatment; (2) the types of combustion units at a facility; (3) the types of air pollution control devices used to control emissions from the combustion units at a facility; (4) the quantity, treatment, and disposal of wastewater generated from combustion operations; (5) available analytical monitoring data on wastewater treatment; (6) the degree of co-treatment (treatment of industrial waste combustor wastewater with wastewater from other industrial operations at the facility); and (7) the extent of wastewater recycling and/or reuse at the facility. Information was also obtained through follow-up telephone calls and written requests for clarification of questionnaire responses.

EPA also requested a subset of industrial waste combustor facilities that received a questionnaire to submit wastewater monitoring data in the form of individual data points rather than monthly or annual aggregates. Only facilities that had identified a sample point location where the stream was over 50 percent wastewater from air pollution control systems or water used to quench flue gas or slag generated as a result of their combustion operations received the Detailed Monitoring Questionnaire. These wastewater monitoring data included information on pollutant concentrations at various points in the wastewater treatment processes. Data were requested from 26 facilities. Sixteen of these facilities operated commercially and 10 operated non-commercially.

2.2 SAMPLING PROGRAM

2.2.1 *Pre-1989 Sampling Program*

In the sampling program for the 1989 Hazardous Waste Treatment Industry Study, twelve facilities were sampled to characterize the wastes received and evaluate the on-site treatment technology performance at combustors, landfills, and hazardous waste treatment facilities. Since all of the facilities sampled had more than one on-site operation (e.g., combustion and landfill leachate generation), the data collected can not be used for this project because data were collected for mixed waste streams and the waste characteristics and treatment technology performance for the combustor facilities cannot be differentiated. Information collected in the study is presented in the Preliminary Data Summary for the Hazardous Waste Treatment Industry (EPA 440/1-89/100, September 1989).

2.2.2 *1993 - 1995 Sampling Program*

2.2.2.1 Facility Selection

Between 1993 and 1995, EPA visited 14 industrial waste combustor facilities. Eight of the fourteen industrial waste combustors EPA visited were captive facilities because captive facilities were still being considered for inclusion in the scope of the CHWC regulation at the time of the site visits. During each visit, EPA gathered the following information:

- the process for accepting waste for combustion,
- the types of waste accepted for combustion,
- design and operating procedures for combustion technologies,
- general facility management practices,

- water discharge options,
- solid waste disposal practices, and
- other facility operations.

EPA also took one grab sample of untreated industrial waste combustor scrubber blowdown water at twelve of the fourteen facilities. EPA analyzed most of these grab samples for over 450 analytes to identify pollutants at these facilities. The grab samples from the twelve site visits allowed EPA to assess whether there was a significant difference in raw wastewater characteristics from a wide variety of combustion unit types. (See Section 3 for a description of the types of combustion units.) EPA determined that the raw wastewater characteristics were similar for all types of combustion units both in types of pollutants found and the concentrations of the pollutants found. Specifically, organics, pesticides/herbicides, and dioxins/furans were generally only found, if at all, in low concentrations in the grab samples. (See Section 5 of this document for a discussion of dioxins/furans found at 7 of the 12 CHWC facilities sampled.) However, a variety of metal analytes were found in significant concentrations in the grab samples.

Based on these data and the responses to the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire, EPA selected three of the industrial waste combustor facilities for the BAT sampling program in order to collect data to characterize discharges and the performance of selected treatment systems. Using data supplied by the facilities, EPA applied five criteria in initially selecting which facilities to sample. The criteria were based on whether the wastewater treatment system: (1) was effective in removing pollutants, (2) treated wastes received from a variety of sources (solids as well as liquids), (3) employed either novel treatment technologies or applied traditional treatment technologies in a novel manner, (4) applied waste management practices that increased the effectiveness of the treatment unit, and (5) discharged its treated wastewater under a NPDES permit. The other 11 facilities visited were not sampled because they did not meet these criteria. Eight of these 11 facilities visited did not operate commercially, and are thus no longer included in the CHWC Industry.

2.2.2.2 Five-Day Sampling Episodes

After a facility was chosen to participate in the five-day sampling program, a draft sampling plan was prepared which described the location of sample points and analyses to be performed at specific sample points as well as the procedures to be followed during the sampling episode. Prior to sampling, a copy of the draft sampling plan was provided to the facility for review and comment to ensure that EPA properly described and understood facility operations. All comments were incorporated into the final sampling plan. During the sampling episode, teams of EPA employees and contractors collected and preserved samples. Samples were sent to EPA approved laboratories for analysis. Samples were collected at influent and effluent points. Samples were also taken at intermediate points to assess the performance of individual treatment units. Facilities were given the option to split all samples with EPA, but most facilities split only effluent sample points with EPA. Following the sampling episode, a draft sampling report was prepared that included descriptions of the treatment/recovery processes, sampling procedures and analytical results. After all information was gathered, the reports were provided to the facilities for review and comment. Corrections were incorporated into the final report. The facilities also identified any information in the draft sampling report that were considered to be Confidential Business Information.

During each sampling episode, wastewater treatment system influent and effluent streams were sampled. Samples were also taken at intermediate points to assess the performance of individual treatment units. Selected sampling information is summarized in Section 4 and Appendix A of this document . In all sampling episodes, samples were analyzed for over 450 analytes to identify the pollutants at these facilities. Again, organic compounds, pesticides/herbicides, and dioxins/furans were generally only found in low concentrations in the composite daily samples, if they were found at all. Dioxin/furan analytes were not detected in the sampling episode used to establish BPT/BAT/PSES. However, dioxin/furan analytes were found in the two other sampling episodes (see discussion in Section 5 of this document).

EPA completed the three sampling episodes for the Commercial Hazardous Waste Combustor Subcategory from 1994 to 1995. Selection of facilities to be sampled was limited due to the small number of facilities in the scope of the project. Only eight of the operating facilities identified discharged their treated wastewater under a NPDES permit. Of these eight facilities, only five burned solid as well as liquid waste. All of the facilities sampled used some form of chemical precipitation for treatment of the metal-bearing waste streams. All of the facilities were direct dischargers and were therefore designed to effectively treat the only conventional pollutant found in this industry, total suspended solids (TSS). Data from one of these facilities could not be used to calculate the proposed limitations and standards because influent concentrations for many parameters were low and thus performance data for the treatment systems could not be adequately ascertained. Also, as discussed in Section 6.4.2, EPA determined that only one of the two remaining facilities employed BPT technology. However, data from all three facilities were used to characterize the raw waste streams. Thus, for the proposal, only one sampling episode contained data which were used to characterize the treatment technology performance of Commercial Hazardous Waste Combustors.

As described in the Notice of Availability on May 17, 1999 (64 FR 26714), EPA received additional wastewater treatment system performance data from CHWC facilities in early 1999, subsequent to the close of the comment period for the proposal. Three CHWCs submitted influent and effluent wastewater treatment system performance data and related information on the operation of their treatment systems. Each facility submitted daily measurements for chlorides, total dissolved solids (TDS), TSS, sulfate, pH and 15 metals (aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, molybdenum, selenium, silver, tin, titanium and zinc.) One facility provided 11 days of sampling data and the two other facilities provided 30 days of sampling data each.

Following an evaluation of the three facilities, EPA determined that two of these three facilities employed BPT treatment technology. EPA used data from these two additional facilities, along with the data used for the proposed regulation, to revise the proposed limitations and standards. The concentrations of pollutants in the treated effluent from these two additional facilities are higher for some pollutants and lower for others, as compared to the facility used to develop limitations and standards for the proposal. On average, the variability of the effluent concentrations at these two additional facilities were lower than those at the facility used as the basis for the proposed numerical guidelines. EPA did not use data from these two facilities in determining the variability factors used to calculate the numerical guidelines because

EPA concluded that the average variability observed in the data used to calculate the limitations and standards for proposal was greater than the average variability determined from the data for the other two CHWCs. The variability factors used at proposal better reflect the variability seen in waste receipts accepted for burning over longer periods of time at CHWCs.

Information on waste stream characteristics is included in Section 4 of this document and information on system performances is included in Section 6.

SECTION 3

DESCRIPTION OF THE INDUSTRY AND SUBCATEGORIZATION

3.1 GENERAL INFORMATION

The universe of combustion facilities currently in operation in the United State is broad. These include municipal waste incinerators that burn household and other municipal trash and incinerators that burn hazardous wastes. Other types of incinerators include those that burn medical wastes exclusively and sewage sludge incinerators for incineration of POTWs' wastewater treatment residual sludge. In addition, some boilers and industrial furnaces (e.g., aggregate kilns) may burn waste materials for fuel.

While many industries began incinerating some of their wastes as early as the late 1950's, the current market for waste combustion (particularly combustion of hazardous wastes) is essentially a creature of the Resource Conservation and Recovery Act (RCRA) and EPA's resulting regulation of hazardous waste disposal. Among the major regulatory spurs to combustion of hazardous wastes have been the land-ban restrictions under the Hazardous and Solid Waste Amendments (HSWA) of 1984 and clean-up agreements for Superfund sites called "Records of Decision" (RODs).

Prior to the promulgation of EPA's Land Disposal Restrictions (LDRs)(40 CFR Part 268), hazardous waste generators were free to send untreated wastes directly to landfills. The LDRs mandated alternative treatment standards for wastes, known as Best Demonstrated Available Technologies (BDATs). Quite often, combustion was the stipulated BDAT. Future modifications to the LDRs may either increase or decrease the quantity of wastes directed to the combustion sector.

The LDRs have also influenced hazardous waste management under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)(42 U.S.C §§ 9601, et. seq.). The RODs set out the clean-up plan for contaminated sites under CERCLA. A key attribute of the RODs is the choice of remediation technology. Incineration is often a technology selected for remediation. While remediation efforts contribute a minority of the wastes managed by combustion, combustion has been used frequently on remediation projects. In addition, future Congressional changes to CERCLA may affect remediation disposal volumes directed to the combustion sector.

The Agency proposed a draft Waste Minimization and Combustion Strategy in 1993 and 1994 to promote better combustion of hazardous waste and encourage reduced generation of wastes. The key projects under the broad umbrella of the strategy are: "Revised Standards for Hazardous Waste Combustors" 61 FR 17358, April 1996, the Waste Minimization National Plan completed in May 1995, and the "RCRA Expanded Public Participation Rule" 60 FR 63417, December 1995. Waste minimization will directly affect waste volumes sent to the combustion and all other waste management sectors.

In recent years, a number of contrary forces have contributed to a reduction in the volume of wastes being incinerated. Declines in waste volumes and disposal prices have been attributed to: waste minimization by waste generators, intense price competition driven by overcapacity, and changes in the competitive balance between cement kilns (and other commercial boilers and industrial furnaces (BIFs)) and commercial incinerators. These trends have been offset by factors such as increased overall waste generation as part of general economic improvement, industrial waste combustor consolidation, and reductions in on-site combustion.

The segment of the universe of combustion units for which EPA is regulating includes units which operate commercially and which use controlled flame combustion in the treatment or recovery of RCRA hazardous waste. For example, industrial boilers, industrial furnaces, rotary kiln incinerators and liquid-injection incinerators are all types of units included in the Commercial Hazardous Waste Combustor (CHWC) Industry.

Combustion or recovery operations at these facilities generate the following types of wastewater, described more fully in Section 4: air pollution control wastewater, flue gas quench wastewater, slag quench, truck/equipment wash water, container wash water, laboratory drain wastewater, and floor washings from the process area. Typical non-wastewater by-products of combustion or recovery operations may include: slag or ash developed in the combustion unit itself, and emission particles collected using air pollution control systems. There are many different types of air pollution control systems in use by combustion units. The types employed by combustion units include, but are not limited to: packed towers (which use a caustic scrubbing solution for the removal of acid gases), baghouses (which remove particles and do not use any water), wet electrostatic precipitators (which remove particles using water but do not generate a wastewater stream), and venturi scrubbers (which remove particles using water and generate a wastewater stream). Thus, the amount and types of wastewater generated by a combustion unit are directly dependent upon the types of air pollution control systems employed by the combustion unit.

3.2 SCOPE OF THE REGULATION

3.2.1 *CHWC Facilities*

EPA promulgated effluent limitations guidelines and pretreatment standards for new and existing thermal units, except cement kilns, that are subject to either to 40 CFR Part 264, Subpart O; Part 265, Subpart O; or Part 266, Subpart H if the thermal unit burns RCRA hazardous wastes received from off-site for a fee or other remuneration in the following circumstances.

The thermal unit is a commercial hazardous waste combustor if the off-site wastes are generated at a facility not under the same corporate structure or subject to the same ownership as the thermal unit and

(1) the thermal unit is burning wastes that are not of a similar nature to wastes being burned from industrial processes on site, or
(2) there are no wastes being burned from industrial processes on site.

3.2.2 *Captive and Intracompany CHWC Facilities*

As noted above, the rule does not apply to wastewater discharges associated with combustion units that burn only wastes generated on-site. Furthermore, wastewater discharges from RCRA hazardous incinerators and RCRA BIFs that burn waste generated off-site (for fee or other remuneration) from facilities that are under the same corporate ownership (or corporate structure) as the combustor are similarly not included within the scope of this rule.

EPA has decided not to include facilities which only burn waste from off-site facilities under the same corporate structure (intracompany facility) and/or only burn waste generated on-site (captive facility) within the scope of this regulation for the following reasons. First, based on its survey, EPA identified (as of 1992) approximately 185 captive facilities and 89 facilities that burn wastes received from other facilities within the same corporate umbrella. A significant number of these facilities generated no CHWC wastewater. EPA's data show that 73 captive facilities (39 percent) and 36 intracompany facilities (42 percent) generated no wastewater as a result of their waste combustor operations. Second, EPA believes the wastewater generated by waste combustor operations at most of the captive and intracompany facilities that EPA has identified are already subject to national effluent limitations (or pretreatment standards) based on the manufacturing operations at the facility. Specifically, 140 of the 156 captive and intracompany facilities which received a screener survey and generated CHWC wastewater as a result of their combustion operations: 1) were either previously identified as subject to other effluent guidelines by EPA or 2) identified themselves as subject to other effluent guidelines. There are 97 facilities subject to the Organic Chemicals, Plastics and Synthetic Fibers category (40 CFR Part 414), 17 subject to the Pharmaceuticals category (40 CFR Part 439), 16 subject to the Steam Electric Power Generating category (40 CFR Part 423), 3 subject to the Pesticide Manufacturing category (40 CFR Part 455), and 7 subject to other categories. EPA could not identify an effluent guideline category applicable to their discharges for 16 of these 156 facilities (five of these are federal facilities). Moreover, in the case of the small number -- less than 10 percent -- for which EPA could not identify a specific guideline that would apply, the permit writer has authority to obtain any necessary data to write facility-specific best professional judgement (BPJ) limitations or standards.

In addition, EPA looked at the pollutant data for commercial and non-commercial hazardous facilities and concluded that their scrubber water is qualitatively different. EPA evaluated the grab samples of untreated scrubber water it collected from eight non-commercial facilities to determine if there was a difference in wastewater characteristics at non-commercial versus commercial facilities. See Table 3-1 for a presentation of grab sample data from non-commercial facilities. For each regulated pollutant, the average untreated CHWC wastewater concentration is less for the eight non-commercial facilities than for the three commercial facilities used to determine the final limitations (see Table 3-2). EPA concluded these results from the fact that non-commercial facilities do not treat the large variety of different wastes that commercial facilities treat. Additionally, two of the nine regulated metal pollutants (mercury and silver) were not at treatable levels at any of the eight non-commercial facilities. Two more of the nine regulated metal pollutants (arsenic and cadmium) were at treatable levels at only one of the eight non-commercial facilities. Further, only one of the nine regulated metal pollutants (zinc) was at treatable levels at more than half of the eight non-commercial facilities. In contrast, seven of the nine regulated metal pollutants (arsenic, cadmium copper, lead, mercury, titanium and zinc) were found at treatable levels at all three of the commercial facilities used to determine the final limitations. Further, the remaining two metal pollutants (chromium and silver) were found at treatable levels at two of these three commercial facilities. These circumstances further support EPA's decision not to subject non-commercial, captive hazardous incinerators to the limitations and standards developed here.

Table 3-1. Non-Commercial Grab Sample Episode Data

Analyte	Non-Commercial Grab Sample Episodes							
	#9	#1	#2	#11	#6	#10	#A	#B
TSS (mg/l)	310	10	ND(4)	44	40	48	46	95
Arsenic	78.4	42.1	ND(1.9)	ND(1.1)	1420	ND(20)	ND(2)	ND(2)
Cadmium	300	ND(5)	ND(1.2)	19.05	41.9	ND(4)	ND(4)	ND(4)
Chromium	250	236	ND(3.6)	24.42	1650	52.7	19.9	ND(9)
Copper	698	101	16.02	75.85	131	59.7	1960	ND(10)
Lead	3300	ND(47)	84.26	319.46	96.6	ND(49)	ND(49)	ND(49)
Mercury	ND(0.2)	0.68	ND(0.1)	ND(0.1)	1.04	ND(0.2)	0.63	ND(0.2)
Silver	ND(4)	ND(5)	4.12	15.74	ND(5)	ND(5)	ND(5)	ND(5)
Titanium	3770	110	ND(2.2)	59.06	98.9	9.2	134	7.5
Zinc	1830	44.7	47.19	1745.6	341	1120	3200	283

Values in (ug/l) unless otherwise noted.
ND = Non-Detects
Note: Values in parentheses are the detection limits.

Table 3-2. Comparison of Non-Commercial and Commercial Data

Analyte	Number of Detects (out of 8)	Treatable Level (10*QL)	Number of Times at Treatable Level	Avg. Influent Concentration of Non-Commercial Grabs	Avg. Influent Concentration of Three Commercial Facilities Used for Final Limitations
TSS (mg/l)	7	40	6 of 8	74.63	147.40
Arsenic	3	100	1 of 8	195.94	654.33
Cadmium	3	50	1 of 8	47.39	376.57
Chromium	6	100	3 of 8	280.70	835.67
Copper	7	100	4 of 8	381.45	2575.33
Lead	4	100	2 of 8	499.29	2395.33
Mercury	3	2	0 of 8	0.39	93.87
Silver	2	50	0 of 8	6.11	124.27
Titanium	7	100	3 of 8	523.86	2163.67
Zinc	8	200	6 of 8	1076.44	6482.00

Values in (ug/l) unless otherwise noted.
QL = Quantitation Limit

There may be instances when a combustor is operated in conjunction with on-site industrial activities and the combustor wastewater is treated and discharged separately from the treatment of industrial wastewater (or treated separately and mixed before discharge). Permit writers should consider this guideline as one source of information when developing limitations and standards for these situations.

3.3 SUMMARY INFORMATION ON 55 CHWC FACILITIES

For 1992, EPA identified 55 combustor facilities that accept hazardous or hazardous and non-hazardous industrial waste from off-site facilities not under the same corporate umbrella for combustion. The following tables provide summary information from the 1992 Waste Treatment Industry Phase II: Incinerators Screener Survey on these 55 combustor facilities.

Many of the 55 CHWC facilities have more than one unit on-site. The majority of facilities with two or more units on-site operate boilers, industrial furnaces, or aggregate kilns. Table 3-3 presents the number of thermal units at each of the 55 CHWC facilities that provided data in the survey.

Table 3-3. Number of Thermal Units at Each of the 55 CHWC Facility Locations

Number of Units	1	2	3	4	5	6	7	8	>8
Number of Facilities	26	14	6	4	2	1	0	0	0

There are more industrial furnaces, boilers, and aggregate kilns than any other unit types. However, more than one of these units often is present at a single facility. Table 3-4 presents the unit types at all 55 CHWC facilities that provided data in the survey.

Table 3-4. Types of Thermal Units at 55 CHWC Facilities

Type of Thermal Unit	Number of Each Unit Type
Rotary Kiln Incinerator	22
Liquid Injection Incinerator	16
Fluidized-Bed Incinerator	1
Multiple-Hearth Incinerator	6
Fixed-Hearth Incinerator	3
Pyrolytic Destructor	3
Industrial Boiler	19
Industrial Furnace	25
Other	9

Most of the waste burned by the 55 CHWC facilities is hazardous or non-hazardous industrial waste containing organic compounds. Only one facility indicated it burned waste containing dioxins/furans and only four facilities indicated burning waste regulated under the Toxic Substances Control Act (TSCA). Table 3-5 presents the types and amount of waste treated at all 55 CHWC facilities.

Table 3-5. Amount of Waste Treated by 55 Commercial Facilities in Calendar Year 1992 (Tons)

	Tons							# of Facilities
Waste Type	1-50	51-100	101-500	501-1,000	1,001-5,000	5,001-10,000	>10,000	
Non-RCRA								
Sewage Sludge	0	1	0	0	0	0	0	1
Containing Metals	3	0	3	1	4	1	4	16
Containing Organics	5	2	9	0	9	5	6	36
All Others	2	0	2	1	5	0	1	11
RCRA								
Containing Metals	6	0	1	1	7	0	16	31
Containing Organics	9	1	6	3	5	1	24	49
Containing Dioxins/Furans	0	0	1	0	0	0	0	1
Containing Pesticides/ Herbicides	0	2	0	1	8	0	1	12
All Others	3	0	1	1	1	1	6	13
Special								
Radioactive Wastes	1	0	0	0	0	0	0	1
TSCA Wastes (PCBs)	0	0	0	0	1	0	3	4
Medical Wastes	0	0	1	0	0	0	0	1

For the CHWC regulations, only air pollution control water, slag quench and flue gas quench are considered "CHWC wastewater." The largest wastewater stream generated by the 55 CHWC facilities, stormwater runoff, is regulated under other effluent guidelines. The industry also generates large quantities of boiler blowdown. Boiler blowdown wastewater was not considered for regulation for this industry because it does not come into contact with any of the wastes being burned. Table 3-6 presents the quantity of process wastewater generated by the 55 CHWC facilities that provided data in the survey.

Table 3-6. Quantity of Process Wastewater Generated by 55 CHWC Facilities in Calendar Year 1992 (Thousand Gallons)

	Gallons (1,000s)							# of Facilities
Type of Process Water	0-5	5-15	15-50	50-100	100-500	500-750	>750	
None	16	0	0	0	0	0	0	16
Air Pollution Control Water	1	1	2	2	0	0	13	19
Slag Quench	1	0	2	0	2	0	0	5
Process Area Washdown	4	2	3	1	4	0	2	16
Truck/Equipment Wash Water	2	0	1	2	1	0	1	7
Container Wash Water	1	0	1	1	1	0	0	4
Stormwater Runoff	0	0	0	2	3	3	11	19
Laboratory Waste	2	0	0	2	2	0	0	6
Flue Gas Quench	1	0	0	0	0	0	7	8
Boiler Blowdown	4	0	2	1	0	2	8	17
Other	2	0	0	0	0	0	3	5

3.4 SUMMARY INFORMATION ON 22 CHWC FACILITIES WHICH GENERATE CHWC WASTEWATER

Following the distribution of the screener survey, EPA sent the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire only to those commercial facilities that generated CHWC wastewater. Thirty-three of the 55 CHWC facilities did not generate any CHWC wastewater; thus, EPA only has detailed operation information on the 22 CHWC facilities that generated CHWC wastewater. The following tables provide summary information from the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire on these 22 commercial combustor facilities.

3.4.1 *RCRA Designation of 22 CHWC Facilities*

Most of the 22 facilities that generate CHWC wastewater are regulated as incinerators under RCRA. Very few boilers and industrial furnaces regulated under RCRA generate air pollution control water, flue gas quench, or slag quench. Table 3-7 presents the RCRA designation of the 22 commercial facilities.

Table 3-7. 1992 RCRA Designation of 22 Commercial Facilities

	Total Thermal Units
Hazardous Waste Incinerator	25
Boiler and/or Industrial Furnace	6

3.4.2 *Waste Burned at 22 CHWC Facilities*

The number of customers served by a facility varies greatly in this industry. Some facilities burn primarily waste generated on site and only take very few waste shipments from facilities not under their corporate structure. Other facilities operate a strictly commercial operation, serving hundreds or thousands of customers on a regular basis. Table 3-8 presents the number of customers served by the 22 commercial facilities.

Table 3-8. Number of Customers/Facilities Served in 1992 by 22 Commercial Facilities

	Number of Customers
Minimum	1
Maximum	4,000
Mean	858
Median	83
Total	27,450

3.4.3 *Air Pollution Control Systems for 22 CHWC Facilities*

The type of air pollution control system used by a CHWC facility has a direct effect on the characteristics and quantity of the CHWC wastewater generated by that facility. Table 3-9 presents the types of air pollution control systems in use at the 22 commercial facilities. Table 3-10 presents the types of air pollutants for which add-on control systems are in operation for the 22 CHWC facilities. Some of these systems do not generate any wastewater (e.g., a fabric filter for particulate removal). Other systems would generate wastewater (e.g., a packed tower scrubber with lime used for halogenated acid gas removal).

Table 3-9. Types of Air Pollution Control Systems at 22 Commercial Facilities

Type of Air Pollution Control System	Total Thermal Units
Spray Chamber Scrubber	16
Impingement Baffle Scrubber	2
Wet Cyclone (including multiclones)	2
Venturi Scrubber	12
Packed Tower	16
Ionizing Wet Scrubber	4
Wet Electrostatic Precipitator	3
Fabric Filter	11
Dry Scrubber	2
Spray Dryer	1
Other (Includes: Demister; Dry Cyclone; Dry Electrostatic Precipitator; Horizontal Packed Absorber; Scrubber Quench Unit; Steam Atomization)	12

Table 3-10. Air Pollutants for Which Add-On Control Systems are in Operation for 22 Commercial Facilities

Air Pollutant	Total Thermal Units
None	2
Halogenated Acid Gases	21
Sulfur Compounds	17
Nitrogen Compounds	5
Particulates	28
Metals	23
Other (Organics)	1

Of the facilities that use water in their air pollution control systems, the chemicals added to the water and the types of water recirculation systems vary greatly by facility. The addition of chemicals to the water is dependent upon the purpose of the scrubbing system (e.g., no chemicals would be used to trap particulates in a cyclonic scrubber and sodium hydroxide would be used to remove halogenated acid gases in a packed tower scrubber). The chemicals added to the scrubber water would have a direct effect on the characteristics of the wastewater generated. Table 3-11 presents the types of scrubbing liquors in use at the 22 commercial facilities.

Table 3-11. Scrubbing Liquor Used in Air Pollution Control Systems of 22 Commercial Facilities

Scrubbing Liquor	Total Thermal Units
None	7
Water With No Added Chemicals	13
Sodium Hydroxide	17
Lime Slurry	8
Other (Includes: Lime-Hydrated; Sodium Carbonate Solution; Sulfuric Acid)	5

The type of water recirculation system used by a facility also has a direct effect on the amount of wastewater generated. If a facility operated a closed loop air pollution control system with no discharge, no wastewater would be generated. Alternately, a facility that did not recirculate its air pollution control system wastewater, would tend to generate a large quantity of wastewater. Table 3-12 presents the types of water recirculation systems.

Table 3-12. Type of Water Recirculation System Used in Air Pollution Control Systems of the 22 CHWC Facilities

Water Recirculation System	Total Thermal Units
None (once through)	2
Closed Loop (no discharge)	7
Recirculating with Intermittent Blowdown	1
Recirculating with Continuous Blowdown	12

3.5 SUMMARY INFORMATION ON 10 CHWC FACILITIES WHICH GENERATE AND DISCHARGE CHWC WASTEWATER

Twelve of the twenty-two facilities generate CHWC wastewater but do not discharge the wastewater to a receiving stream or to a POTW. These facilities are considered “zero or alternative dischargers” and use a variety of methods to dispose of their wastewater. At these facilities, (1) wastewater is sent off-site for treatment or disposal (four facilities); (2) wastewater is burned or evaporated on site (four facilities); (3) wastewater is sent to a surface impoundment on site (three facilities); and (4) wastewater is injected underground on-site (one facility). Thus, EPA has identified only 10 facilities that were discharging CHWC wastewater to a receiving stream or to a POTW in 1992. Of these 10 facilities, 2 facilities have either stopped accepting waste from off-site for combustion or have closed their combustion operations since 1992. These eight facilities are found near the industries generating the wastes undergoing combustion.

The eight open facilities identified by EPA operate a wide variety of combustion units. Three facilities operate rotary kilns and are regulated as incinerators under RCRA. Three facilities operate liquid injection incinerators and are regulated as incinerators under RCRA. One facility operates a furnace and is regulated as a BIF under RCRA. One facility operates a liquid injection device and is regulated as a BIF under RCRA.

Also, the eight open facilities identified by EPA use a wide variety of air pollution control systems. The types of air pollution control systems in use are: fabric filters, spray chamber scrubbers, packed tower scrubbers, ionizing wet scrubbers, venturi scrubbers, dry scrubbers, dry cyclones, and wet electrostatic precipitators. Seven of the eight open facilities use more than one of the air pollution control systems listed above. Four of the eight facilities use a combination of wet and dry air pollution control systems. Three of the eight facilities use only wet air pollution control systems.

3.6 INDUSTRY SUBCATEGORIZATION

Division of an industry into groupings entitled "subcategories" provides a mechanism for addressing variations between products, raw materials, processes, and other parameters which result in distinctly different effluent characteristics. Regulation of an industry by subcategory provides that each has a uniform set of effluent limitations which take into account technology achievability and economic impacts unique to that subcategory.

The factors considered in the regulation of the CHWC Industry include:

- waste type received;
- type of combustion process;
- air pollution control used;
- nature of wastewater generated;
- facility size, age, and location;
- non-water quality impact characteristics; and
- treatment technologies and costs.

EPA evaluated these factors and determined that subcategorization is not required.

For most facilities in this industry, a wide variety of wastes are combusted. These facilities, however, employ the same wastewater treatment technologies regardless of the specific type of waste being combusted in a given day.

EPA concluded that a number of factors did not provide an appropriate basis for subcategorization. The Agency concluded that the age of a facility should not be a basis for subcategorization because many older facilities have unilaterally improved or modified their treatment process over time. Facility size is also not a useful technical basis for subcategorization for the CHWC Industry because wastes can be burned to the same level regardless of the facility size and has no significant relation to the quality or character of the wastewaters generated or treatment performance. Likewise, facility location is not a good basis for subcategorization; no consistent differences in wastewater treatment performance or costs exist because of geographical location. Non-water quality characteristics (waste treatment residuals and air emission effects) did not constitute a basis for subcategorization. The environmental effects associated with disposal of waste treatment residual or the transport of potentially hazardous wastewater are a result of individual facility practices. The Agency did not identify any consistent basis for these decisions that would support subcategorization. Treatment costs do not appear to be a basis for subcategorization because costs will vary and are dependent on the following waste stream variables: flow rates, waste quality, waste energy content, and pollutant loadings. Therefore, treatment costs were not used as a factor in determining subcategories.

EPA identified three factors with significance for potentially subcategorizing the CHWC Industry: the type of waste received for treatment, the type of air pollution control system used by a facility, and the types of CHWC wastewater sources (e.g., container wash water vs. air pollution control water).

A review of untreated CHWC air pollution control system wastewater showed that there is some difference in the concentration of pollutants between solid and liquid waste combustion units. In particular, for nine of the 27 metals analyzed at six CHWC facilities, the average concentration of a particular metal was higher in the water from facilities that burned solids (as well as liquids) than in facilities that burned liquids only. EPA believes that this difference is probably the result of two factors: the type of air pollution control employed by the facilities and the amount of wastewater generated. Specifically, the data reviewed by EPA showed that two of the three facilities that burn liquid waste use dry scrubbing devices prior to using scrubbing devices which generate wastewater. One of these facilities uses a baghouse initially and the other uses a fabric filter. These dry scrubbers would remove some of the metals which would have ended up in the wastewater stream. In comparison, only one of the three facilities that burn solids uses a dry scrubbing device prior to using scrubber devices which generate wastewater. This facility uses an electrostatic precipitator initially. In addition, all three of the facilities that burn liquid waste do not recycle any of their wastewater for reuse in the scrubbing system following partial wastewater treatment. In comparison, two of the three facilities that burn solids recycle some of their partially treated wastewater for reuse in their scrubbing system. One of these facilities recycles 60 percent and the other recycles 82 percent. The reuse of partially treated wastewater would have the effect of reducing the wastewater discharge and increasing the concentration of metals in the recycled wastewater. Thus, the Agency could not conclude that there is in fact any significant difference in the concentrations of pollutants in wastewater from facilities burning solid versus liquid waste. This situation in general makes subcategorizing on this basis difficult. See CHWC Record W-97-08, #7.2.0.1 for the presentation of this statistical analysis. Therefore, EPA has concluded that available data do not support subcategorization either by the type of waste received for treatment or the type of air pollution control system used by a facility.

Based on analysis of the CHWC Industry, EPA has determined that it should not subcategorize the Commercial Hazardous Waste Combustors for purposes of determining appropriate limitations and standards.

SECTION 4
WASTEWATER USE AND WASTEWATER CHARACTERIZATION

In 1993, under authority of Section 308 of the Clean Water Act (CWA), the EPA distributed the "1992 Waste Treatment Industry Phase II: Incinerators Screener Survey" and, subsequently, the "1994 Waste Treatment Industry Phase II: Incinerators Questionnaire" to facilities that EPA had identified as possible CHWC facilities. Responses to the screener survey and questionnaire indicated that, in 1992, 10 CHWC facilities operated commercially and discharged their CHWC wastewater to a receiving stream or to a POTW. Of these 10 facilities, 2 facilities have either stopped accepting waste from off site for combustion or have closed their combustion operations since 1992. Thus, this section presents information on water use at only the remaining 8 facilities. This section also presents information on wastewater characteristics for the CHWC facilities that were sampled by EPA and for some of those facilities that provided self-monitoring data.

4.1 WATER USE AND SOURCES OF WASTEWATER

Approximately 820 million gallons of wastewater are generated and discharged annually at the 8 CHWC facilities. EPA has identified the sources described below as contributing to wastewater discharges at CHWC operations. Only air pollution control wastewater, flue gas quench, and slag quench, however, would be subject to the CHWC effluent limitations and standards. Most of the wastewater generated by CHWC operations result from these sources.

a. Air Pollution Control System Wastewater. Particulate matter in the effluent gas stream of a CHWC is removed by four main physical mechanisms (Handbook of Hazardous Waste Incineration, Brunner 1989). One mechanism is interception, which is the collision between a water droplet and a particle. Another method is gravitational force, which causes a particle to fall out of the direction of the streamline. The third mechanism is impingement, which causes a water particle to fall out of the streamline due to inertia. Finally, contraction and expansion of a gas stream allow particulate matter to be removed from the stream. Thus, removal of particulate matter can be accomplished with or without the use of water. Depending upon the type of waste being burned, Commercial Hazardous Waste Combustors may produce acid gases in the air pollution control system. In order to collect these acid gases, a caustic solution is generally used in a wet scrubbing system.

b. Flue Gas Quench Wastewater. Water is used to rapidly cool the gas emissions from combustion units. There are many types of air pollution control systems that are used to quench the gas emission from Commercial Hazardous Waste Combustors. For example, in packed tower scrubbing systems, water enters from the top of the tower and gas enters from the bottom. Water droplets collect on the packing material and are rinsed off by the water stream entering the top of the tower (Handbook of Hazardous Waste Incineration, Brunner 1989). This rapidly cools the gas stream along with removing some particulate matter.

c. Slag Quench Wastewater. Water is used to cool molten material generated in slagging-type combustors.

d. Truck/Equipment Wash Water. Water is used to clean the inside of trucks and the equipment used for transporting wastes.

e. Container Wash Water. Water is used to clean the insides of waste containers.

f. Laboratory Wastewater. Water is used in on-site laboratories which characterize incoming waste streams and monitor on-site treatment performance.

g. Floor Washings and Other Wastewater from Process Area. This includes stormwater which comes in direct contact with the waste or waste handling and treatment areas. (Stormwater which does not come into contact with the wastes would not be subject to today's promlugated limitations and standards. However, this stormwater is covered under the NPDES stormwater rule, 40 CFR 122.26).

4.2 WATER USE

As mentioned in Section 4.1, approximately 820 million gallons of wastewater were discharged from 8 of the 55 commercial industrial combustors identified by EPA based on questionnaire responses.

Table 4-1 presents the total, average, and range of discharge flow rates for the eight discharging facilities. There were 45 facilities that either do not generate any CHWC wastewater (33) or do not discharge their wastewater (12) as discussed previously. In general, the primary types of wastewater discharges from discharging facilities are: air pollution control system wastewater, flue gas quench, and slag quench. EPA is using the phrase "CHWC wastewater" to refer to these three types of wastewaters only. Other types of wastewater generated as a result of combustor operations (e.g., truck washing water) are not considered "CHWC wastewater".

This regulation applies to direct and indirect discharges only.

Table 4-1. Amount of CHWC Wastewater Discharged

Number of Facilities	Total Amount of CHWC Wastewater Discharged (Gallons/Day)	Average Amount of CHWC Wastewater Discharged (Gallons/Day)	Range In Average Amount of CHWC Wastewater Discharged (Gallons/Day)
8	2,247,580	280,948	47,430 to 1,007,640

4.3 WASTEWATER CHARACTERIZATION

EPA conducted 15 sampling episodes at 13 different facilities in an effort to characterize CHWC raw influent wastewaters during the formulation of the CHWC rule. These included three five-day sampling efforts and twelve individual grab samples. A total of 467 pollutants were analyzed in the raw wastewater, including 232 toxic and non-conventional organic compounds, 69 toxic and non-conventional metals, 4 conventional pollutants, and 162 toxic and non-conventional pollutants including pesticides, herbicides, dioxins, and furans. Of these 467 pollutants, only 139 were ever detected at any of the CHWC influent samples; most being metals and other non-organic compounds. Therefore, 328 pollutants analyzed were never found at detectable levels in any CHWC influent samples. Appendix A presents a list of all analytes that were detected at least once, along with: the detection limit, number of observations (samples), number of detects, and minimum, maximum, and mean values of the pollutant. Appendix B lists all of the remaining

328 pollutants never found in CHWC wastewaters, including the number of observations and detection levels of the analytes.

4.3.1 *Five-Day Sampling Episodes*

The Agency's five-day sampling program for this industry detected 21 pollutants (conventional, priority, and non-conventional) in waste streams at treatable levels at the facility that provides the basis for the BPT/BAT limits. Two additional pollutants were detected at treatable levels in the two other five-day sampling episodes: strontium and dichlorprop. The quantity of these pollutants currently being discharged from all facilities is difficult to assess. Limited monitoring data are available from facilities for the list of pollutants identified from the Agency's sampling program prior to commingling of these wastewaters with non-contaminated stormwater and other industrial wastewater before discharge. EPA used monitoring data supplied in the 1994 Waste Treatment Industry Phase II: Incinerators Questionnaire and data supplied in the Detailed Monitoring Questionnaire, wastewater permit information, and EPA sampling data to estimate raw waste and current pollutant discharge levels. EPA used a “non-process wastewater” factor to quantify the amount of non-contaminated stormwater and other industrial process water in a facility's discharge. Section 4.4 of this document provides a more detailed description of “non-process wastewater” factors and their use. A facility's current discharge of treated CHWC wastewater was calculated using the monitoring data supplied multiplied by the “non-process wastewater” factor.

4.3.1.1 Conventional Pollutants

The most appropriate conventional pollutant parameters for characterizing untreated wastewater and wastewater discharged by CHWC facilities are:

- Total Suspended Solids, and
- pH

Total solids in wastewater are defined as the residue remaining upon evaporation at just above the boiling point. Total suspended solids (TSS) is the portion of the total solids that can be filtered out of the solution using a 1 micron filter. Untreated wastewater TSS content is a function of the type and form of waste accepted for treatment (e.g., wastewater that results from the combustion of solid waste receipts would tend to have higher TSS values than waste received in a liquid form). TSS can also be due to treatment chemicals added to the wastewater as it is being generated (e.g., a caustic solution may be used in a CHWC air pollution control system). The total solids are composed of matter which is settleable, in suspension or in solution, and can be removed in a variety of ways, such as during the metals precipitation process or by multimedia filtration, depending on a facility's operation. Untreated wastewater TSS levels found in the three five-day EPA sampling episodes are presented in Table 4-2.

The pH of a solution is a unitless measurement which represents the acidity or alkalinity of a wastewater stream, based on the dissociation of the acid or base in the solution into hydrogen (H+) or hydroxide (OH-) ions, respectively. Untreated wastewater pH is a function of the source of waste receipts as well as a function of the chemicals used in the air pollution control devices. This parameter can vary widely from facility to facility. Control of pH is necessary to achieve proper removal of pollutants in the BPT/BAT treatment system (chemical precipitation).

As shown in Table 4-2, raw waste five-day biochemical oxygen demand and oil and grease are very low, ranging from 1 mg/l to 53 mg/l and from 5 mg/l (not detected) to 6 mg/l, respectively. Both of these parameters are indirect measurements of the organic strength of wastewater. The wastewater sampled by EPA is generated from air pollution control systems and consists primarily of inorganic pollutants and very low concentrations of organic compounds because they are destroyed during combustion. (Furthermore, a more direct measure of the organic strength of the raw wastewater, total organic carbon, also shown in Table 4-2, only ranges from 10 mg/l (not detected) to 16 mg/l).

Table 4-2. Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three Five-Day EPA Sampling Episodes (ug/l)

Pollutant	Mean	Minimum	Maximum
Aluminum	897.6	13.6	2,538.0

Pollutant	Mean	Minimum	Maximum
Ammonia as Nitrogen	14,312.4	100.0	75,000.0
Antimony	268.2	7.8	958.8
Arsenic	166.4	4.6	827.2
BOD_5	9,960	1,000	53,000
Boron	1,604.6	918.0	3,760.0
Cadmium	312.2	1.8	2,616.0
Calcium	293,146.0	8,140.0	1,270,000.0
Chemical Oxygen Demand	343,140.0	67,000.0	1,036,000.0
Chloride	6,833,746.7	1,010,000.0	17,002,400.0
Chromium	127.2	5.8	529.2
Copper	1,786.7	8.5	10,554.0
Fluoride	82,620.5	16,500.0	360,000.0
Iron	2,904.1	149.0	10,838.0
Lead	1,613.9	2.1	13,248.0
Manganese	114.7	4.0	388.0
Mercury	21.1	0.2	115.4
Molybdenum	336.7	4.6	1024.4
Nitrate/Nitrite	2,650.9	360.0	4,560.0
Oil and Grease	5,067	5,000	6,000
Phosphorus	32,480.0	3,210.0	225,800.0
Potassium	77,743.0	1,310.0	195,400.0
Selenium	102.8	2.3	429.2
Silicon	15,414.0	5,380.0	28,100.0
Silver	98.9	1.0	390.8
Sodium	3,443,333.3	6,400.0	11,250,600.0
Strontium	630.2	100.0	2,280.0
Sulfur	400,788.1	2,145.0	1,078,240.0
Tin	665.9	14.5	6,046.0
Titanium	777.7	5.0	4,474.2
Total Dissolved Solids	12,815,853.3	158,000.0	32,641,200.0
Total Organic Carbon	10,485	10,000	16,000
Total Phosphorus	1,088.6	10.0	4,460.0
Total Sulfide	28,261.3	1,000.0	103,200.0

Pollutant	Mean	Minimum	Maximum
Total Suspended Solids	122,553.3	4,000.0	522,000.0
Zinc	3,718.8	89.8	12,310.0
Dichlorprop	7.7	1.0	47.0
MCPP	375.7	50.0	2,594.0

4.3.1.2 Priority and Non-Conventional Pollutants

Table 4-2 above presents the range of the pooled daily pollutant influent concentration data from the three five-day EPA sampling episodes. This table includes treatment chemicals and nutrients found in CHWC wastewater as well as pollutants to be removed from CHWC wastewater.

4.3.2 *Characterization Sampling Episodes*

As discussed in Section 2.2.2.1 of this document, EPA obtained a grab sample of untreated CHWC wastewater at 12 facilities. These samples were used to help characterize the CHWC wastewaters at a wide range of combustor types, including captive facilities. Data from one facility was excluded due to the sample solidifying soon after collection, thus provided, in the Agency's opinion, data of a poor and misrepresentative nature. Table 4-3 below presents a breakdown of levels of typical pollutants found in the raw CHWC wastewater at 11 different facilities. The pollutants presented in Table 4-3 were detected at more than one facility with a mean concentration of at least 10 times the pollutant detection limit.

Table 4-3. Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Characterization EPA Sampling Episodes (ug/l)

Pollutant	Mean	Minimum	Maximum
Aluminum	5,458.8	21.5	34,800.0
Ammonia as Nitrogen	2,908.8	130.0	13,000.0
Arsenic	323.2	1.1	1,420.0
Benzoic Acid	263,249.8	50.0	3,157,556.0

Pollutant	Mean	Minimum	Maximum
BOD_5	1,092,333.3	1,000.0	10,100,000.0
Boron	22,565.2	20.0	182,000.0
Cadmium	225.7	1.2	1,632.8
Chemical Oxygen Demand	2,284,583.3	13,000.0	19,100,000.0
Chloride	10,203,416.7	40,000.0	28,300,000.0
Chromium	342.0	3.6	1,650.0
Copper	894.2	10.0	4,621.8
Fluoride	879,230.0	120.0	7,500,000.0
Iron	10,413.5	239.2	50,600.0
Lead	1,604.5	45.5	12,358.0
Manganese	245.8	10.8	1,534.6
Mercury	32.7	0.1	217.0
Molybdenum	131.3	4.0	508.5
Nitrate/Nitrite	5,166.7	210.0	33,280.0
Potassium	147,574.2	478.6	805,000.0
Selenium	65.8	0.5	288.0
Silicon	42,997.6	28.2	340,000.0
Sodium	12,377,392.9	8,244.3	62,400,000.0
Sulfur	22,998,416.6	12,500.0	174,000,000.0
Titanium	463.9	2.2	3,770.0
Total Dissolved Solids	37,896,083.3	89,000.0	185,000,000.0
Total Organic Carbon	391,041.7	1,700.0	4,540,000.0
Total Phenols	12,316.3	6.0	146,000.0
Total Phosphorus	1,279.2	10.0	4,520.0
Total Sulfide	163,340.8	10.0	1,180,000.0
Total Suspended Solids	100,000.0	1,000.0	416,000.0
Uranium	10,099.6	608.2	67,100.0
Zinc	5,436.6	44.7	28,569.0

4.4 WASTEWATER POLLUTANT DISCHARGES

As previously discussed, most of the effluent monitoring data received from facilities included non-CHWC wastewater, such as other industrial waste streams and stormwater. Due to the lack of effluent data for CHWC wastewater, the EPA had to develop various methods to estimate their current wastewater pollutant discharge. This section describes the various methodologies used to estimate current performance.

Most of the data supplied by the CHWC facilities represented data that included non-CHWC wastewater in the form of non-contaminated stormwater and other industrial stormwater prior to discharge. Therefore, the amount of a pollutant in the final effluent would be equal to the amount of the pollutant in the CHWC process in addition to the amount in the non-CHWC process, as shown in Equation 4.1.

$$C_{T} * F_{TOTAL} = C_{CHWC} * F_{CHWC} + C_{NON\text{-}CHWC} * F_{NON\text{-}CHWC} \tag{4.1}$$

where:

C_T = Concentration of pollutant in the combined wastewater stream -- the concentration reported in the CHWC Questionnaire, the CHWC Detailed Monitoring Questionnaire, in POTW permits, in NPDES permits, or from EPA sampling program.
F_{TOTAL} = Flowrate of total wastewater stream.
C_{CHWC} = Concentration of pollutant in the CHWC (and other similar) wastewater streams.
F_{CHWC} = Flowrate of CHWC (and other similar) wastewater streams.
$C_{NON\text{-}CHWC}$ = Concentration of pollutant in stormwater or non-contact wastewater streams.
$F_{NON\text{-}CHWC}$ = Flowrate of stormwater or non-contact wastewater streams.

Stormwater or non-contact wastewater was assumed to be significantly lower in concentration in comparison to the CHWC wastewater, and thus, the concentration of non-CHWC wastewater streams was set equal to zero. This assumption simplifies Equation 4.1 as shown in Equation 4.2 below. Also, other industrial wastewater streams were assumed to have the same concentrations as the CHWC wastewater streams.

$$C_T * F_{TOTAL} = C_{CHWC} * F_{CHWC} \tag{4.2}$$

For each facility, the EPA calculated the portion of CHWC wastewater in the facility discharge and then calculated the CHWC effluent concentration by solving Equation 4.2. Thus, the non-process wastewater factor is the flowrate of the total wastewater stream divided by the flowrate of the CHWC (and other similar) wastewater stream.

The hierarchy of data used to estimate current loading concentrations was as follows:

1.) *Detailed Monitoring Questionnaire (DMQ) for the CHWC Industry data from effluent sample locations for 1992.* The facility's long-term monitoring data was supplied in this questionnaire. Often, this data had to be corrected for inclusion of non-CHWC wastewater streams using Equation 4.2 above.
2.) *Detailed Monitoring Report (DMR) data from effluent sample locations for 1992.* The facility's long-term monitoring data was supplied to EPA in this report. Often, this data had to be corrected for inclusion of non-CHWC wastewater streams using Equation 4.2.
3.) *Waste Treatment Industry Phase II: Incinerators Questionnaire data from effluent sample locations for 1992.* The facility's year-long monitoring data was supplied in this questionnaire. Often, this data had to be corrected for inclusion of non-CHWC wastewater streams using Equation 4.2.
4.) *POTW or NPDES permit effluent concentrations for 1992.* Often, this data had to be corrected for inclusion of non-CHWC wastewater streams using Equation 4.2.
5.) *EPA Five-Day Sampling Data for three CHWC facilities.* This data was used either for specific facilities sampled or averages were obtained to model facilities for which limited data was available.
6.) *Averages from similar facilities.* Data averages from similar facilities were used to model current loadings concentrations for facilities for which limited data was available.

The average, flow-weighted, estimated 1992 discharge concentration for facilities in the CHWC Industry is presented in Table 4-4.

Table 4-4. CHWC Industry 1992 Discharge Concentration

Pollutant	Discharge Concentration	Unit
Chemical Oxygen Demand	145.2	mg/l
Total Dissolved Solids	10,430.0	mg/l
Total Suspended Solids	30.6	mg/l
Aluminum	663.7	ug/l
Antimony	559.0	ug/l
Arsenic	217.7	ug/l
Boron	1,614.9	ug/l
Cadmium	118.4	ug/l
Chromium	4,276.9	ug/l
Copper	944.2	ug/l
Iron	306.2	ug/l
Lead	363.4	ug/l
Manganese	156.2	ug/l
Mercury	10.6	ug/l
Molybdenum	239.2	ug/l
Selenium	34.2	ug/l
Silver	31.0	ug/l
Tin	88.4	ug/l
Titanium	79.6	ug/l
Zinc	385.6	ug/l

SECTION 5

SELECTION OF POLLUTANTS AND POLLUTANT PARAMETERS FOR REGULATION

5.1 INTRODUCTION

As previously discussed, EPA evaluated sampling data that was collected from the industry prior to the proposal of this regulation as well as data submitted by industry following the proposal of this regulation. EPA used these data (presented in Section 4) to identify which pollutants present in combustor wastewaters it should consider for regulation -- the so called “pollutants of concern” for the Commercial Hazardous Waste Combustor (CHWC) Industry. EPA classifies pollutants into three categories: conventional, non-conventional, and toxic pollutants. Conventional pollutants include 5-day biolgoical oxygen demand (BOD_5), total suspended solids (TSS), oil and grease, and pH. Toxic pollutants -- EPA also refers to them as priority pollutants -- include selected metals, pesticides and herbicides, and over 100 organic parameters that represent a comprehensive list of volatile and semi-volatile compounds. Non-conventional pollutants are any pollutants that do not fall within the specific conventional and toxic pollutant lists, for example, total organic carbon (TOC), chemical oxygen demand (COD), chloride, fluoride, ammonia as nitrogen, nitrate/nitrite, total phenol and total phosphorus.

This section presents the criteria used for the selection of pollutants EPA evaluated for regulation and the selection of pollutants for which EPA has established effluent limitations and standards.

5.2 POLLUTANTS CONSIDERED FOR REGULATION

To characterize CHWC wastewaters and to determine the pollutants that it should evaluate for potential limitations and standards, EPA collected wastewater characterization samples at 12 CHWC facilities, in addition to influent data collected during three five-day sampling episodes. EPA analyzed wastewater samples for 467 conventional, toxic, and non-conventional pollutants including metals, organics, pesticides, herbicides, and dioxins and furans. Section 4 presents this wastewater characterization data.

From the original list of 467 analytes, EPA developed a list of "pollutants of concern" that it would further evaluate for possible regulation. A total of 328 pollutants were never detected in CHWC wastewaters during EPA sampling episodes, leaving 139 pollutants to be considered as pollutants of concern that served as the basis for selecting pollutants for regulation. These 328 pollutants are presented in Section 4.

5.3 SELECTION OF POLLUTANTS OF CONCERN

EPA determined "pollutants of concern" -- pollutants that EPA evaluates for regulation -- using the raw wastewater data collected during the EPA sampling program. EPA only considered the three five-day sampling episodes to determine the pollutants of concern. Therefore, EPA did not include sampling data from the 12 wastewater characterization sampling episodes. Of these 12 facilities, eight were captive facilities that did not operate commercially (outside the scope of this regulation) and the samples from one facility solidified during transport to the analytical laboratory and were not re-sampled. Two of the remaining three facilities were selected for five-day sampling episodes and therefore, characterization data is included as part of these events. A total of 25 pollutants were detected during the wastewater characterization sampling episodes but were not detected during the three five-day sampling episodes and were eliminated as pollutants of concern. These 25 pollutants are listed in Table 5-1.

Table 5-1. Pollutants Detected Only During Wastewater Characterization Sampling

Pollutants	
Amenable Cyanide	N-Decane
Atrazine	N-Docosane
Benzoic Acid	N-Docecane
Beryllium	N-Eicosane
Bromodichloromethane	N-Tetradecane
Carbon Disulfide	P-Cresol
Chloroform	Tribromomethane

Pollutants	
Dibenzothiophene	Trichlorofluoromethane
Dibromochloromethane	Yttrium
Erbium	2-Butanone
Hexanoic Acid	2-Propanone
Isophrone	2-Propenol
Methylene Chloride	

EPA further determined a pollutant to be a potential pollutant of concern if it was detected three or more times in the influent above the method detection limit (MDL) at a five-day sampling episode. This ensured that pollutants that were detected relatively frequently at CHWC facilities were given consideration as pollutants of concern. This criterion eliminated the 47 pollutants listed in Table 5-2.

Table 5-2. Pollutants Not Detected Three or More Times Above MDL

Pollutants	
Acetophenone	Oil and Grease
Cerium	Osmium
Cobalt	Phenol
Dalapon	Platinum
Dicamba	Praseodymium
Dinoseb	Rhenium
Dysprosium	Rhodium
Europium	Ruthenium
Gadolinium	Samarium
Gallium	Scandium
Germanium	Tantalum
Hafnium	Terbium
Holmium	Thallium
Indium	Thorium
Iodine	Thulium

Pollutants	
Iridium	Total Phenols
Lanthanum	Tungsten
Lutetium	Ytterbium
MCPA	Zirconium
Monocrotophos	2,4 - D
Neodymium	2,4 - DB
Niobium	2,4,5 - T
Norflurazon	2,4,5 - TP
OCDF	

EPA then further examined the characteristics of the three facilities that were sampled as part of the five-day episodes. As noted in Section 6, influent concentrations for many parameters were low due to the liquid injection system employed at the facility sampled during Episode # 4733 and the actual raw wastewater characteristics as well as treatment system performance could not be adequately determined. In addition, raw wastewater pollutant concentrations also were lower at the treatment system employed at the facility sampled during Episode 4671 and treatment system performance was not as good as the system considered BAT. Therefore, EPA determined that only data collected from five-day sampling Episode 4646 should be considered further in determining pollutants of concern. This criterion eliminated the six pollutants listed in Table 5-3, leaving a total of 61 pollutants remaining.

Table 5-3. Pollutants Only Found During Sampling Episodes 4733 and 4671

Pollutants	
Bismuth	Total Cyanide
Dichloroprop	Total Organic Carbon
Strontium	Uranium

Next, EPA evaluated which pollutants were present in raw wastewaters at treatable levels by determining the pollutants that were detected three or more times at an average influent concentration greater than or equal to 10 times the MDL (in the case of aluminium and lead, criteria of five and three times the MDL was used, respectively, to determine treatable levels because of higher MDLs). EPA determined that this criterion eliminated the 11 pollutants listed in Table 5-4, leaving a total of 50 pollutants remaining.

The raw wastewater value for pollutants detected during sampling Episode 4646 was a flow-weighted average of two sample points. Barium (291 ug/l), bis (2-ethylhexyl) phthalate (37 ug/l), BOD_5 (3.7 mg/l), hexavalent chromium (35 ug/l), lithium (497 ug/l), magnesium (5,431 ug/l), nickel (151 ug/l) and vanadium (315 ug/l) were all detected at an average concentration well below the 10 times the MDL threshold for treatable levels. For n-hexacosane, n-octacosane and n-tricotane, samples were analyzed using different analytical methods that yielded values in different units, ug/kg and ug/l. In both cases, the average concentration also was well below the 10 times the MDL threshold for treatable levels for all three pollutants.

Table 5-4. Pollutants Not Detected Three or More Times at an Average Influent Concentration Greater Than or Equal To 10 Times the MDL

Pollutants	
Barium	N-Hexacosane
Bis (2-Ethylhexyl) Phthalate	N-Octacosane
BOD_5	N-Tricotane
Hexavalent Chromium	Nickel
Lithium	Vanadium
Magnesium	

EPA then excluded pollutants that are used as treatment chemicals in this industry from the pollutants of concern list. These compounds include ammonia as nitrogen, calcium, chloride, fluoride, nitrate/nitrite, phosphorus, potassium, silicon, sodium, sulfur, total phosphorus, and total sulfide. Eliminating these 12 pollutants leaves a total of 38 pollutants remaining.

EPA eliminated pollutants that received ineffective treatment by the selected BAT treatment technology. Concentrations of these pollutants increased or decreased insignificantly during sampling Episode 4646 and could not be considered treated. This criterion eliminated the five pollutants listed in Table 5-5, leaving a total of 33 pollutants remaining.

Table 5-5. Pollutants Not Treated by the BAT Treatment System

Pollutants	
Boron Chemical Oxygen Demand Manganese	MCPP Total Dissolved Soilds

EPA then eliminated those pollutants indirectly controlled through the regulation of other pollutants in the final rule. This criterion eliminated the six pollutants shown in Table 5-6, leaving a total of 27 pollutants remaining.

Table 5-6. Pollutants Indirectly Controlled Through Regulation of Other Pollutants

Pollutants	
Aluminum Antimony Iron	Molybdenum Selenium Tin

Finally, EPA eliminated the 16 dioxins and furans presented in Table 5-7, for the reasons presented below.

Table 5-7. Dioxins and Furans Eliminated as Pollutants of Concern

Pollutants	
234678 - HXCDF 23478 - PECDF	123678 - HXCDF 12378 - PECDD

Pollutants	
2378 - TCDD	12378 - PECDF
2378 - TCDF	123789 - HXCDD
123478 - HXCDD	123789 - HXCDF
123478 - HXCDF	OCDD
1234789 - HPCDF	1234678 - HPCDD
123678 - HXCDD	1234678 - HPCDF

5.3.1 *Dioxins/Furans in Commercial Hazardous Waste Combustor Industry*

5.3.1.1 Background

Scientific research has identified 210 isomers of chlorinated dibenzo-p-dioxins (CDD) and chlorinated dibenzofurans (CDF). EPA's attention has primarily focused on the 2,3,7,8-substituted congeners, a priority pollutant under the CWA, of which 2,3,7,8-TCDD and 2,3,7,8-TCDF are considered the most toxic. Evidence suggests that non-2,3,7,8-substituted congeners may not be as toxic. Some sources report that these non-2,3,7,8-substituted congeners may either be broken down or quickly eliminated by biological systems. Dioxins and furans are formed as a by-product during many industrial and combustion activities, as well as during several other processes. The combustion activities that may create dioxins under certain conditions may include:

- Combustion of chlorinated compounds, including PCBs;
- Some metals are suspected to serve as catalysts in the formation of dioxin/furans;
- Metal processing and smelting;
- Petroleum refining;
- Chlorinated organic compound manufacturing.

5.3.1.2 Dioxin/Furans in Commercial Hazardous Waste Combustor Wastewater

EPA identified a number of dioxin/furan compounds as present in the untreated wastewater streams at seven of the twelve facilities sampled (including grab and composite samples). Two of the facilities with dioxins detected in their CHWC wastewater are now closed and no longer within the scope of the final rule, so data from these facilities has not been considered further here. Thus, the following discussion relates to data from the ten remaining facilities (a total of 32 aqueous samples). Table 5-8 below summarizes the dioxin/furans detected in CHWC wastewaters during the sampling program. Similar isomers that contain the 2,3,7,8 base were grouped together for this analysis due to their similar nature and characteristics.

Table 5-8. Breakdown of Detected Dioxin/Furans During CHWC Sampling Program

Dioxin/Furan	Toxic Equivalent Value (TEQ)	Universal Treatment Standards	Mean Concentrations CHWC Industry (detects only)	Total # of Aqueous Samples Detected (out of 32)	# of Facilities Detected (out of 10)
2,3,7,8- TCDF	0.1	63,000 pg/l	17 pg/l	2	2
2,3,7,8- PeCDF	0.5	35,000 pg/l	93 pg/l	1	1
2,3,7,8- HxCDD	0.1	63,000 pg/l	68 pg/l	1	1
2,3,7,8- HxCDF	0.1	63,000 pg/l	249 pg/l	7	3
2,3,7,8- HpCDD	0.01	none	272 pg/l	5	4
2,3,7,8- HpCDF	0.01	none	939 pg/l	7	4
OCDD	0.001	none	971 pg/l	10	5
OCDF	0.001	none	6165 pg/l	6	4

It is important to note that EPA did not detect 2,3,7,8-TCDD (the most toxic congener) or 2,3,7,8-PeCDD in the raw wastewater samples collected. The dioxin/furans detected in untreated CHWC wastewaters during EPA sampling at 10 sites show that these dioxin/furans were all detected at levels significantly (orders of magnitude) below the "Universal Treatment Standard" (40 CFR 268.48) level established under RCRA for dioxins/furans. In addition, low levels of HpCDD and OCDD (as indicated above) are generally considered pervasive in the environment and Universal Treatment Standards have not been set for these compounds. EPA identified no dioxin/furans in the CHWC wastewater treated effluent.

CDD/CDFs are lipophilic and hydrophobic. As such, they are most often associated, or have an affinity for, suspended particulates in wastewater matrices. The more highly chlorinated isomers (i.e., the hepta- and octa- congeners) are the least volatile and more likely to be removed through particulate adsorption or filtration. While recommended treatment technologies differ according to the wastewater characteristics, there is some evidence that dioxins generally will bind with suspended solids and some sources (EPA NRMRL Treatability database) have asserted that these compounds may be removed by precipitation and filtration technologies.

Of the three five-day sampling episodes conducted by EPA, the episode from which BAT/BPT limits were developed had no dioxins detected in the influent or effluent. At the other two facilities, HpCDD, HpCDF, OCDD, and OCDF were detected in the influent but none were detected in the effluent. Both facilities employed a combination of chemical precipitation and filtration that may have contributed to these removals.

The most toxic congener, 2,3,7,8-TCDD, was never detected in CHWC wastewater during the sampling program and the CDD/CDFs detected were neither detected at most facilities sampled nor found in any significant quantity. The toxic equivalent (TEQ) values found in the CHWC wastewater were low when compared to other dioxin sources in industry. The detected congeners were of the highly chlorinated type which may be treated by the methods recommended by this guideline (chemical precipitation, filtration, see Section 6). Also, since no dioxins were detected in the treated effluents at any of the three facilities EPA sampled, this may be evidence of dioxin removals.

Based on EPA's sampling program, no CDD/CDF met the criteria for wastewater regulation in the final rule.

The Agency has proposed CDD/CDF air emission limits of 0.2 ng/dscm from the stacks of hazardous waste burning incinerators (see 61 FR 17358 of 4/19/96 and 62 FR 24212 of 5/2/97), and believes that the incinerators have to operate with good combustion conditions to meet the proposed emission limits. In the final Land Disposal Restrictions (LDR) rulemaking that set treatment standards for

CDD/CDF constituents in non-wastewater and wastewater from RCRA code F032 wastes, the Agency has established (62 FR 26000, 5/12/97) incineration as the BDAT, after which the CDD/CDF constituents do not have to be analyzed in the effluent.

Based on the data available and the resulting decision not to establish limitations and standards for dioxins, EPA also cannot justify a monitoring program for dioxins, as suggested by a commenter on the proposal. While EPA recognizes that the promulgation of the Hazardous Waste Combustor (HWC) MACT (64 FR 52828, September 30, 1999) dioxin/furan emission standards may result in some changes in the volume and character of air pollution control wastewater generated, EPA does not believe that the changes will result in a media transfer for dioxins that would change its decision not to establish dioxin limitations and standards. The promulgated MACT standards for 85 percent of the hazardous waste incinerators in the final HWC rule are based on changes in air pollution control device process conditions to minimize generation of dioxins and furans. Various studies have shown that a significant source of dioxin in waste incinerators is from the formation of dioxin in the flue gas as it is cooled to around 400 degrees C. The longer the flue gas is held at this temperature the greater the formation of dioxin. One useful control measure is the rapid cooling of flue gas to levels below this temperature range to minimize this dioxin production window. EPA has concluded that the largest portion of the reduction in dioxin emissions will be through reductions in the amount generated rather than media transfer.

Table 5-9 presents the 11 pollutants selected for regulation for the CHWC Industry.

Table 5-9. Pollutants Selected for Regulation

Pollutants	
Arsenic	pH
Cadmium	Silver
Chromium	Titanium
Copper	Total Suspended Solids
Lead	Zinc
Mercury	

5.4 SELECTION OF POLLUTANTS FOR REGULATION

All of the analytes listed in Table 5-9 were included in data submitted by two facilities (Sampling Episodes 6181 and 6183) following the proposal of the CHWC regulation, presented in Tables 5-10 and 5-11. EPA received additional sampling data from three facilities. These facilities only tested for conventional, priority and non-conventional pollutants that they considered treatable and likely to be found in CHWC wastewater. These pollutants included TSS, total dissolved solids (TDS), chloride, sulfate, aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, molybdenum, selenium, silver, tin, titanium, and zinc. TDS, chloride and sulfate were included in the testing to characterize the wastewater and evaluate the pollutants' potential effect on the treatability of metals.

Based on several factors, EPA specifically excluded data from the third facility (Episode 6182) from consideration as BAT technology. The facility treated less than 2 percent of their wastewater through the filtration unit considered BPT/BCT/BAT. Hence, the data submitted represents single-stage precipitation with clarification only. Not only does the single-stage treatment sampled during Episode 6183 not represent BPT/BCT/BAT technology, but it does not provide sufficient treatment for the typical profile of metals detected in CHWC wastewaters. There are a variety of metals at significant and treatable concentrations in CHWC wastewaters that pose a problem for a single-stage precipitation system. To properly treat a large number of different metals effectively, several different pH settings and treatment chemicals are ususally required. Hence, many CHWC facilities currently employ two-stage chemical precipitation. When a single-stage of precipitation is employed with a narrow pH range (as was the case for Episode 6182), many of the metals present in the influent are not effectively removed and some are not removed at all. Removal efficiencies and effluent concentrations for Episode 6182 can be characterized as poor when compared to EPA-conducted sampling episodes. Based on these factors, the Agency determined that data from sampling Episode 6182 would not be used in this rulemaking.

After reviewing the data submitted by these two facilities (Sampling Episodes 6181 and 6183), EPA has decided to promulgate the CHWC regulations for the same analytes as proposed. Review of the additional TSS and TDS data submitted brought EPA to the same conclusion as at proposal: TDS should not be regulated because treatment chemicals associated with the technology selected for BPT/BCT/BAT increased TDS levels and TSS should be continue to be regulated. In addition, not all of the analytes proposed for regulation were found in one of the submitted sampling episodes (Episode 6181) in "treatable levels" at the influent sampling point, as defined above in this section. Also, not all of the analytes proposed for regulations were effectively treated (as indicated by the percent removal calculated in Section 6) in Episode 6181.

The following tables illustrate the results of the analyses to determine which pollutant data could be used from Episode 6181 and 6183 to develop the final regulations. For four of the metal analytes (arsenic, lead, selenium and silver), EPA received data for Episodes 6181 and 6183 using more than one analytical method. For arsenic, methods 200.7, 200.8 and 206.3 were used. For lead, methods 200.7 and 200.8 were used. For selenium, methods 200.7, 200.8 and 270.3 were used. For silver, methods 200.7 and 200.8 were used. EPA elected to use the results from method 200.8 for all of these metal analytes because of the quantitation limit achieved by this method and because of the reliability of this method. EPA received data using only method 200.7 for aluminum, antimony, cadmium, chromium, copper, iron, molybdenum, tin, titanium and zinc. EPA received data using only method 245.1 for mercury. Finally, EPA received data using only method 160.2 for TSS.

Table 5-10. Sampling Episode 6181 Analytical Results[1]

Episode 6181				Treatable Level?	Avg. Effluent Conc.	% Removal	Pollutants used from Epsiode 6181 to Develop Final Regulations
Pollutant	Avg. Influent Conc.	Quantitation Limit (QL)$^+$	10X QL				
TSS (mg/l)	78.8	4	40	Yes	4.77	93.95	TSS
Aluminum	7000	100	500*	Yes	102	98.54	Aluminum
Antimony	874	60	600	Yes	806	7.78	Antimony
Arsenic	278	10	100	Yes	87.8	68.42	Arsenic
Cadmium	103	5	50	Yes	7.1	93.11	Cadmium
Chromium	37.0	10	100	No	13.1	64.59	-
Copper	528	10	100	Yes	11.9	97.75	Copper
Iron	3050	20	200	Yes	23.6	99.23	Iron

Episode 6181				Treatable Level?	Avg. Effluent Conc.	% Removal	Pollutants used from Epsiode 6181 to Develop Final Regulations
Pollutant	Avg. Influent Conc.	Quanti-tation Limit (QL)+	10X QL				
Lead	895	10	100	Yes	10.3	98.85	Lead
Mercury	3.40	0.2	2	Yes	0.209	93.85	Mercury
Molybdenum	387	50	500	No	445	-14.99	-
Selenium	136	10	100	Yes	137	-0.74	-
Silver	20.0	5	50	No	5.37	73.15	-
Tin	151	50	500	No	62.6	58.54	-
Titanium	345	10	100	Yes	10	97.10	Titanium
Zinc	1690	20	200	Yes	23.1	98.63	Zinc

[1] Values in (ug/l) unless otherwise noted.

\+ Quantitation limit development is detailed in Commercial HWC record (W-97-08, Item 16.4.9, Attachment VI.)

* For aluminum, the treatable level was set at 5 times the quantitation limit of 100 ug/l because 100 ug/l is a high quantitation limit.

Table 5-11. Sampling Episode 6183 Analytical Results[1]

Episode 6183				Treatable Level?	Avg. Effluent Conc.	% Removal	Pollutants used from Epsiode 6183 to Develop Final Regulations
Pollutant	Avg. Influent Conc.	Quanti-tation Limit (QL)+	10X QL				
TSS (mg/l)	350	4	40	yes	84.6	75.83	TSS
Aluminum	61500	100	500*	yes	319	99.48	Aluminum
Antimony	1710	60	600	yes	289	83.10	Antimony
Arsenic	1210	10	100	yes	26.1	97.84	Arsenic
Cadmium	97.7	5	50	yes	5	94.88	Cadmium
Chromium	2250	10	100	yes	10	99.56	Chromium
Copper	1970	10	100	yes	10	99.49	Copper
Iron	231000	20	200	yes	434	99.81	Iron
Lead	1600	10	100	yes	10	99.38	Lead
Mercury	219	0.2	2	yes	0.478	99.78	Mercury
Molybdenum	1550	50	500	yes	856	44.77	Molybdenum
Selenium	113	10	100	yes	32.8	70.97	Selenium

Episode 6183				Treatable Level?	Avg. Effluent Conc.	% Removal	Pollutants used from Epsiode 6183 to Develop Final Regulations
Pollutant	Avg. Influent Conc.	Quantitation Limit (QL)+	10X QL				
Silver	69.8	5	50	yes	5.53	92.08	Silver
Tin	1330	50	500	yes	134	89.92	Tin
Titanium	4030	10	100	yes	10	99.75	Titanium
Zinc	8300	20	200	yes	64.3	99.23	Zinc

[1] Values in (ug/l) unless otherwise noted.

\+ Quantitation limit development is detailed in Commercial HWC record (W-97-08, Item 16.4.9, Attachment VI.)

* For aluminum, the treatable level was set at 5 times the quantitation limit of 100 ug/l because 100 ug/l is a high quantitation limit.

5.5 SELECTION OF POLLUTANTS TO BE REGULATED FOR PSES AND PSNS

Indirect dischargers in the CHWC Industry send their wastewater streams to a POTW for further treatment, unlike direct dischargers, whose wastewater will receive no further treatment once it leaves their facility. Therefore, the levels of pollutants allowable in the wastewater of an indirect discharger are dependent upon (1) whether a given pollutant "passes through" the POTW's treatment system or (2) whether additional treatment provided by the POTW will result in removal of the pollutant to a level equivalent to that obtained through treatment by a direct discharger.

5.5.1 *Removal Comparison Approach*

To establish PSES, EPA must first determine which of the CHWC Industry pollutants of concern (identified earlier in Section 5.3) may not be susceptible to POTW treatment, interfere with, or are incompatible with the operation of POTWs (including interferences with sludge disposal practices). EPA evaluates the susceptibility of a pollutant to POTW treatment by looking at the removal performance of POTWs for a particular pollutant. EPA's removal comparison evaluates the percentage removed by POTWs with the percentage removed by direct dischargers using BPT/BCT/BAT technology. EPA has assumed, for the purposes of its removal comparison and based upon the data received, that the untreated wastewater at indirect discharge facilities is not significantly different from direct discharge facilities.

EPA's comparison satisfies two competing objectives set by Congress: (1) that standards for indirect dischargers be equivalent to standards for direct dischargers, and (2) that the treatment capability and performance of the POTW be recognized and taken into account in regulating the discharge of pollutants from indirect dischargers. Rather than compare the mass or concentration of pollutants discharged by the POTW with the mass or concentration of pollutants discharged by a BAT facility, EPA compares the percentage of the pollutants removed by the facility with the POTW removal. EPA takes this approach because a comparison of mass or concentration of pollutants in a POTW effluent with pollutants in a BAT facility's effluent would not take into account the mass of pollutants discharged to the POTW from non-industrial sources, nor the dilution of the pollutants in the POTW effluent to lower concentrations from the addition of large amounts of non-industrial wastewater.

5.5.2 *50 POTW Study Database*

For past effluent guidelines, a study of 50 well-operated POTWs was used for the pass-through analysis. This study is referred to as the "The Fate of Priority Pollutants in Publicly Owned Treatment Works", September 1982 (EPA 440/1-82/303), also known as the 50 POTW Study. Because the data collected for evaluating POTW removals included influent levels of pollutants that were close to the detection limit, the POTW data were edited to eliminate influent levels less than 10 times the minimum level and the corresponding effluent values, except in the cases where none of the influent concentrations exceeded 10 times the minimum level. In the latter case, where no influent data exceeded 10 times the minimum level, the data were edited to eliminate influent values less than 5 times the minimum level. Further, where no influent data exceeded 5 times the minimum level, the data were edited to eliminate influent values less than 20 ug/l and the corresponding effluent values. These editing rules were used to allow for the possibility that low POTW removals simply reflected the low influent levels.

EPA then averaged the remaining influent data and also averaged the remaining effluent data from the 50 POTW database. The percent removals achieved for each pollutant were determined from these averaged influent and effluent levels. This percent removal was then compared to the percent removal for the BAT option treatment technology.

5.5.3 *Final POTW Data Editing*

The final percent removal for each pollutant was selected based on a data hierarchy, which was related to the quality of the data source. This hierarchy was:

1. 50 POTW Study Data (10x NOMDL edit)
2. 50 POTW Study Data (5x NOMDL edit)
3. 50 POTW Study Data (20 ug/l edit)

The final POTW removals for the CHWC regulated pollutants, determined via the data use hierarchy, are presented in Table 5-12.

Table 5-12. Final POTW Removals for CHWC Industry Pollutants

Pollutant	CAS Number	Percent Removal	Source of Data
Arsenic	7440382	66	50 POTW - (20 ug/l edit)
Cadmium	7440439	90	50 POTW - (10x NOMDL edit)
Chromium	7440473	91	50 POTW - (10x NOMDL edit)
Copper	7440508	84	50 POTW - (10x NOMDL edit)
Lead	7439921	92	50 POTW - (10x NOMDL edit)
Mercury	7439976	90	50 POTW - (10x NOMDL edit)
Silver	7440224	88	50 POTW - (10x NOMDL edit)
Titanium	7440326	92	50 POTW - (10x NOMDL edit)
Zinc	7440666	78	50 POTW - (10x NOMDL edit)

5.5.4 *Final Removal Comparison Results*

For each CHWC regulated pollutant, the daily removals were calculated using the BPT/BCT/BAT data. Then, the average overall BPT/BCT/BAT removal was calculated for each pollutant from the daily removals (see Table 5-13). The averaging of daily removals is appropriate for this industry as BPT/BCT/BAT treatment technologies typically have retention times of less than one day. For the final assessment, the final POTW removal data determined for each CHWC regulated pollutant was compared to the percent removal achieved for that pollutant using the BPT/BCT/BAT option treatment technologies. Of the 9 pollutants regulated under BPT/BCT/BAT, all were found to pass through for the regulatory wastewater treatment technology option selected (see Section 7 for a description of the selected BPT/BCT/BAT Regulatory Option) and are proposed for PSES. The final results for the CHWC Regulatory Option are presented in Table 5-14.

Table 5-13. Sampling Episode Percent Removals

	6181 Percent Removal	6183 Percent Removal	4646 Percent Removal	Average Percent Removal
Aluminum	98.54	99.48	85	94
Antimony	7.78	83.10	49	47
Arsenic	68.42	97.84	98	88
Cadmium	93.11	94.88	98	95
Chromium	*64.59	99.56	95	97
Copper	97.75	99.49	99	99
Iron	99.23	99.81	98	99
Lead	98.85	99.38	99	99
Mercury	93.85	99.78	97	97
Molybdenum	*-14.99	44.77	38	41
Selenium	*-0.74	70.97	89	80
Silver	*73.15	92.08	98	95
Tin	*58.54	89.92	99	94
Titanium	97.10	99.75	99	99

	6181 Percent Removal	6183 Percent Removal	4646 Percent Removal	Average Percent Removal
Zinc	98.63	99.23	99	99

* These pollutants from Episode 6181 could not be used to develop final regulations either because they were not found at a treatable level or because the percent removal was a negative value.

Table 5-14. Final Results for CHWC Industry Regulatory Option

Pollutant	Option Percent Removal	POTW Percent Removal
Arsenic	88	66
Cadmium	95	90
Chromium	97	91
Copper	99	84
Lead	99	92
Mercury	97	90
Silver	95	88
Titanium	99	92
Zinc	99	78

SECTION 6

WASTEWATER TREATMENT TECHNOLOGIES

This section describes the technologies available for the treatment of wastewater generated by the 55 commercial facilities within the Commercial Hazardous Waste Combustor (CHWC) Industry. This section also presents an evaluation of performance data on treatment systems collected by EPA during field sampling programs and the rationale used in the development of the regulatory options. Specifically, Section 6.1 describes the technologies used by CHWC facilities to treat air pollution control, flue gas quench, and ash/slag quench wastewaters, which are the only types of wastewater covered by this regulation. Section 6.2 describes technologies used by CHWC facilities for the treatment of wastewater generated as a result of CHWC operations (e.g., container wash water and truck wash water) for which EPA is not proposing regulations. Section 6.3 lists technologies used by CHWC facilities for the treatment of wastewater generated as a result of other operations on-site (e.g., landfill leachate and sanitary water). Section 6.4 presents the EPA performance data on selected treatment technologies as well as the rationale used in selecting the treatment technologies for the regulatory options.

Of the 55 CHWC facilities, 16 facilities generate no wastewater. A breakdown of the types of wastewaters collected at the remaining 39 CHWC facilities which generate wastewater is as follows:

Type of wastewater collected	Number of CHWC facilities
CHWC wastewaters only (air pollution control, ash/slag quench, flue gas quench)	8
Wastewaters generated from CHWC operations only (container, area, and truck wash waters)	7
Other on-site wastewaters only (sanitary wastewater, leachates)	9
CHWC wastewaters and wastewaters generated from CHWC operations	13
CHWC wastewaters, wastewaters generated from CHWC operations, and other on-site wastewaters	1
Wastewaters generated from CHWC operations and other on-site wastewaters	3

As demonstrated above, only 22 of the 55 CHWC facilities generate CHWC wastewaters and therefore, were considered to be within the scope of this regulation.

6.1 AVAILABLE BAT AND PSES TECHNOLOGIES

CHWC facilities use either physical/chemical treatment technology to treat CHWC wastewaters or treatment and disposal methods that result in no discharge of CHWC wastewaters.

Through its CWA Section 308 Questionnaire, EPA obtained information on nine different wastewater treatment technologies currently in use by the 22 CHWC facilities for the treatment of air pollution control, flue gas quench, and ash/slag quench wastewater. In addition, EPA collected other detailed information on available technologies from engineering plant visits to a number of CHWC facilities. The data presented in Section 6.4 are based on these data collection activities.

6.1.1 *Physical/Chemical Treatment*

6.1.1.1 Equalization

Wastewater generation rates at incinerators are sometimes variable due to variations in burn rates and system down times. To allow for the equalization of pollutant loadings and flow rates, CHWC wastewaters may be collected in tanks or lined ponds prior to treatment. These are designed with sufficient capacity to hold the peak flows and thus dampen the variation in hydraulic and pollutant loads. Minimization of this variability increases the performance and reliability of downstream treatment systems, and can reduce the size of subsequent treatment by reducing the maximum flow rates and concentrations of pollutants that they will experience. Equalization also lowers the operating costs of associated treatment units by reducing instantaneous treatment capacity demand and by optimizing the amount of treatment chemicals required for a less erratic set of treatment variables. The EPA's Section 308 Questionnaire database identifies 10 facilities that use equalization technology as part of their treatment of CHWC wastewaters.

Equalization systems consist of steel or fiberglass holding tanks or lined ponds that provide sufficient capacity to contain peak flow conditions and wastewater volumes of high pollutant loadings. Detention times can vary from a few hours to several days, with one day being a typical value. Some equalization systems contain mechanical mixing systems that enhance the equalization process. A breakdown of equalization systems used is as follows:

Equalization Type	Number of Units
Unstirred	7
Mechanically stirred	2

A typical equalization system is shown in Figure 6-1.

6.1.1.2 Neutralization or pH Control

In the treatment of CHWC wastewaters, neutralization or pH control systems are used in conjunction with certain chemical treatment processes, such as chemical precipitation, to adjust the pH of the wastewater to optimize process control. Acids, such as sulfuric acid or hydrochloric acid, are added to reduce pH, whereas, alkalis, such as sodium hydroxides, are added to raise pH values. Neutralization may be performed in a holding tank, rapid mix tank, or an equalization tank. Neutralization systems are widely used at CHWC facilities for pH control in chemical precipitation systems. Chemicals, such as sodium hydroxide or lime, are frequently used in order to raise the pH of the wastewater to a range somewhere between 9 to 12 in order to optimize precipitation of metal compounds. Acids, such as hydrochloric acid, are also used in conjunction with ferric chloride for chemical precipitation. Neutralization systems at the end of a treatment system are typically designed to control the pH of the discharge to between 6 and 9. There are 14 neutralization systems in place among the CHWC facilities that use various caustic and/or alkalis to treat CHWC wastewaters. A breakdown of these neutralization systems is as follows:

Type of Neutralization	Number of Units
Caustic	4
Acid	2
Multiple Chemicals	5
Other	1

Figure 6-2 presents a flow diagram for a typical neutralization system.

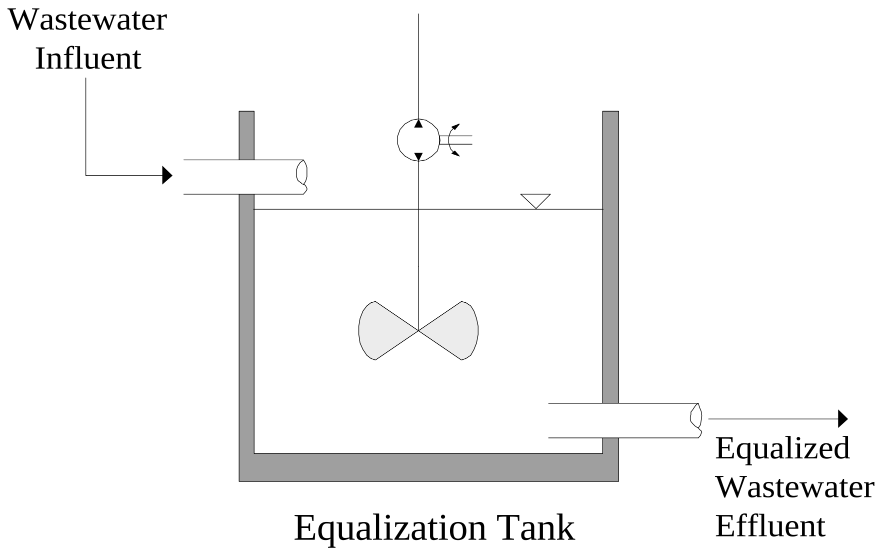


Figure 6-1. Equalization

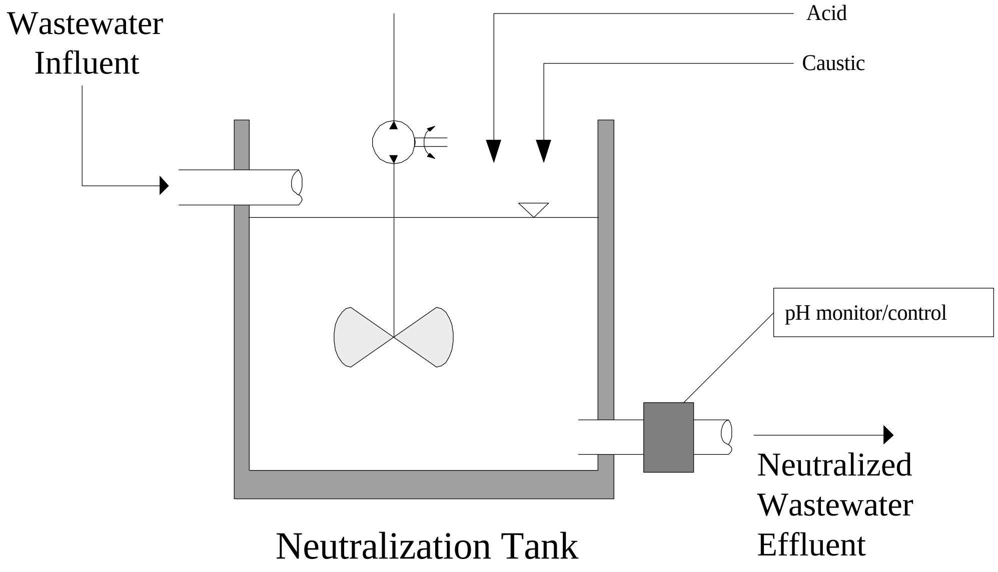


Figure 6-2. Neutralization

6.1.1.3 Flocculation

Flocculation is a treatment technology used to enhance sedimentation or filtration treatment. Flocculation precedes these processes and consists usually of a rapid mix tank, or in-line mixer and a flocculation tank. The waste stream is initially mixed while a flocculation chemical is added. Flocculants adhere readily to suspended solids and each other to facilitate gravity sedimentation or filtration. Coagulants can be added to reduce the electrostatic surface charges and enhance the formation of complex hydrous oxides. Coagulation allows for the formation of larger, heavier particles, or flocculants (which are usually formed in a flocculation chamber), that can settle faster. There are three different types of flocculants commonly used; inorganic electrolytes, natural organic polymers, and synthetic polyelectrolytes. The selection of the specific treatment chemical is highly dependent upon the characteristics and chemical properties of the contaminants. A rapid mix tank is usually designed for a detention time ranging from 15 seconds to several minutes. After mixing, the coagulated wastewater flows to a flocculation basin where slow mixing of the waste occurs. The slow mixing allows for the particles to agglomerate into heavier, more settleable solids. Mixing is provided either by mechanical paddle mixers or by diffused air. Flocculation basins are typically designed for a detention time of 15 to 60 minutes. There are 5 flocculation systems used among the CHWC facilities used to treat CHWC wastewaters.

6.1.1.4 Gravity-Assisted Separation

Gravity-assisted separation is a simple, economical, and widely used method for the treatment of CHWC wastewaters. There are 12 such systems in place at the CHWC facilities. Clarification systems remove suspended matter by allowing the wastewater to become quiescent. As a result, suspended matter, which is heavier than water, settles to the bottom, forming a sludge which can be removed. This process may take place in specially designed tanks, or in earthen ponds and basins. Sedimentation units at CHWC facilities are typically used as either primary treatment options to remove suspended solids or following a chemical precipitation process.

Clarifiers may be rectangular, square, or circular in shape. In rectangular tanks, wastewater flows from one end of the tank to the other with settled sludge collected into a hopper located at one end of the tank. In circular tanks, flow enters from the center and flows towards the outside edge with sludge collected in a center hopper. Treated wastewater exits the clarifier by flowing over a weir located at the top of the clarifier. Sludge which accumulates in the bottom of the clarifiers is periodically removed and is typically stabilized and/or dewatered prior to disposal.

Flocculation systems are commonly used in conjunction with gravity assisted clarification systems in order to improve their solids removal efficiency. Some clarifiers are designed with a center well to introduce flocculants and allow for coagulation in order to improve removal efficiencies. A schematic of a typical clarification system using coagulation and flocculation is shown in Figure 6-3. The main design parameters used in designing a clarifier are the overflow rate, detention time and the side water depth. The overflow rate is the measure of the flow as a function of the surface area of the clarifier. Typical design parameters used for both primary and secondary clarifiers are presented below:

Design Parameter	Primary	Secondary
Overflow Rate, gpd/sq ft	600-1,000	500-700
Detention Time, min	90-150	90-150
Minimum Side Water Depth, ft	8	10

Source: ASCE/WEF, *Design of Municipal Wastewater Treatment Plants*, 1991.

There are three facilities that use corrugated plate interceptor technology. These systems include a series of small (approximately 2 inch square) inclined tubes in the clarification settling zone. The suspended matter must only travel a short distance, when settling or floating, before they reach a surface of the tube. At the tubes' surface, the suspended matter further coagulates. Because of the enhanced removal mechanism, corrugated plate interceptor units can have much smaller settling chambers than standard clarifiers.

6.1.1.5 Chemical Precipitation

Chemical precipitation is used for the removal of metal compounds from wastewater. In the chemical precipitation process, soluble metallic ions and certain anions, which are found in CHWC

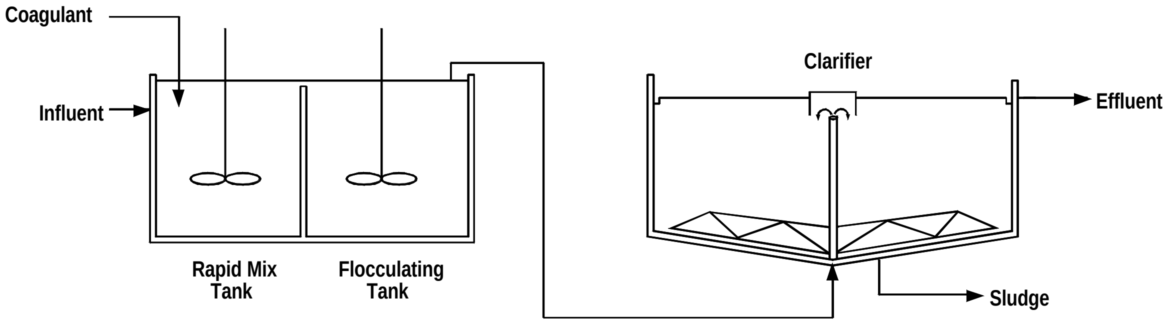


Figure 6-3. Clarification System Incorporating Coagulation and Flocculation

wastewaters, are converted to insoluble forms, which precipitate from the solution. Most metals are relatively insoluble as hydroxides, sulfides, or carbonates. Coagulation processes are used in conjunction with precipitation in order to facilitate removal by agglomeration of suspended and colloidal materials. The precipitated metals are subsequently removed from the wastewater stream by liquid filtration or clarification (or some other form of gravity assisted sedimentation). Other treatment processes such as equalization, chemical oxidation or reduction (e.g., hexavalent chromium reduction), precede the chemical precipitation process. The performance of the chemical precipitation process is affected by chemical interactions, temperature, pH, solubility of waste contaminants, and mixing effects. There are a total of 7 chemical precipitation systems in use by the CHWC facilities to treat CHWC wastewater.

Common precipitation chemicals used in the CHWC Industry include lime, sodium hydroxide, soda ash, sodium sulfide, and alum. Other chemicals used in the precipitation process for pH adjustment and/or coagulation include sulfuric and phosphoric acid, ferric chloride, and polyelectrolytes. Many facilities use, or have the means to use, a combination of these chemicals. Precipitation using sodium hydroxide or lime is the conventional method of removing metals from wastewater. However, sulfide precipitation is also frequently used instead of hydroxide precipitation in order to remove certain metal ions. Hydroxide precipitation is effective in removing such metals as antimony, arsenic, chromium, copper, lead, mercury, nickel, and zinc. Sulfide precipitation is more appropriate for removing mercury, lead, and silver. Carbonate precipitation, while not frequently used in the CHWC Industry, is another method of chemical precipitation and is used primarily to remove antimony and lead. Alum, another precipitant/coagulant agent infrequently used, forms aluminum hydroxides in wastewaters containing calcium or magnesium bicarbonate alkalinity. Aluminum hydroxide is an insoluble gelatinous floc which settles slowly and entraps suspended materials. For metals such as arsenic and cadmium, coprecipitation with iron or aluminum is an effective treatment process.

Hydroxide precipitation using lime or sodium hydroxide is the most commonly used means of chemical precipitation in the CHWC industry, and of these, lime is used more often than sodium hydroxide. The chief advantage of lime over caustic is its lower cost. However, lime is more difficult to handle and feed, as it must be slaked, slurried, and mixed, and can plug the feed system lines. Lime precipitation also produces a larger volume of sludge. The reaction mechanism for precipitation of a divalent metal using lime is shown below:

$$M^{++} + Ca(OH)_2 \rightarrow M(OH)_2 + Ca^{++}$$

The reaction mechanism for precipitation of a divalent metal using sodium hydroxide is as follows:

$$M^{++} + 2NaOH \rightarrow M(OH)_2 + 2Na^{++}$$

In addition to the type of treatment chemical chosen, another important design factor in the chemical precipitation operation is pH. Metal hydroxides are amphoteric, meaning that they can react chemically as acids or bases. As such, their solubilities increase toward both lower and higher pH levels. Therefore, there is an optimum pH for precipitation for each metal, which corresponds to its point of minimum solubility. Figure 6-4 presents calculated solubilities of metal hydroxides. Another key consideration in a chemical precipitation application is the detention time in the sedimentation phase of the process, which is specific to the wastewater being treated and the desired effluent quality.

The first step of a chemical precipitation process is pH adjustment and the addition of coagulants. This process usually takes place in separate mixing and flocculation tanks. After mixing the wastewater with treatment chemicals, the resultant mixture is allowed to agglomerate in the flocculation tank which is slowly mixed by either mechanical means, such as mixers, or recirculation pumping. The wastewater then undergoes a separation/dewatering process such as clarification or filtration, where the precipitated metals are removed from solution. In a clarification system, a flocculent, such as a polymer, is sometimes added to aid in the settling process. The resulting sludge from the clarifier or filter must be further treated, disposed, or recycled. A typical chemical precipitation system is shown in Figure 6-5.

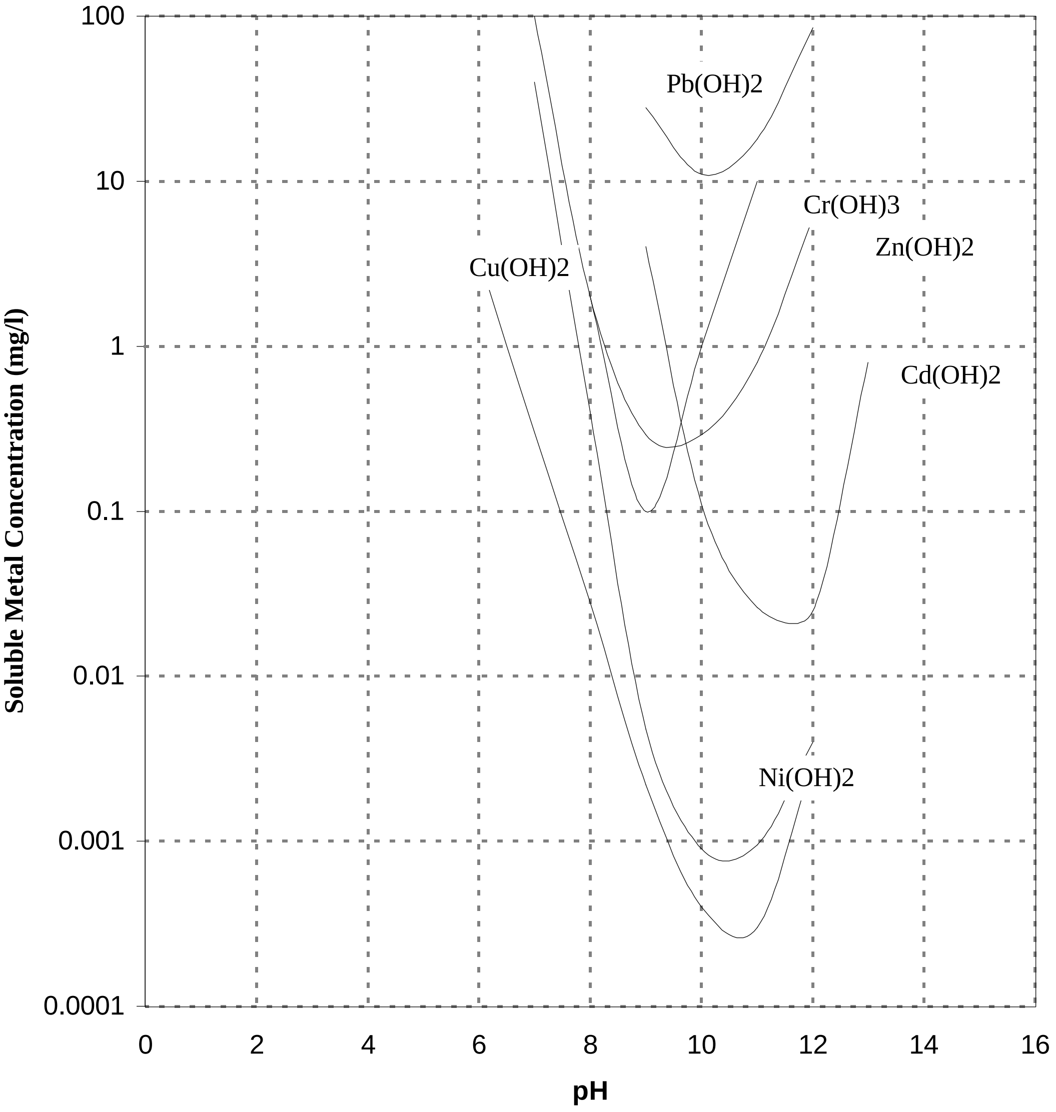


Figure 6-4. Calculated Solubilities of Metal Hydroxides

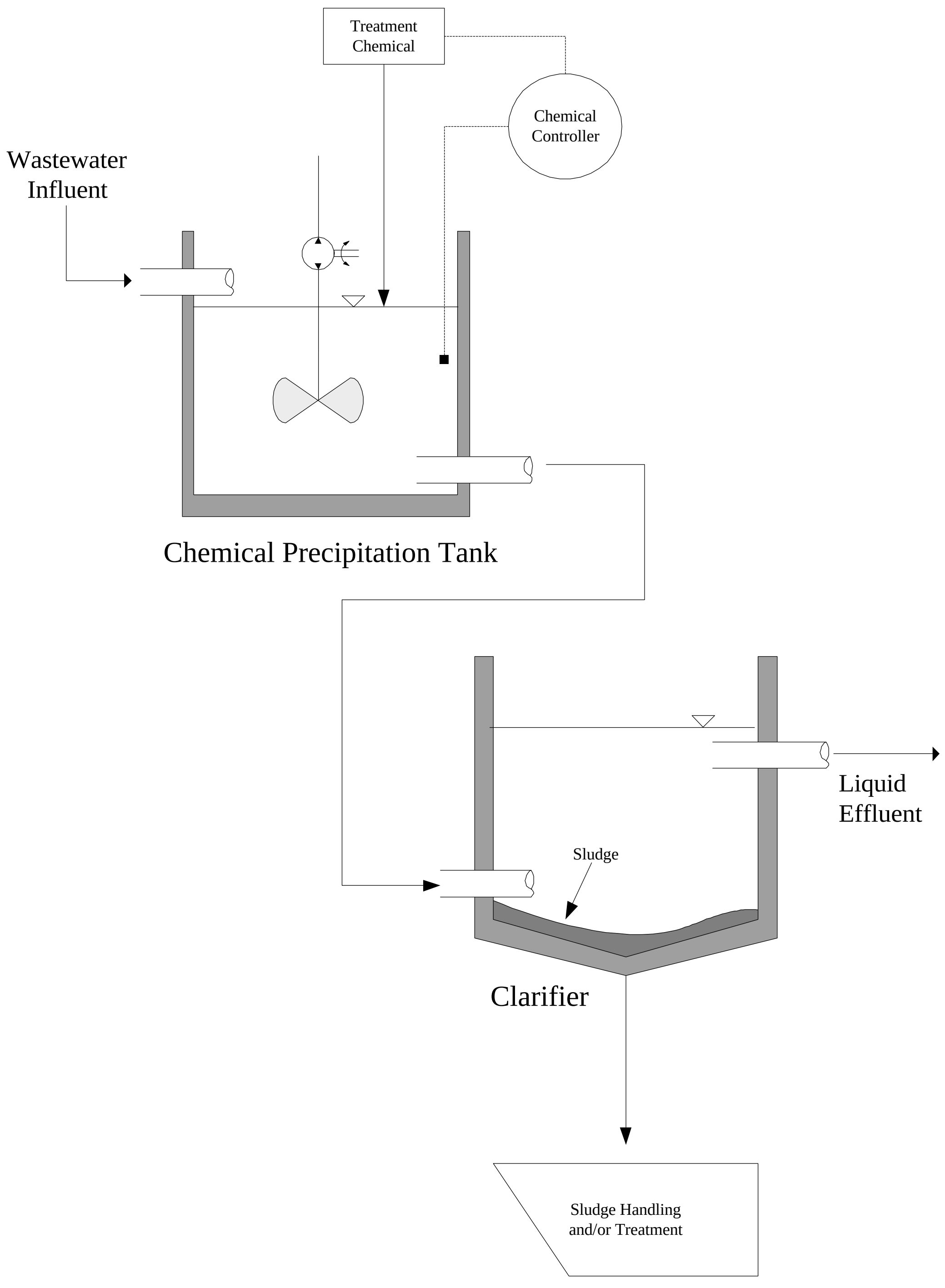


Figure 6-5. Chemical Precipitation System Design

6.1.1.6 Stripping

Stripping refers to the removal of pollutant compounds from a wastewater by the passage of air, steam, or other gas, through the liquid. The stripped volatile components are generally condensed and recovered for reuse, disposal, or allowed to be stripped into the atmosphere. If the pollutants are in sufficiently low concentrations, the gaseous phase can be emitted through a stack without treatment.

Air stripping is a process in which air is brought into contact with the liquid. During this contact, the volatile compounds move from the liquid to the gas stream. The process usually takes place in a stripping tower (as shown in Figure 6-6) which consists of a vertical shell filled with packing material to increase the surface area for gas-liquid contact. Usually, the liquid flows down through the stripping column and air passes upward in a counter-current fashion. Another orientation is called "crossflow", where the air is pulled through the sides of the tower along its entire length.

There is only one CHWC facility that uses air stripping as a treatment option for the removal of excess treatment chemicals contained in its flue gas quench wastewater.

6.1.1.7 Filtration

Filtration is a method for separating solid particles from wastewaters through the use of a porous medium. The driving force in filtration is a pressure gradient, caused by gravity, centrifugal force, vacuum, or higher than atmospheric pressure. Filtration treatment processes can be used at CHWC facilities to remove solids from wastewaters after a chemical precipitation treatment step, or can used as the primary source of treatment. Filtration processes include a broad range of media and membrane separation technologies from sand filtration to ultrafiltration. To aid in removal, the filter medium may be precoated with a filtration aid such as ground cellulose or diatomaceous earth.

CHWC facilities currently have the following types of filtration systems in operation to treat their CHWC wastewaters:

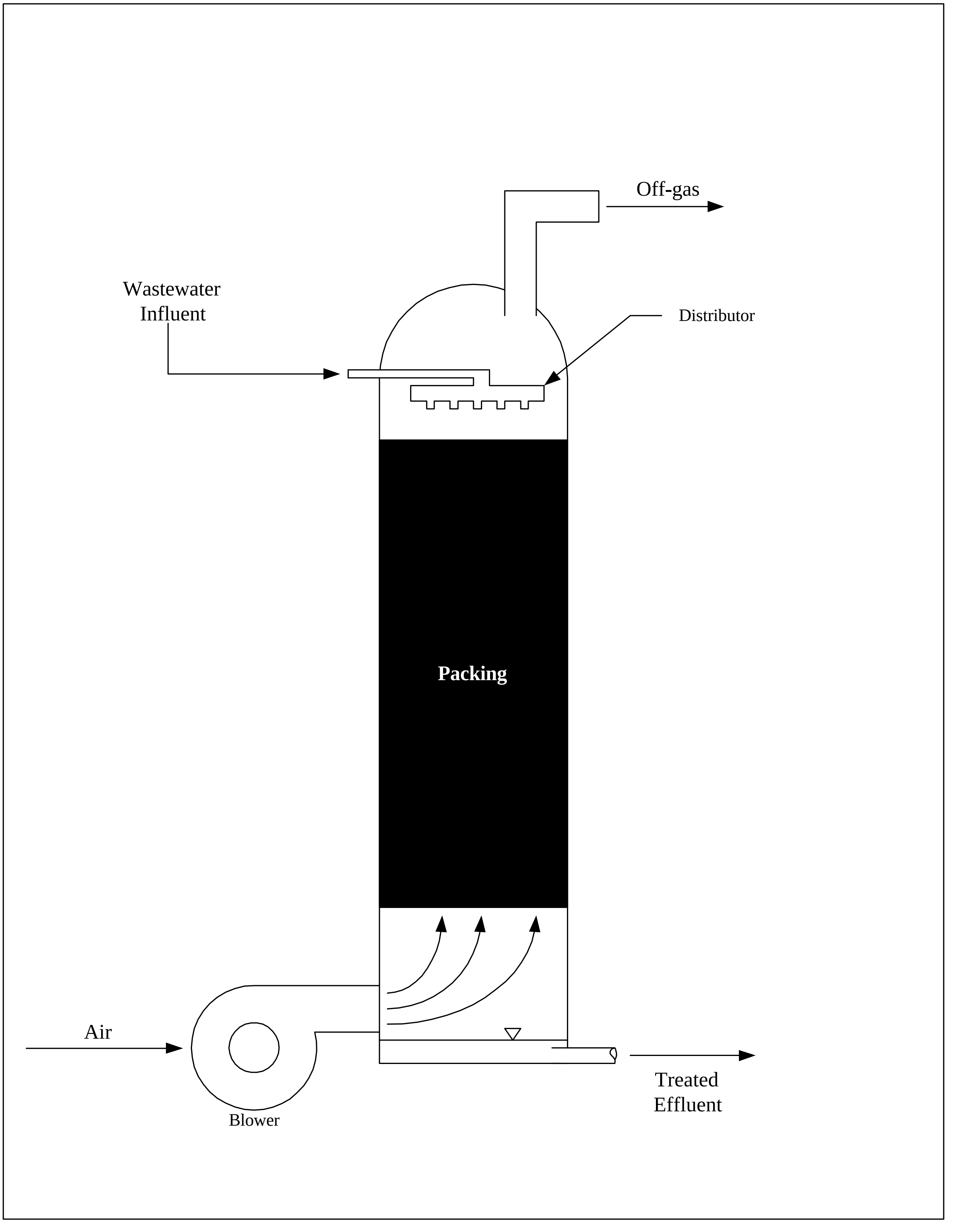


Figure 6-6. Typical Air Stripping System

Type of Filtration System	Number of Units
Sand	2
Granular Multimedia	1
Fabric	1
Ultrafiltration	1

Dissolved compounds in CHWC wastewaters can be pretreated by chemical precipitation processes to convert the compound to an insoluble solid particle before filtration. Polymers can be injected into the filter feed piping downstream of feed pumps to enhance flocculation of smaller flocs that may escape an upstream clarifier.

The following paragraphs describe each type of filtration system.

6.1.1.7.1 Sand/Multimedia Filtration

Granular bed filtration in the CHWC industry is used primarily for achieving supplemental removal of residual suspended solids from the effluent of chemical treatment processes, or rarely, as the primary form of wastewater treatment. These filters can be operated either by gravity or in a pressure vessel. In granular bed filtration, the wastewater stream is sent through a bed containing one or more layers of different granular materials. The solids are retained in the voids between the media particles while the wastewater passes through the bed. Typical media used in granular bed filters include anthracite coal, sand, and garnet. These media can be used alone, such as in sand filtration, or in a multimedia combination. Multimedia filters are designed such that the individual layers of media remain fairly discrete. This is accomplished by selecting appropriate filter loading rates, media grain size, and bed density. Hydraulic loading rates for a multimedia filter are between 4 to 10 gpm/sq ft. A typical multimedia filter vessel is shown in Figure 6-7.

The complete filtration process involves two phases: filtration and backwashing. As the filter becomes filled with trapped solids, the efficiency of the filtration process falls off. Head loss is a measure of solids trapped in the filter. As the head loss across the filter bed increases to a limiting value, the end of the filter run is reached and the filter must be backwashed to remove the suspended solids in the bed. During backwashing, the flow through the filter is reversed so that the solids trapped in the media are

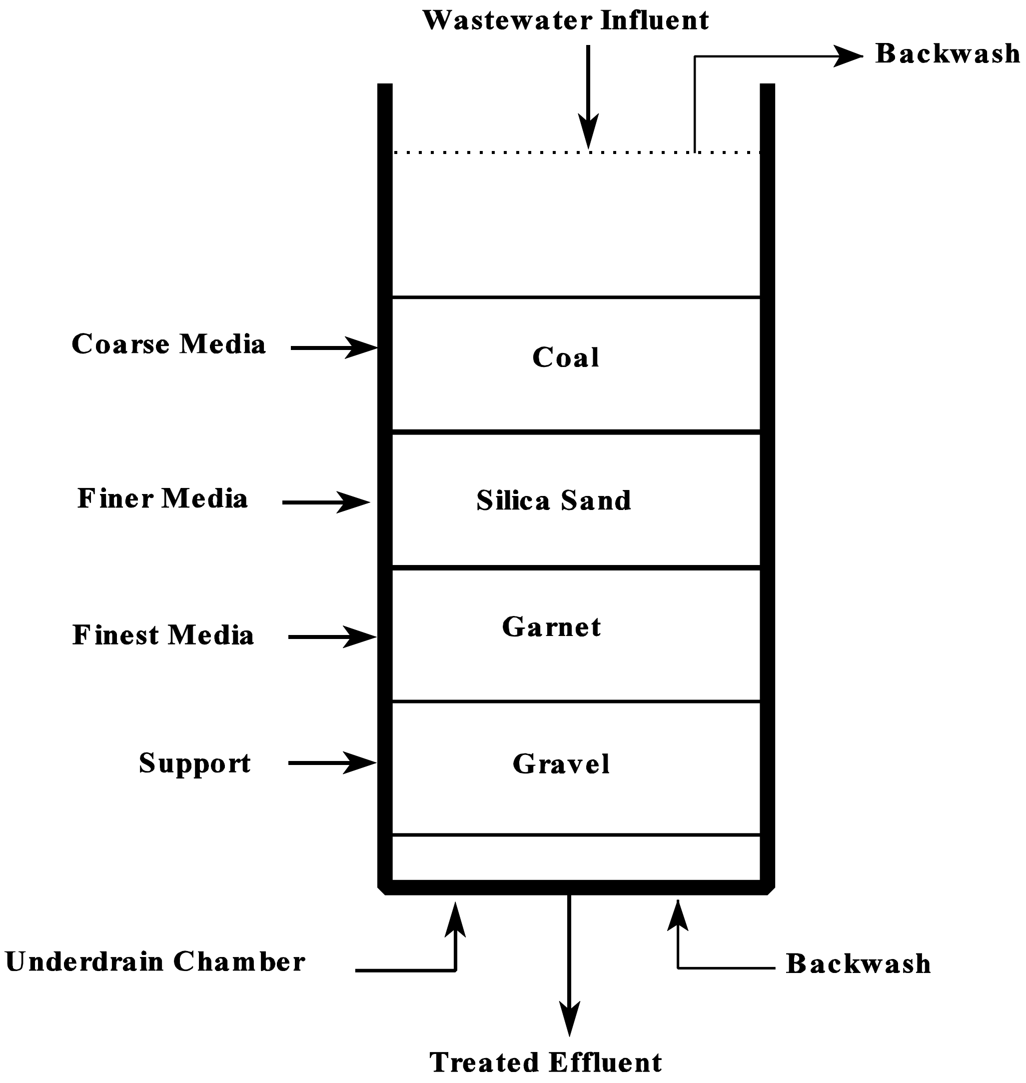


Figure 6-7. Multimedia Filtration

dislodged and can exit the filter. The bed may also be agitated with air to aid in solids removal. The backwash water is then recycled back into the wastewater feed stream.

6.1.1.7.2 Fabric Filters

Fabric filters consist of a vessel that contains a cloth or paper barrier through which the wastewater must pass. The suspended matter is screened by the fabric, and the effectiveness of the filter depends on the mesh size of the fabric. Fabric filters may either be backwashed, or built as disposable units.

For waters having less than 10 mg/l suspended solids, cartridge fabric filters may be cost effective. Cartridge filters have very low capital cost and can remove particles of one micron or larger in size. Using two-stage cartridge filters (coarse and fine) in series extends the life of the fine cartridge. Disposable or backwashable bag filters are also available and may be quite cost effective for certain applications. Typically, these fabric filters act as a pre-filter and are used to remove suspended solids prior to other filtrations systems in order to protect membranes and equipment and reduce solids fouling.

6.1.1.7.3 Ultrafiltration

Ultrafiltration uses a semi-permeable, microporous membrane, through which the wastewater is passed under pressure. Water and low molecular weight solutes, such as salts and surfactants, pass through the membrane and are removed as permeate. Emulsified oils and suspended solids are rejected by the membrane and removed with some of the wastewater as a concentrated liquid. The concentrate is recirculated through the membrane unit until the flow of permeate drops, while the permeate can either be discharged or passed along to another treatment unit. The concentrate is usually stored and held for further treatment or disposal. Several types of ultrafiltration membranes configurations are available: tubular, spiral wound, hollow fiber, and plate and frame. A typical ultrafiltration system is presented in Figure 6-8.

Ultrafiltration in the CHWC industry is used for the treatment of metal-bearing wastewaters. It can remove substances with molecular weights greater than 500, including suspended solids, oil and grease, and complexed heavy metals. Ultrafiltration is used when the solute molecules are greater than ten times the size of the solvent molecules, and are less than one-half micron. The primary design consideration in

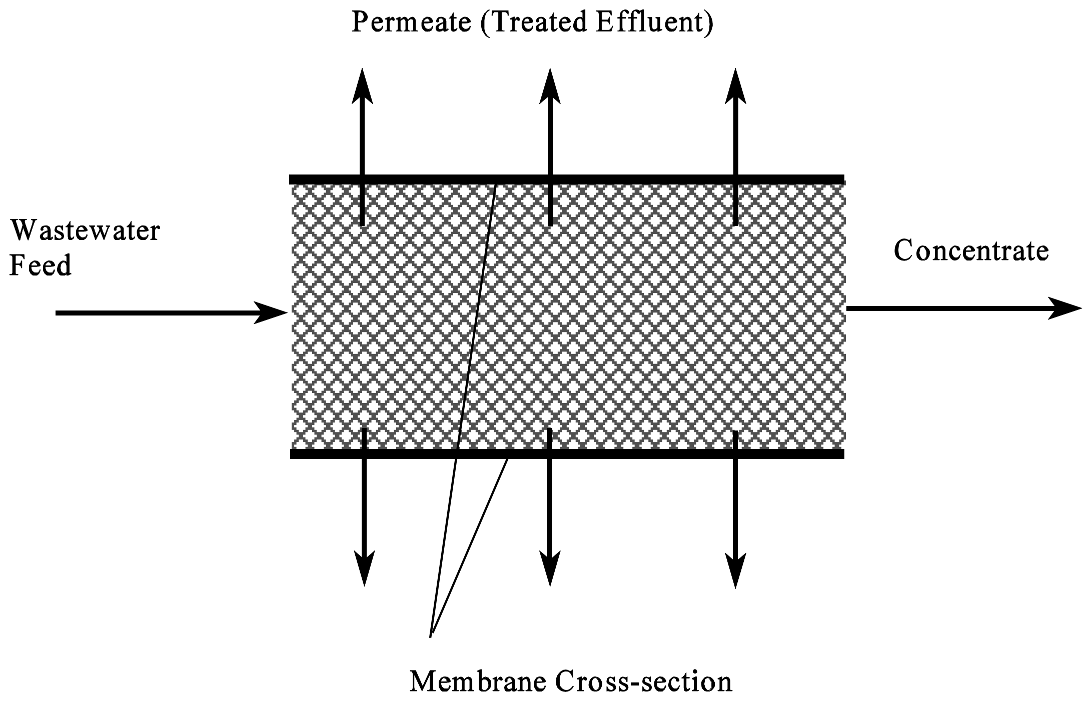


Figure 6-8. Ultrafiltration System Diagram

ultrafiltration is the membrane selection. A membrane pore size is chosen based on the size of the contaminant particles targeted for removal. Other design parameters to be considered are the solids concentration, viscosity, and temperature of the feed stream, and the membrane permeability and thickness.

6.1.1.8 Carbon Adsorption

Granular activated carbon (GAC) adsorption is a physical separation process in which organic and inorganic materials are removed from wastewater by adsorption, attraction, and/or accumulation of the compounds on the surface of the carbon granules. While the primary removal mechanism is adsorption, the activated carbon also acts as a filter for additional pollutant removal. Adsorption capacities of 0.5 to 10 percent by weight are typical. Spent carbon can be regenerated thermally on site by processes such as wet-air oxidation or steam stripping. For smaller operations, spent carbon can be regenerated off site or sent directly for disposal. Vendors of carbon typically, under contract, exchange spent carbon with fresh carbon.

Activated carbon systems usually consist of a vessel containing a bed of carbon (typically 4 to 12 feet in depth), whereby the wastewater is either passed upflow or downflow through the filter bed. A carbon adsorption vessel is shown in Figure 6-9. Carbon vessels are typically operated under pressure, however, some designs use gravity beds. For smaller applications, GAC systems are also available in canister systems which can be readily changed-out and sent for either off-site regeneration or disposal. The key design parameter is the adsorption capacity of the GAC, which is a measure of the mass of contaminant adsorbed per unit mass of carbon, and is a function of the chemical compounds being removed, type of carbon used, and process and operating conditions. The volume of carbon required is based upon the COD of the wastewater to be treated and desired frequency of carbon change-outs. The vessel is typically designed for an empty bed contact time of 15 to 60 minutes. Non-polar, high molecular weight organics with low solubility are readily adsorbed using GAC. Certain organic compounds have a competitive advantage for adsorption onto the GAC, which results in compounds being preferentially adsorbed or causing other less competitive compounds to be desorbed from the GAC. Most organic compounds and

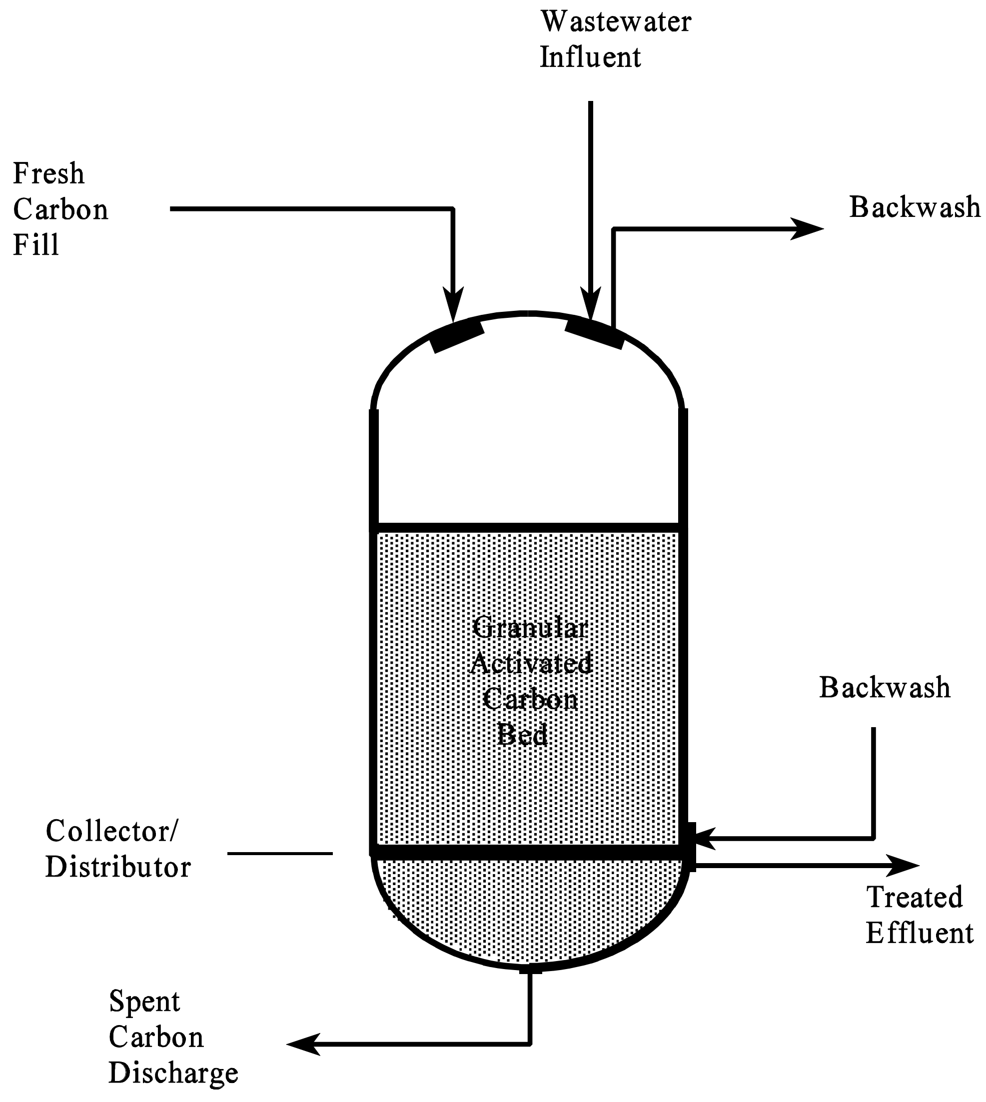


Figure 6-9. Granular Activated Carbon Adsorption

some metals typically found in CHWC wastewaters are effectively removed using GAC. Two CHWC facilities employ GAC for treatment of CHWC wastewaters.

6.1.1.9 Chromium Reduction

Chemical reduction processes involve a chemical reaction in which electrons are transferred from one chemical to another in order to reduce the chemical state of a contaminant. The main application of chemical reduction in CHWC wastewater treatment is the reduction of hexavalent chromium to trivalent chromium. The reduction enables the trivalent chromium to be precipitated from solution in conjunction with other metallic salts. Sodium bisulfate is the reducing agent used by one CHWC facility that incorporates reduction technology for treatment of its CHWC wastewater.

Once the chromium has been reduced to the trivalent state, it can be further treated in a chemical precipitation process, where it is removed as a metal hydroxide or sulfide. A typical chromium reduction process is shown in Figure 6-10.

6.1.2 *Sludge Handling*

Sludges are generated by a number of treatment technologies, including gravity-assisted separation and filtration. These sludges are further processed at CHWC facilities using various methods. Following are the number of CHWC facilities which employ each type of sludge handling process.

Type of Sludge Handling	Number of Units
Sludge Slurrying	1
Vacuum Filtration	1
Pressure Filtration	6
Centrifuge	1
Dryer	1

The following paragraphs describe each type of sludge handling system.

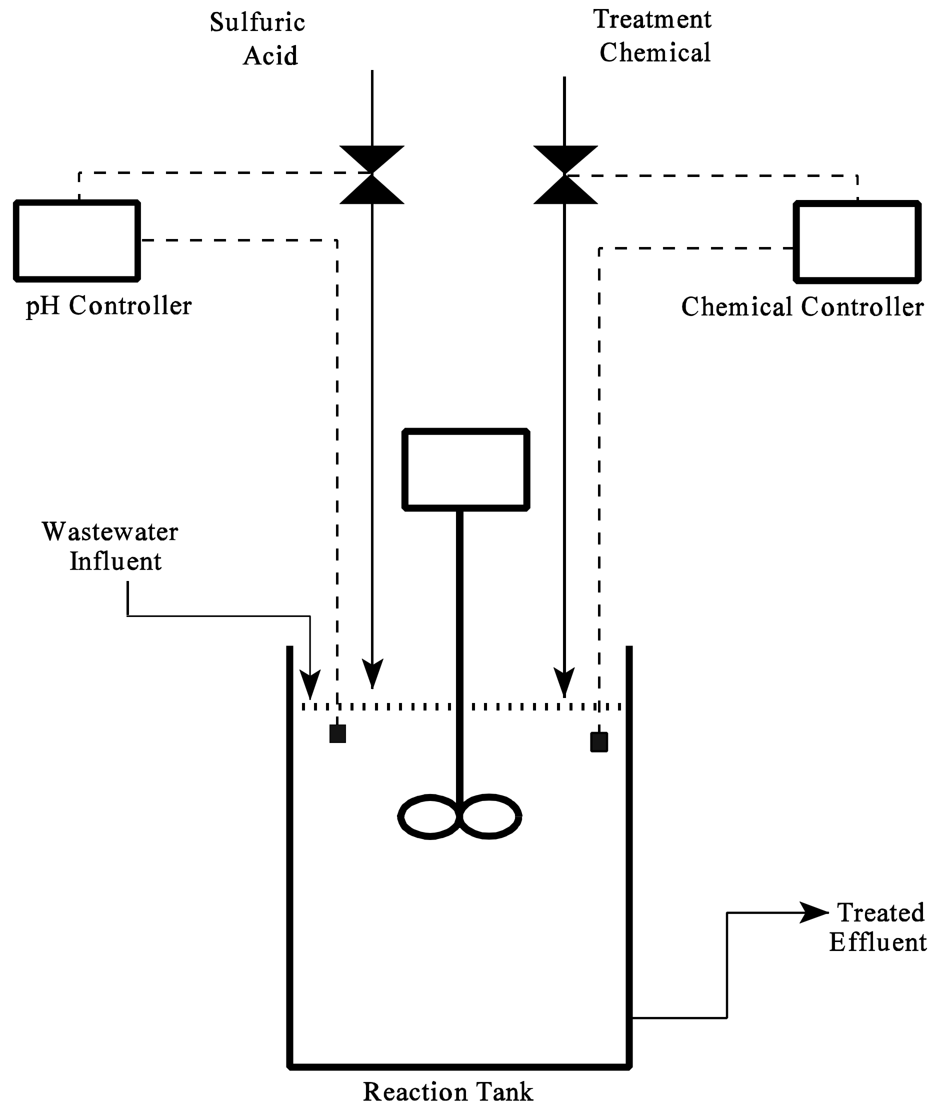


Figure 6-10. Chromium Reduction

6.1.2.1 Sludge Slurrying

Sludge slurrying is the process of transporting sludge from one treatment process to another. It can only be applied to liquid sludges that can be pumped through a pipe under pressure. Only one CHWC facility utilizes a sludge slurry process.

6.1.2.2 Vacuum Filtration

A typical vacuum filtration unit is shown in Figure 6-11. Vacuum filtration provides more aggressive sludge drying by placing the sludge on a screen or mesh and drawing a vacuum through the screen, which draws the liquid out of the sludge. Often the screen is oriented on a cylindrical support, which rotates. The sludge is distributed over the cylinder as it rotates. As the screen rotates, the dried sludge is removed with a scraper, and collected in a hopper placed below the filtration unit. These units can dry sludges to approximately 30 to 50 percent solids. Only one CHWC facility utilizes vacuum filtration for sludge dewatering.

6.1.2.3 Pressure Filtration

The plate and frame pressure filtration system is the most common process used by the CHWC industry to dewater sludges from physical/chemical treatment processes. Six CHWC facilities use a plate and frame pressure filtration system to dewater sludge. Sludges generated by CHWC wastewater treatment processes are typically 2 to 5 percent solids by weight. These sludges are then dewatered to a 30 to 50 percent solids by weight using a plate and frame filter. Sludges from treatment systems can be thickened by gravity or stabilized prior to dewatering, or may be processed directly with the plate and frame pressure filtration unit.

A pressure filter consists of a series of screens (see Figure 6-12) upon which the sludge is applied under pressure. A precoat material may be applied to the screens to aid in solids removal. The applied pressure forces the liquid through the screen, leaving the solids to accumulate behind the screen. Filtrate which passes through the screen media is typically recirculated back to the head of the on-site wastewater

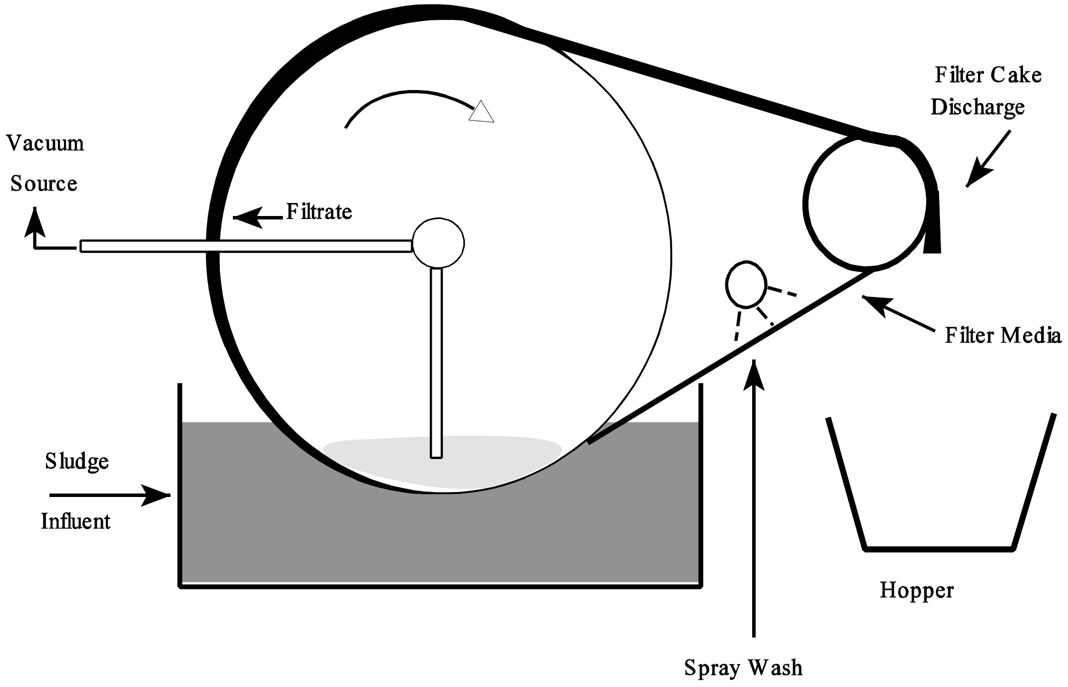


Figure 6-11. Vacuum Filtration

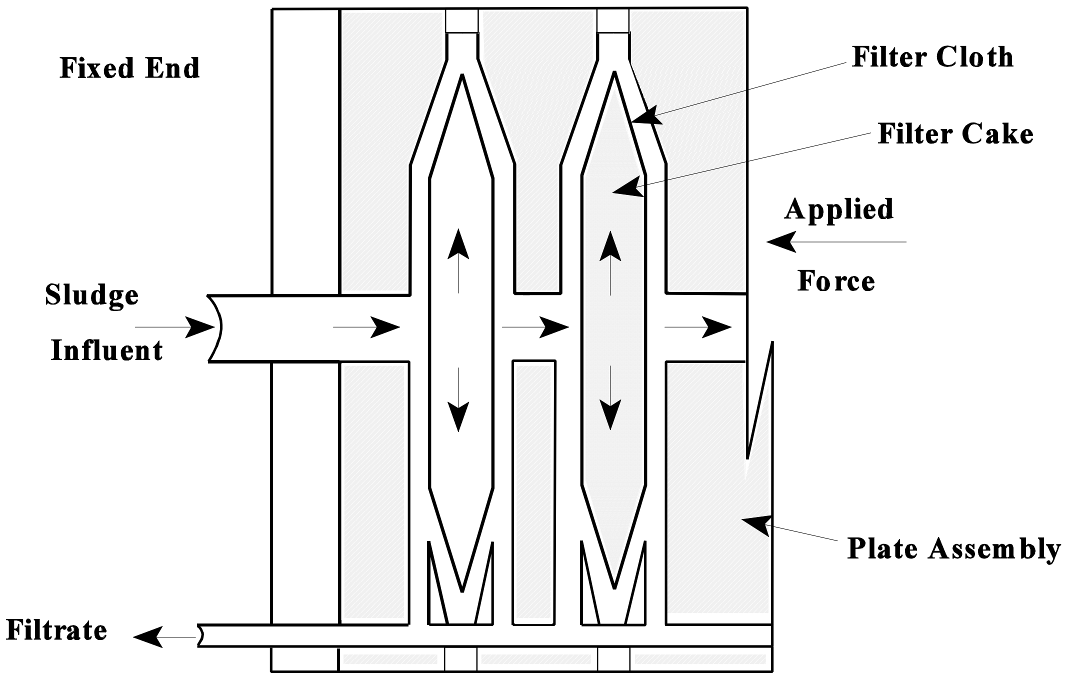


Figure 6-12. Plate and Frame Pressure Filtration System Diagram

treatment plant. Screens (also referred to as plates) are held by frames placed side by side and held together with a vice-type mechanism. The unit processes sludge until all of the plates are filled with dry sludge as indicated by a marked rise in the application pressure. Afterwards, the vice holding the plates is loosened and the frames separated. Dried sludge is manually scraped from the plates and collected in a hopper for final disposal. The size of the filter and the number of plates utilized depends not only on the amount of solids produced by treatment processes, but also is highly dependent on the desired operational requirements for the filter (e.g., shifts per day). A plate and frame pressure filter can produce a sludge with a higher solids content than most other methods of sludge dewatering. Pressure filters offer operational flexibility since they are typically operated in a batch mode.

6.1.2.4 Centrifuges

Centrifuges use centripetal force to separate the liquid from the sludge solids. The sludge enters the top of a rapidly spinning cylinder where the solids are "thrown" to the outer wall of the vessel. The separated solids are continually removed through an orifice on the outer wall, and the liquid stream is collected at the bottom.

Because the unit is spinning rapidly, and sludge often contains abrasive materials, centrifuges often require a high level of maintenance. Centrifuges typically dry sludges to the range of 20 to 30 percent solids by weight. One CHWC facility utilizes a centrifuge for sludge dewatering.

6.1.2.5 Dryer

One CHWC facility employs a sludge dryer to remove the moisture from its sludge prior to disposal of the solid waste. The sludge dryer uses thermal energy derived from steam or electricity to evaporate the moisture from the sludge in a drying bed/tank.

6.1.3 *Zero Discharge Options*

Some CHWC facilities use treatment and disposal practices that result in no discharge of CHWC wastewaters to surface waters. These practices are described below.

6.1.3.1 Incineration

Two CHWC facilities generate annual flow rates of 108,100 gallons and 300,000 gallons and dispose of their CHWC wastewater exclusively by incinerating them on site. Normally, these wastewater flows are minimal compared to the amount of fuel and/or waste the thermal unit handles, and as such, these CHWC facilities find it cheaper to dispose of their wastewaters in this fashion rather than utilizing other disposal methods.

6.1.3.2 Off-Site Disposal

Three CHWC facilities transport their wastewater off site to either another CHWC facility's wastewater treatment system or to a Centralized Wastewater Treatment (CWT) facility for ultimate disposal. These three facilities generate annual flow rates of 18,250 gallons, 10,000 gallons, and 43 million gallons. A fourth facility with an annual flow rate of 4.865 million gallons sells their wastewater as oil well completion fluid.

6.1.3.3 Evaporation/Land Applied

One CHWC facility with an annual flow rate of approximately 100 million gallons discharges its CHWC wastewater into on-site surface impoundments as a means of ultimate disposal. There is no discharge to a receiving water from these impoundments. Rather, water is lost by evaporation.

6.2 TREATMENT OPTIONS FOR OTHER WASTEWATERS GENERATED BY CHWC OPERATIONS

CHWC facilities employ the same two treatment options (physical/chemical treatment or zero discharge) to treat other wastewaters generated as a result of CHWC operations (see Section 4). Most of the same treatment technologies are used to treat these secondary wastewaters as are being used to treat CHWC wastewaters. The EPA's Section 308 Questionnaire obtained information on eight different technologies currently in use by 37 CHWC facilities for the treatment of various washdown waters, run-off from CHWC areas, and laboratory wastewater. A breakdown of these treatment systems is shown below:

Treatment Technology	Number of CHWC Facilities
Equalization	7
Neutralization	8
Flocculation	5
Gravity Assisted Separation	7
Chemical Precipitation	5
Air Stripping	1
Carbon Adsorption	5
Chemical Oxidation	2
Sludge Handling	9

Each of the above treatment technologies, with the exception of chemical oxidation, has been previously described in Section 6.1. As for CHWC wastewaters, the design and operation of these treatment systems to treat other wastewaters generated by CHWC operations are the same. Since the amount of wastewater generated by other CHWC operations is minimal as compared to CHWC wastewater flow rates, these small flows are typically mixed with CHWC wastewaters for treatment in the physical/chemical treatment system. Below is a description of the only new treatment technology listed above that was not described in the previous section: chemical oxidation.

6.2.1 *Chemical Oxidation*

Chemical oxidation treatment processes may be used to remove ammonia, to reduce the concentration of residual organics, and to reduce the bacterial and viral content of wastewaters. CHWC facilities that use chemical oxidation processes use them for the treatment of other out-of-scope wastewaters generated at these facilities, such as landfill leachate, storm water, groundwater, or sanitary wastewater. Both chlorine and ozone can be used to destroy some residual organics in wastewater. When these chemicals are used for this purpose, disinfection of the wastewater is usually an added benefit. A further benefit of using ozone is the removal of color. Ozone can also be combined with hydrogen peroxide for removing organic compounds in contaminated wastewater. Oxidation is also used to convert pollutants to terminal end products or to intermediate products that are more readily biodegradable or more readily removed by adsorption. There are two CHWC facilities that use chemical oxidation units as part of their treatment process to treat secondary CHWC wastewaters.

Chemical oxidation is a chemical reaction process in which one or more electrons are transferred from the chemical being oxidized to the chemical initiating the transfer (the oxidizing agent). The electron acceptor may be another element, including an oxygen molecule, or it may be a chemical species containing oxygen, such as hydrogen peroxide and chlorine dioxide or some other electron acceptor. This process is also effective in destroying cyanide and toxic organic compounds. Figure 6-13 illustrates one such chemical oxidation process. According to the Section 308 Questionnaire data, CHWC facilities use chemical oxidation processes to treat organic pollutants and as a disinfectant. When treating organic wastes, these processes use oxidizing chemicals, such as hydrogen peroxide, or ozone. As a disinfection process, an oxidant (usually chlorine) is added to the wastewater in the form of either chlorine dioxide or sodium hypochlorite. Other disinfectant chemicals include ozone, peroxide, and calcium hypochlorite. Once the oxidant is mixed with the wastewater, sufficient detention time is allowed (usually 30 minutes) for the disinfecting reactions to occur.

6.2.2 *Zero Discharge Options*

Other CHWC facilities use treatment and disposal practices that result in no discharge of their secondary CHWC wastewaters to surface waters. A breakdown of the zero discharge options for secondary CHWC wastewaters at CHWC facilities is as follows:

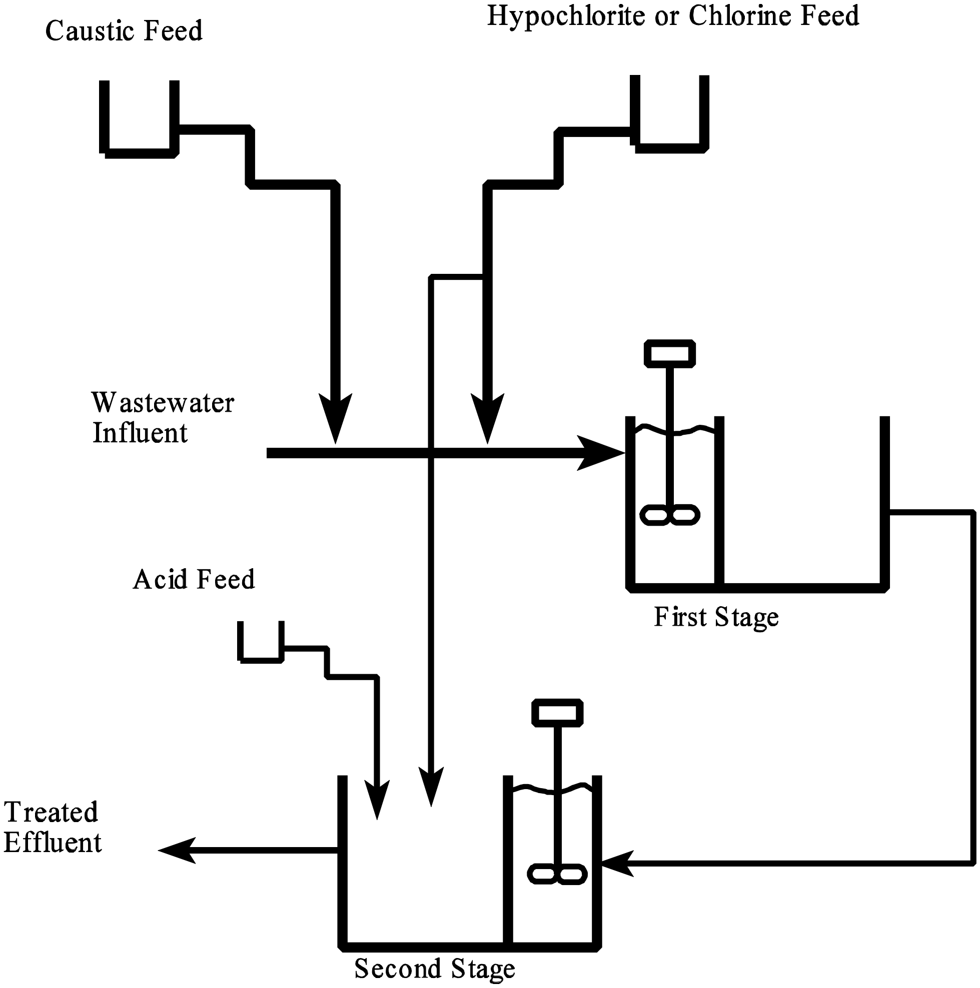


Figure 6-13. Cyanide Destruction

Zero Discharge Option	Number of CHWC Facilities
Incineration	2
Off-Site Disposal	5
Evaporated/Land Applied	1
Recycled	2
Deep Well Disposal	2

Most of the above zero discharge options, with the exception of deep well disposal, have been described previously in Section 6.1.3. Below is a description of the only new zero discharge option listed above that was not described in the previous section; deep well disposal.

6.2.2.1 Deep Well Disposal

Deep well disposal consists of pumping the wastewater into a disposal well which discharges the liquid into a deep aquifer. These aquifers do not typically contain potable water and commonly are brackish. These aquifers are thoroughly characterized to insure that they are not hydrogeologically connected to an aquifer which is or has the potential to be used for potable water. Characterization confirms the existence of impervious layers of rock above and below the aquifer in order to prevent the migration of pollutants.

6.3 OTHER ON-SITE WASTEWATER TREATMENT TECHNOLOGIES

There are other treatment technologies used by CHWC facilities to treat other on-site wastewaters (leachates, sanitary wastewater). Some facilities may use one or more of the technologies described above for the treatment of these wastewaters. Four CHWC facilities use some form of biological treatment as the preferred method of treatment of leachates and other organic wastewaters. The biological treatment technologies used at these CHWC facilities are listed below:

Treatment Technology	Number of Facilities
Activated Sludge	1
Trickling Filter	1
PAC System (Powdered Activated Carbon)	2

6.4 TREATMENT PERFORMANCE AND DEVELOPMENT OF REGULATORY OPTION

This section presents an evaluation of performance data on treatment systems collected both by EPA during field sampling programs and by industry generated data (provided to the Agency post-proposal and used to revise limitations), as well as the rationale used in the development of the regulatory option.

6.4.1 *Performance of EPA Sampled Treatment Processes*

To collect data on potential BAT treatment technologies, Questionnaire responses were reviewed to identify candidate facilities that had well operated and designed wastewater treatment systems. EPA conducted site visits to 13 CHWC facilities to evaluate treatment systems; based on these site visits, three facilities were selected for a five consecutive day sampling episode (Episode ID #s 4646, 4671, and 4733). At these facilities, EPA collected data on a variety of physical and chemical treatment processes. Technologies evaluated at the selected sampling facilities include hydroxide precipitation, sulfide precipitation, sedimentation, carbon adsorption, sand filtration and ultrafiltration. Table 6-1 presents a summary of the treatment technologies sampled during each EPA sampling episode. Summaries of the treatment system performance data collected by EPA during each of these sampling episodes are presented below.

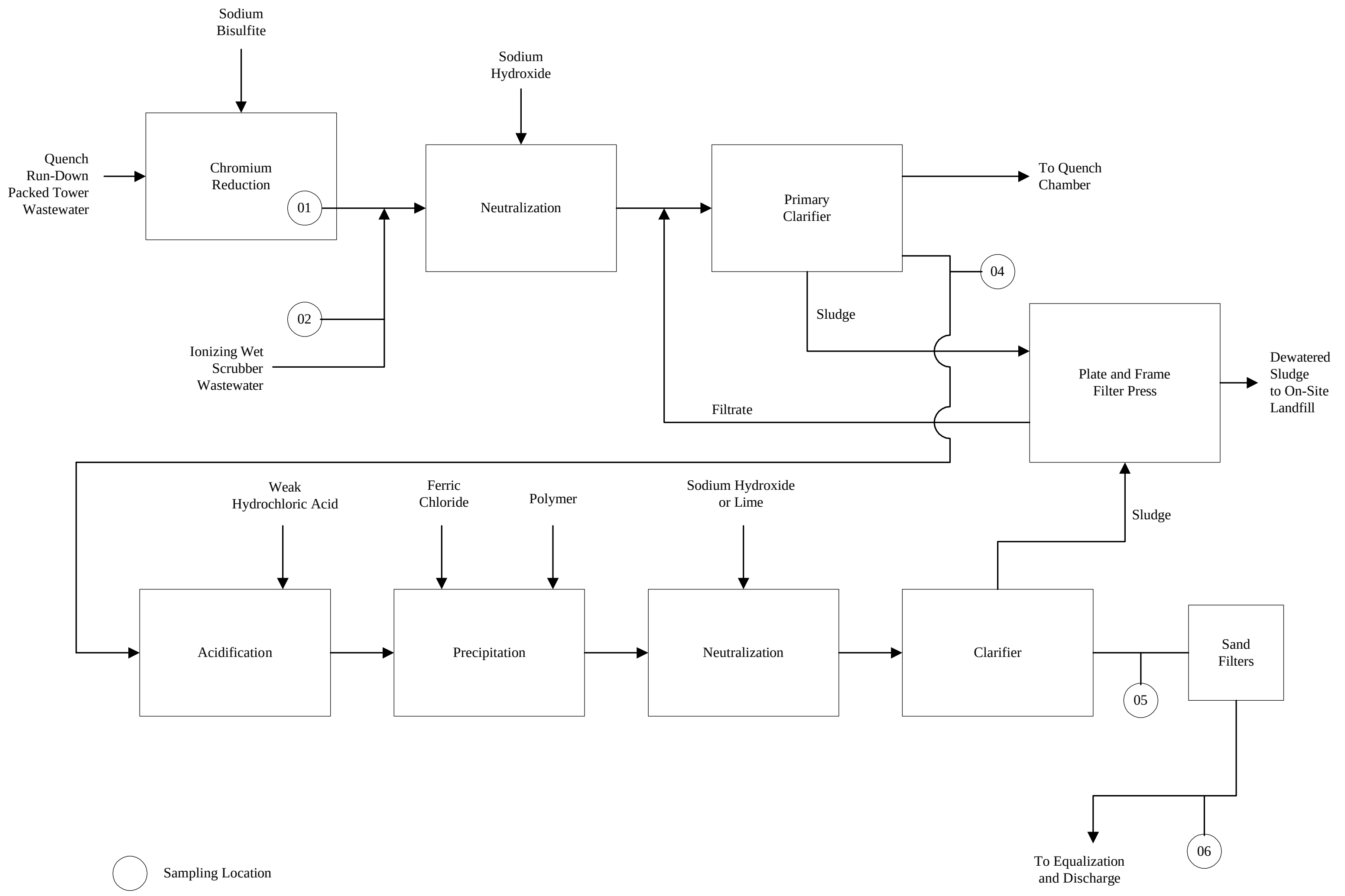
6.4.1.1 Treatment Performance for Episode #4646

EPA performed a five-day sampling program, Episode # 4646. This facility was evaluated by EPA in order to obtain performance data on several treatment technologies installed at this facility including hydroxide precipitation, ferric chloride precipitation, and sand filtration. A flow diagram of the CHWC wastewater treatment system sampled during Episode # 4646 is presented in Figure 6-14. The wastewater treatment system used at this CHWC facility treats wastewater from the air pollution control system (quench chamber run-down and packed tower wastewater) and the ionizing wet scrubber. The

Table 6-1. Description of CHWC Sampling Episodes

Episode	Influent Sample Point	Effluent Sample Point	Description
4646	1+2	4	First-stage chemical precipitation using sodium hydroxide
	4	5	Second-stage chemical precipitation using ferric chloride
	5	6	Sand filtration
	1+2	6	Overall treatment system- first-stage chemical precipitation, second-stage chemical precipitation, and sand filter
4671	1	2	First-stage chemical precipitation using sodium hydroxide
	2	3	Second-stage chemical precipitation using sodium hydroxide and ultrafiltration
	1	3	Overall treatment system- first-stage chemical precipitation,second-stage chemical precipitation, and ultrafiltration
4733	1	2	Sulfide precipitation and Lancy filters
	2	4	Carbon adsorption system
	1	4	Overall treatment system- sulfide precipitation, Lancy filters and carbon adsorption system

Figure 6-14. EPA Sampling Episode 4646 - CHWC Wastewater Treatment System Block Flow Diagram with Sampling Locations



wastewater treatment system is comprised of two separate systems both of which were sampled by EPA. The primary system is part of the primary water circulation loop that serves the incinerator and consists of chromium reduction and hydroxide precipitation treatment followed by sedimentation. Only the precipitation portion of the primary system was sampled by EPA. Blowdown from the primary loop is treated in the secondary system. Treatment in the secondary loop consists of precipitation using ferric chloride followed by sedimentation and sand filtration. Table 6-2 presents a summary of percent removal data collected at Episode #4646 for the performance of the entire treatment system, both the primary and secondary system, as well as the primary system, secondary system, and sand filter separately. Percent removal efficiencies for the processes were calculated by first obtaining an average concentration based upon the daily sampling results for each sample collection location (influent and effluent point to the treatment process). Next, the percent removal efficiency of the system was calculated using the following equation:

$$\text{Percent Removal} = \frac{[\underline{\text{Concentration Influent - Concentration Effluent}}]}{\text{Concentration Influent}} \text{x100}$$

Negative percent removals for a treatment process were reported on the table as “0.0" percent removals.

The treatment efficiency of the primary system was assessed using the data obtained from sampling points 01, 02, and 04 (see Figure 6-14). Influent concentration data was obtained using a flow-weighted average for sample points 01 and 02. Effluent from the primary treatment system was represented by sample point 04. As demonstrated on Table 6-2, the primary treatment system experienced good overall removals for TSS (90.9 percent). COD was removed at 70.9 percent, whereas, no removal was observed for TDS. Many of the metals observed in the influent were removed to high levels; these include aluminum, cadmium, chromium, copper, iron, lead, tin, titanium, and zinc. Other metals also with limited removals include manganese (66.5 percent), mercury (63.9 percent), silver (40.3 percent), and strontium (19.7 percent). Poor removal efficiencies were observed in the primary system for antimony, arsenic, boron, molybdenum, and selenium.

Table 6-2. Treatment Technology Performance for Episode 4646

		First-Stage Chemical Precipitation Sample Points 1+2 to 4						Second-Stage Chemical Precipitation Sample Points 4 to 5					
Pollutant of Concern	**CAS #**	**DL**	**SP**	**Influent Conc. (ug/l)**	**SP**	**Effluent Conc. (ug/l)**	**% Removal**	**DL**	**SP**	**Influent Conc. (ug/l)**	**SP**	**Effluent Conc. (ug/l)**	**% Removal**
Conventional													
TSS	C-009	4,000	01+02	122,560	04	11,200	90.9	4,000	04	11,200	05	13,400	0.0
Non-Conventional													
COD	C-004	5,000	01+02	535,920	04	156,200	70.9	5,000	04	156,200	05	238,800	0.0
TDS	C-010		01+02	30,694,160	04	50,320,000	0.0		04	50,320,000	05	36,910,000	26.6
Metals													
Aluminum	7429905	200	01+02	1,104	04	170	84.6	200	04	170	05	197	0.0
Antimony	7440360	20.0	01+02	672	04	1,026	0.0	20.0	04	1,026	05	381	62.9
Arsenic	7440382	10.0	01+02	475	04	494	0.0	10.0	04	494	05	8.8	98.2
Boron	7440428	100	01+02	1,280	04	1,744	0.0	100	04	1,744	05	1,705	2.2
Cadmium	7440439	5.0	01+02	929	04	174	81.2	5.0	04	174	05	47.2	72.9
Chromium	7440473	10.0	01+02	220	04	53.4	75.8	10.0	04	53.4	05	ND	81.3
Copper	7440508	25.0	01+02	5,228	04	321	93.9	25.0	04	321	05	18.8	94.2
Iron	7439896	100	01+02	7,066	04	254	96.4	100	04	254	05	1,994	0.0
Lead	7439921	50.0	01+02	4,691	04	117	97.5	50.0	04	117	05	47.7	59.1
Manganese	7439965	15.0	01+02	228	04	76.6	66.5	15.0	04	76.6	05	517	0.0
Mercury	7439976	0.2	01+02	59.2	04	21.4	63.9	0.2	04	21.4	05	2.6	87.7
Molybdenum	7439987	10.0	01+02	936	04	1,137	0.0	10.0	04	1,137	05	578	49.1
Selenium	7782492	5.0	01+02	240	04	263	0.0	5.0	04	263	05	49.6	81.1
Silver	7440224	10.0	01+02	283	04	169	40.3	10.0	04	169	05	9.5	94.4
Strontium	7440246	100	01+02	408	04	328	19.7	100	04	328	05	689	0.0
Tin	7440315	30.0	01+02	1,882	04	45.9	97.6	30.0	04	45.9	05	33.0	28.2
Titanium	7440326	5.0	01+02	2,116	04	32.9	98.4	5.0	04	32.9	05	3.9	88.2
Zinc	7440666	20.0	01+02	9,456	04	209	97.8	20.0	04	209	05	121	42.2
Pesticides/Herbicides													
Dichloroprop	120365	1.0	01+02	3.1	04	NS	NS	1.0	04	NS	05	NS	NS
MCPP	7085190	50.0	01+02	1,027	04	NS	NS	50.0	04	NS	05	NS	NS

Negative percent removal are recorded as 0.0

NS: Not Sampled

ND: Non-Detect

DL: Specific detection limits of sample when there is a non-detect, otherwise it is the method detection limit

SP: Sample Point

Table 6-2. Treatment Technology Performance for Episode 4646 (continued)

		Sand Filtration Sample Points 5 to 6						Entire Treatment System Sample Points 1+2 to 6					
Pollutant of Concern	CAS #	DL	SP	Influent Conc. (ug/l)	SP	Effluent Conc. (ug/l)	% Removal	DL	SP	Influent Conc. (ug/l)	SP	Effluent Conc. (ug/l)	% Removal
Conventional													
TSS	C-009	4,000	05	13,400	06	5,500	59.0	4,000	01+02	122,560	06	5,500	95.5
Non-Conventional													
COD	C-004	5,000	05	238,800	06	257,900	0.0	5,000	01+02	535,920	06	257,900	51.9
TDS	C-010		05	36,910,000	06	38,150,000	0.0		01+02	30,694,160	06	38,150,000	0.0
Metals													
Aluminum	7429905	200	05	197	06	160	18.4	200	01+02	1,104	06	160	85.5
Antimony	7440360	20.0	05	381	06	346	9.3	20.0	01+02	672	06	346	48.5
Arsenic	7440382	10.0	05	8.8	06	8.1	8.1	10.0	01+02	475	06	8.1	98.3
Boron	7440428	100	05	1,705	06	1,731	0.0	100	01+02	1,280	06	1,731	0.0
Cadmium	7440439	5.0	05	47.2	06	19.9	57.7	5.0	01+02	929	06	19.9	97.9
Chromium	7440473	10.0	05	ND	06	ND	0.0	10.0	01+02	220	06	ND	95.5`
Copper	7440508	25.0	05	18.8	06	10.1	46.1	25.0	01+02	5,228	06	10.1	99.8
Iron	7439896	100	05	1,994	06	128	93.6	100	01+02	7,066	06	128	98.2
Lead	7439921	46.8	05	47.7	06	ND	1.8	46.8	01+02	4,691	06	ND	99.0
Manganese	7439965	15.0	05	517	06	545	0.0	15.0	01+02	228	06	545	0.0
Mercury	7439976	2.0	05	2.6	06	ND	24.2	2.0	01+02	59.2	06	ND	96.6
Molybdenum	7439987	10.0	05	578	06	580	0.0	10.0	01+02	936	06	580	38.0
Selenium	7782492	5.0	05	49.6	06	26.0	47.5	5.0	01+02	240	06	26.0	89.1
Silver	7440224	5.0	05	9.5	06	ND	47.3	5.0	01+02	283	06	ND	98.2
Strontium	7440246	100	05	689	06	674	2.1	100	01+02	408	06	674	0.0
Tin	7440315	30.0	05	33.0	06	31.5	4.5	30.0	01+02	1,882	06	31.5	98.3
Titanium	7440326	5.0	05	3.9	06	6.8	0.0	5.0	01+02	2,116	06	6.8	99.7
Zinc	7440666	20.0	05	121	06	24.2	80.0	20.0	01+02	9,456	06	24.2	99.7
Pesticides/Herbicides													
Dichloroprop	120365	1.0	05	NS	06	ND	NS	1.0	01+02	3.1	06	ND	67.3
MCPP	7085190	50.0	05	NS	06	1,482	NS	50.0	01+02	1,027	06	1,482	0.0

Negative percent removal are recorded as 0.0
NS: Not Sampled
ND: Non-Detect
DL: Specific detection limits of sample when there is a non-detect, otherwise it is the method detection limit
SP: Sample Point

The treatment efficiency of the secondary system was assessed using the data obtained from sampling points 04 and 05 (see Figure 6-14). Influent concentration data to the secondary system was obtained using sampling point 04 which is also the effluent from the primary system. Effluent from the secondary treatment system was represented by sample point 05. As demonstrated in Table 6-2, the secondary treatment system experienced no additional removals for TSS or COD. As in the primary system, no removal was observed for TDS. For those metals for which there was little or no removal in the primary system, improved removals were generally observed in the second system. These metals include antimony (62.9 percent), arsenic (98.2 percent), selenium (81.1 percent), and silver (94.4 percent). Other metals for which adequate removals were observed in the primary system also experienced additional removals in the secondary system. The data show the following removals: cadmium (72.9 percent), chromium (81.3 percent), copper (94.2 percent), mercury (87.7 percent), and titanium (88.2 percent).

The treatment efficiency of the sand filter was evaluated using the data obtained from sampling points 05 and 06 (see Figure 6-14). Influent concentration data was obtained using sample point 05 which represents the discharge from the secondary treatment system. Effluent from the sand filter as well as the overall effluent from the treatment process was represented by sample point 06. As demonstrated in Table 6-2, the treatment system achieved a removal rate for TSS of 59.0 percent. No removals were observed for COD or TDS. Additional metals were removed by the sand filter including cadmium, copper, iron, selenium, silver, and zinc. Limited additional removals were also observed for aluminum and mercury.

The treatment efficiency of the entire treatment system was evaluated using the data obtained from sampling points 01, 02, and 06 (see Figure 6-14). Influent concentration data was obtained using a flow-weighted average for sample points 01 and 02. Effluent from the treatment system was represented by sample point 06. As demonstrated in Table 6-2, the treatment system achieved good overall removal for TSS (95.5 percent). COD was removed at 51.9 percent, whereas, no removal was observed for TDS. Many of the metals observed in the influent were removed to levels exceeding 95 percent. These include arsenic, cadmium, chromium, copper, iron, lead, mercury, silver, tin, titanium, and zinc. Other metals also with high removals include aluminum (85.5 percent) and selenium (89.1 percent). Overall poor removal efficiencies were observed for antimony (48.5 percent) and molybdenum (38.0 percent). No removals were observed for the treatment system for boron, manganese, and strontium. Dichloroprop, a pesticide parameter, was detected in the influent in low levels and was not detected in the effluent. MCPP did not experience any removal through the treatment system.

6.4.1.2 Treatment Performance for Episode #4671

EPA performed a five-day sampling program, Episode #4671. This facility was evaluated by EPA in order to obtain performance data on various treatment units which are in operation at this facility, including a combination sulfide and hydroxide precipitation process, conventional hydroxide precipitation, and ultrafiltration. A flow diagram of the CHWC wastewater treatment system sampled during Episode # 4671 is presented in Figure 6-15. The wastewater treatment system used at this CHWC facility treats wastewater from the air pollution control system. The air pollution control system consists of a quench tank, packed tower, and a venturi scrubber. The wastewater treatment system is comprised of two separate systems both of which were sampled by EPA. The primary system is part of the primary water circulation loop that serves the incinerator. Treatment processes for the primary system consists of sulfide precipitation using ferrous sulfate followed by hydroxide precipitation using sodium hydroxide and lime and then followed by sedimentation. The facility treats the discharge from the primary loop in the secondary system. Treatment in the secondary loop consists of hydroxide precipitation using sodium hydroxide followed by sedimentation and ultrafiltration. Table 6-3 presents a summary of percent removal data collected at Episode #4671 for the performance of the entire treatment system, both the primary and secondary system, and for the primary system only.

The treatment efficiency of the primary treatment system was evaluated using the data obtained from sampling points 01 and 02 (see Figure 6-15). Influent concentration data for the primary system was obtained using sample point 01. Effluent from the primary treatment system was represented by sample point 02. As demonstrated on Table 6-3, the primary treatment system removal rate for TSS was 70.6 percent. COD was removed at 12.3 percent, whereas, TDS was removed at 7.8 percent. Metals with

Figure 6-15. EPA Sampling Episode 4671 - CHWC Wastewater Treatment System Block Flow Diagram with Sampling Locations

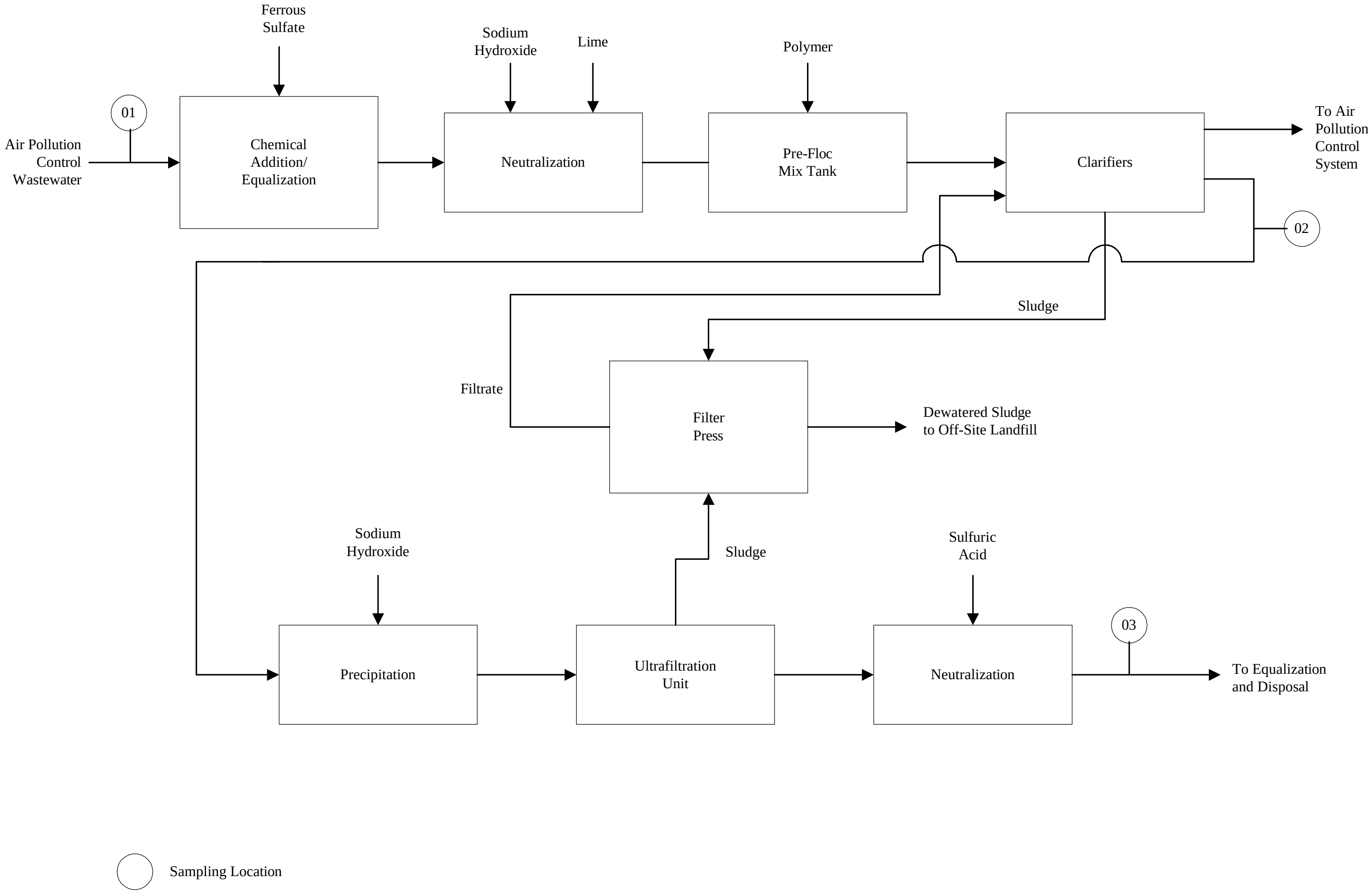


Table 6-3. Treatment Technology Performance for Episode 4671

		First-Stage Chemical Precipitation Sample Points 1 to 2						Second-Stage Chemical Precipitation Sample Points 2 to 3					
Pollutant of Concern	**CAS #**	**DL**	**SP**	**Influent Conc. (ug/l)**	**SP**	**Effluent Conc. (ug/l)**	**% Removal**	**DL**	**SP**	**Influent Conc. (ug/l)**	**SP**	**Effluent Conc. (ug/l)**	**% Removal**
Conventional													
TSS	C-009	4,000	01	241,100	02	70,900	70.6	4,000	02	70,900	03	13,800	80.5
Non-Conventional													
COD	C-004	5,000	01	259,400	02	227,600	12.3	5,000	02	227,600	03	154,800	32.0
TDS	C-010		01	7,481,000	02	6,896,000	7.8		02	6,896,000	03	6,560,000	4.9
Metals													
Aluminum	7429905	200	01	1,575	02	266	83.1	6.5	02	266	03	ND	97.6
Antimony	7440360	20.0	01	110	02	107	2.5	20.0	02	107	03	94.2	12.2
Arsenic	7440382	10.0	01	19.2	02	19.9	0.0	10.0	02	19.9	03	25.6	0.0
Boron	7440428	100	01	1,723	02	1,219	29.2	100	02	1,219	03	1,069	12.3
Cadmium	7440439	5.0	01	4.2	02	2.4	43.1	5.0	02	2.4	03	0.4	83.6
Chromium	7440473	10.0	01	124	02	3.2	97.4	10.0	02	3.2	03	1.0	67.7
Copper	7440508	25.0	01	121	02	33.8	72.0	25.0	02	33.8	03	18.8	44.4
Iron	7439896	100	01	1,217	02	79.8	93.4	100	02	79.8	03	50.1	37.1
Lead	7439921	50.0	01	149	02	14.3	90.4	1.5	02	14.3	03	ND	89.5
Manganese	7439965	15.0	01	107	02	74.3	30.5	15.0	02	74.3	03	2.3	96.9
Mercury	7439976	0.2	01	0.7	02	0.4	33.8	0.2	02	0.4	03	ND	54.5
Molybdenum	7439987	10.0	01	69.7	02	66.6	4.5	10.0	02	66.6	03	59.5	10.6
Selenium	7782492	9.7	01	ND	02	14.0	0.0	11.5	02	14.0	03	ND	17.6
Silver	7440224	10.0	01	5.7	02	9.1	0.0	10.0	02	9.1	03	2.0	77.7
Strontium	7440246	100	01	1,382	02	1,582	0.0	100	02	1,582	03	1,315	16.8
Tin	7440315	30.0	01	49.5	02	39.0	21.2	28.3	02	39.0	03	ND	27.4
Titanium	7440326	10.0	01	206	02	ND	95.1	10.0	02	ND	03	ND	0.0
Zinc	7440666	20.0	01	1,598	02	813	49.1	20.0	02	813	03	239	70.7
Pesticides/Herbicides													
Dichloroprop	120365	1.0	01	ND	02	NS	NS	1.0	02	NS	03	ND	NS
MCPP	7085190	50.0	01	ND	02	NS	NS	50.0	02	NS	03	ND	NS

Negative percent removal are recorded as 0.0
NS: Not Sampled
ND: Non-Detect
DL: Specific detection limits of sample when there is a non-detect, otherwise it is the method detection limit
SP: Sample Point

Table 6-3. Treatment Technology Performance for Episode 4671 (continued)

		Entire Treatment System Sample Points 1 to 3					
Pollutant of Interest	**CAS #**	**DL**	**SP**	**Influent Conc. (ug/l)**	**SP**	**Effluent Conc. (ug/l)**	**% Removal**
Conventional							
TSS	C-009	4,000	01	241,100	03	13,800	94.3
Non-Conventional							
COD	C-004	5,000	01	259,400	03	154,800	40.3
TDS	C-010		01	7,481,000	03	6,560,000	12.3
Metals							
Aluminum	7429905	6.5	01	1,575	03	ND	99.6
Antimony	7440360	20.0	01	110	03	94.2	14.4
Arsenic	7440382	10.0	01	19.2	03	25.6	0.0
Boron	7440428	100	01	1,723	03	1,069	37.9
Cadmium	7440439	5.0	01	4.2	03	0.4	90.7
Chromium	7440473	10.0	01	124	03	1.0	99.2
Copper	7440508	25.0	01	121	03	18.8	84.5
Iron	7439896	100	01	1,217	03	50.1	95.9
Lead	7439921	1.5	01	149	03	ND	99.0
Manganese	7439965	15.0	01	107	03	2.3	97.8
Mercury	7439976	0.2	01	0.7	03	ND	69.9
Molybdenum	7439987	10.0	01	69.7	03	59.5	14.6
Selenium	7782492	9.7 /11.5	01	ND	03	ND	0.0
Silver	7440224	10.0	01	5.7	03	2.0	64.1
Strontium	7440246	100	01	1,382	03	1,315	4.8
Tin	7440315	28.3	01	49.5	03	ND	42.8
Titanium	7440326	10.0	01	206	03	ND	95.1
Zinc	7440666	20.0	01	1,598	03	239	85.1
Pesticides/Herbicides							
Dichloroprop	120365	1.0	01	ND	03	ND	0.0
MCPP	7085190	50.0	01	ND	03	ND	0.0

Negative percent removal are recorded as 0.0
NS: Not Sampled
ND: Non-Detect
DL: Specific detection limits of sample when there is a non-detect, otherwise it is the method detection limit
SP: Sample Point

high removal rates in the primary system include: aluminum (83.1 percent), chromium (97.4 percent), copper (72.0 percent), iron (93.4 percent), lead (90.4 percent), and titanium (95.1 percent). The system achieved limited removals for other metals through the primary system. These include boron, cadmium, manganese, mercury, tin, and zinc.

Poor to no removals were observed for antimony, arsenic, molybdenum, silver, and strontium. However, influent concentrations to the primary treatment system for some metals, such as arsenic, cadmium, silver, and zinc, were low or not detected. Therefore, the influent concentrations for these parameters are close to the treatability levels using chemical precipitation, making it difficult to achieve additional removals for these pollutants. For example, cadmium was found in the influent and effluent of the primary treatment system at concentrations of 4.2 ug/l and 2.4 ug/l, respectively. This resulted in a percent removal of only 43.1 percent. Therefore, the low percent removal efficiency is a function of the low influent concentration (near treatability levels) and not indicative of poor performance.

The treatment efficiency of the secondary treatment system was evaluated using the data obtained from sampling points 02 and 03 (see Figure 6-15). Influent concentration data to the secondary system was obtained using sample point 02, which is the effluent from the primary system. Effluent from the secondary treatment system was represented by sample point 03. As demonstrated on Table 6-3, the secondary treatment system removal rate for TSS was 80.5 percent. COD was removed at 32.0 percent, whereas, TDS was removed at 4.9 percent. Metals with high removal rates or removed to non-detectable levels in the secondary system include; aluminum, cadmium, chromium, lead, manganese, mercury, silver, tin, and zinc. Limited additional removals were observed for copper and iron. Poor removals were observed in the secondary system for antimony, boron, molybdenum, and strontium.

The treatment efficiency of the entire treatment system, both primary and secondary treatment systems, were evaluated using the data obtained from sampling points 01 and 03 (see Figure 6-15). Influent concentration data was obtained using sample point 01. Effluent from the entire treatment system was represented by sample point 03. As demonstrated on Table 6-3, the treatment system achieved good overall removals for TSS (94.3 percent). COD was removed at 40.3 percent, whereas, TDS was removed at 12.3 percent. Selenium, dichloroprop, and MCPP were not detected in the influent or effluent.

Many of the metals observed in the influent were removed to levels exceeding 95 percent removal; these include aluminum, chromium, iron, lead, manganese, and titanium. Other metals also with high removals or removed to non-detectable levels include cadmium (90.7 percent), copper (84.5 percent), mercury (69.9 percent), silver (64.1 percent), and tin (42.8 percent). Poor removal efficiencies were observed for the entire treatment system for antimony (14.4 percent), boron (37.9 percent), molybdenum (14.6 percent), and strontium (4.8 percent). Arsenic was observed at below treatable levels throughout the system.

6.4.1.3 Treatment Performance for Episode #4733

EPA performed a five-day sampling program, Episode #4733. This facility was evaluated by EPA in order to obtain performance data on various treatment units which are in operation at this facility, including sulfide precipitation, Lancy filtration, and carbon adsorption. A flow diagram of the CHWC wastewater treatment system sampled during Episode # 4733 is presented in Figure 6-16. The wastewater treatment system used at this CHWC facility treats wastewater from the air pollution control system. The air pollution control system consists of a quench tank and a wet scrubber. Table 6-4 presents a summary of percent removal data collected at Episode #4733 for the performance of the sulfide precipitation and Lancy filtration process, carbon adsorption system, and the entire treatment system.

The treatment efficiency of the sulfide precipitation and Lancy filtration system was evaluated using the data obtained from sampling points 01 and 02 (see Figure 6-16). Influent concentration data to the primary system was obtained using sample point 01. Effluent from the first-stage treatment system was represented by sample point 02. As demonstrated on Table 6-4, the first-stage treatment system had non-detectable levels in the influent for TSS, aluminum, cadmium, lead, molybdenum, silver, strontium, and MCPP. Other parameters were observed in the influent at levels near to or below treatable levels, such as antimony, arsenic, and copper. COD was removed at 11.8 percent, whereas, no removal was observed for TDS. Metals with high removal rates in the first-stage system include; chromium (84.4 percent), iron (85.3 percent), manganese (86.3 percent), mercury (94.0 percent), and zinc (92.2 percent). Titanium was removed to non-detectable levels in the first-stage system. The treatment system achieved limited removal

Figure 6-16. EPA Sampling Episode 4733 - CHWC Wastewater Treatment System Block Flow Diagram with Sampling Locations

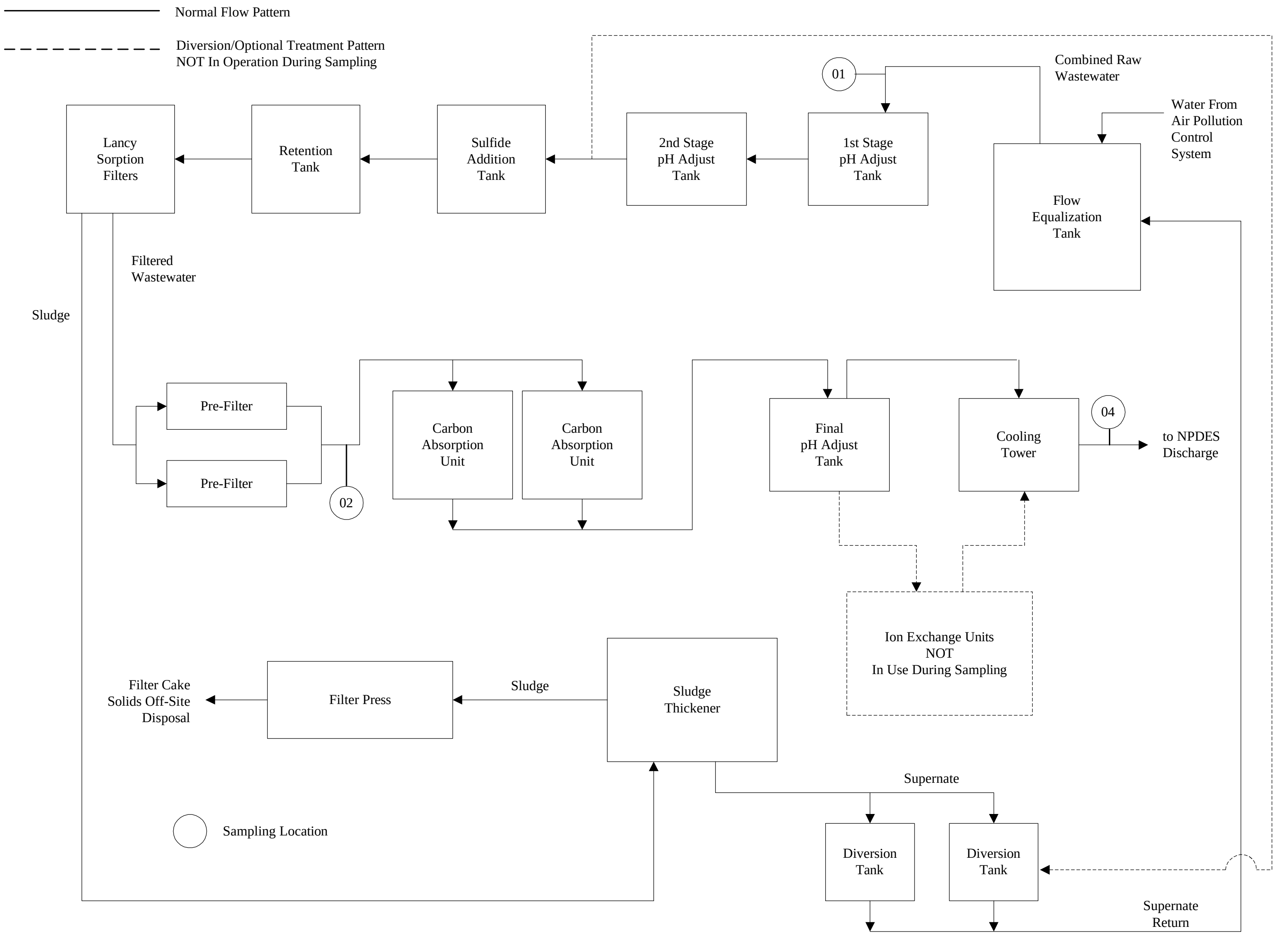


Table 6-4. Treatment Technology Performance for Episode 4733

		First-Stage Lancy Filter Sample Points 1 to 2						Carbon Adsorption System Sample Points 2 to 4					
Pollutant of Concern	**CAS #**	**DL**	**SP**	**Influent Conc. (ug/l)**	**SP**	**Effluent Conc. (ug/l)**	**% Removal**	**DL**	**SP**	**Influent Conc. (ug/l)**	**SP**	**Effluent Conc. (ug/l)**	**% Removal**
Conventional													
TSS	C-009	4,000	01	ND	02	ND	0.0	4,000	02	ND	04	ND	0.0
Non-Conventional													
COD	C-004	5,000	01	234,100	02	206,600	11.8	5,000	02	206,600	04	192,300	6.9
TDS	C-010		01	272,400	02	2,206,000	0.0		02	2,206,000	04	2,899,000	0.0
Metals													
Aluminum	7429905	13.6	01	ND	02	ND	0.0	13.6	02	ND	04	ND	0.0
Antimony	7440360	20.0	01	22.8	02	24.6	0.0	20.0	02	24.6	04	26.4	0.0
Arsenic	7440382	10.0	01	5.3	02	4.9	8.3	10.0	02	4.9	04	4.1	15.4
Boron	7440428	100	01	1,811	02	1,846	0.0	100	02	1,846	04	2,381	0.0
Cadmium	7440439	3.5	01	ND	02	ND	0.0	3.5	02	ND	04	ND	0.0
Chromium	7440473	5.8	01	37.1	02	ND	84.4	5.8	02	ND	04	ND	0.0
Copper	7440508	25.0	01	10.9	02	9.5	12.5	25.0	02	9.5	04	7.4	22.1
Iron	7439896	100	01	430	02	63.4	85.3	2.4	02	63.4	04	ND	96.2
Lead	7439921	2.1	01	ND	02	ND	0.0	2.1 /1.8	02	ND	04	ND	0.0
Manganese	7439965	1.2	01	8.8	02	ND	86.3	1.2	02	ND	04	1.3	0.0
Mercury	7439976	0.2	01	3.3	02	ND	94.0	0.2	02	ND	04	0.4	0.0
Molybdenum	7439987	4.6	01	ND	02	ND	0.0	4.6	02	ND	04	7.1	0.0
Selenium	7782492	5.0	01	59.1	02	43.9	25.6	5.0	02	43.9	04	56.5	0.0
Silver	7440224	7.8	01	ND	02	8.1	0.0	7.8	02	8.1	04	8.1	0.0
Strontium	7440246	100	01	ND	02	ND	0.0	100 /86.7	02	ND	04	ND	0.0
Tin	7440315	30.0	01	65.9	02	145	0.0	30.0	02	145	04	48.6	66.4
Titanium	7440326	5.0	01	11.4	02	ND	56.3	5.0	02	ND	04	ND	0.0
Zinc	7440666	20.0	01	102	02	7.9	92.2	2.4	02	7.9	04	ND	69.8
Pesticides/Herbicides													
Dichloroprop	120365	1.0	01	18.9	02	NS	NS	1.0	02	NS	04	ND	NS
MCPP	7085190	50.0	01	ND	02	NS	NS	50.0	02	NS	04	ND	NS

Negative percent removal are recorded as 0.0

NS: Not Sampled

ND: Non-Detect

DL: Specific detection limits of sample when there is a non-detect, otherwise it is the method detection limit

SP: Sample Point

Table 6-4. Treatment Technology Performance for Episode 4733 (continued)

		Entire Treatment System Sample Points 1 to 4					
Pollutant of Concern	**CAS #**	**DL**	**SP**	**Influent Conc. (ug/l)**	**SP**	**Effluent Conc. (ug/l)**	**% Removal**
Conventional							
TSS	C-009	4,000	01	ND	04	ND	0.0
Non-Conventional							
COD	C-004	5,000	01	234,100	04	192,300	17.9
TDS	C-010		01	272,400	04	2,899,000	0.0
Metals							
Aluminum	7429905	13.6	01	ND	04	ND	0.0
Antimony	7440360	20.0	01	22.8	04	26.4	0.0
Arsenic	7440382	10.0	01	5.3	04	4.1	22.5
Boron	7440428	100	01	1,811	04	2,381	0.0
Cadmium	7440439	3.5	01	ND	04	ND	0.0
Chromium	7440473	5.8	01	37.1	04	ND	84.4
Copper	7440508	25.0	01	10.9	04	7.4	31.8
Iron	7439896	2.4	01	430	04	ND	99.4
Lead	7439921	2.1 /1.8	01	ND	04	ND	0.0
Manganese	7439965	15.0	01	8.8	04	1.3	85.2
Mercury	7439976	0.2	01	3.3	04	0.4	88.6
Molybdenum	7439987	4.6	01	ND	04	7.1	0.0
Selenium	7782492	5.0	01	59.1	04	56.5	4.4
Silver	7440224	7.8	01	ND	04	8.1	0.0
Strontium	7440246	100 /86.7	01	ND	04	ND	0.0
Tin	7440315	30.0	01	65.9	04	48.6	26.2
Titanium	7440326	5.0	01	11.4	04	ND	56.3
Zinc	7440666	2.4	01	102	04	ND	97.7
Pesticides/Herbicides							
Dichloroprop	120365	1.0	01	18.9	04	ND	94.7
MCPP	7085190	5.0	01	ND	04	ND	0.0

Negative percent removal are recorded as 0.0
NS: Not Sampled
ND: Non-Detect
DL: Specific detection limits of sample when there is a non-detect, otherwise it is the method detection limit
SP: Sample Point

of selenium through the first-stage primary system (25.6 percent). Poor to no removals were observed for boron and tin.

The treatment efficiency of the carbon adsorption system was evaluated using the data obtained from sampling points 02 and 04 (see Figure 6-16). Influent concentration data to the carbon adsorption system was obtained using sample point 02, which is also the effluent from the first-stage treatment system. Effluent from the carbon adsorption system was represented by sample point 04 which is also the effluent point for the entire treatment system. As demonstrated on Table 6-4, the carbon adsorption system had non-detectable levels in the influent for the same parameters as in the first-stage system, plus the metals were removed to non-detectable levels in the first-stage system, such as chromium, manganese, mercury, and titanium. Additional removals were observed for iron (96.2 percent), tin (66.4 percent), and zinc (69.8 percent). No removals in the carbon adsorption system were observed for boron and selenium. As in the first-stage system, antimony, arsenic, and copper are at concentrations in the influent below treatable levels.

The treatment efficiency of the entire treatment system, including the first-stage sulfide precipitation, Lancy filtration, and carbon adsorption, were evaluated using the data obtained from sampling points 01 and 04 (see Figure 6-16). Influent concentration data was obtained using sample point 01. Effluent from the entire treatment system was represented by sample point 04. As demonstrated on Table 6-4, the treatment system achieved a COD removal of 17.9 percent, whereas, there is no removal for TDS. For the overall treatment system, the metals with high removal rates include chromium, iron, manganese, mercury, titanium, and zinc. Poor removals were observed for selenium and tin. Other metals were only detected at concentrations at or near treatable levels. Dichlorprop was removed to non-detectable levels at 94.7 percent. MCPP was not detected in the influent or effluent from the treatment system.

6.4.2 *Rationale Used for Selection of BAT Treatment Technologies*

This section presents the rationale used in selecting the treatment technologies used in the regulatory option. Treatment technologies used at Episode # 4733 were not considered for further evaluation, since influent concentrations for many parameters were low and performance data for the treatment systems could not adequately be ascertained. Therefore, the technologies utilized at Episodes # 4646 and # 4671 were further evaluated in order to select the most appropriate technologies to be used as the basis for the BAT options. The basis of this evaluation consists of a comparative analysis of the performance data for the BAT treatment technologies based upon EPA sampling data.

Table 6-5 presents a summary of the percent removal data collected at EPA sampling Episodes # 4646 and # 4671 for the primary chemical precipitation systems. As demonstrated on this table, both chemical precipitation systems achieved similar removals for many of the same metal parameters. Although the loadings for some metal parameters were lower for Episode # 4671 which resulted in lower percent removals, the overall concentrations for some of the pollutants were treated to similar concentration levels as those for Episode # 4646. For instance, the percent removal for manganese at Episode # 4671 was only 33.8 percent, however the effluent concentration of 74.3 ug/l was comparable to that at Episode # 4646 of 76.6 ug/l during which a 66.5 percent removal was achieved. Metals which experienced good overall removals in both chemical precipitation treatment systems include aluminum, cadmium, chromium, copper, iron, lead, manganese, mercury, tin, titanium, and zinc. Neither system was effective in treating antimony, arsenic, boron, selenium, silver, and strontium. Episode # 4646 had higher removals for TSS (90.9 percent) and COD (70.9 percent).

Next, an evaluation of the secondary precipitation process plus filtration for both facilities was performed. Table 6-6 presents a summary of the percent removal data collected at EPA for sampling Episodes # 4646 and # 4671 for the secondary precipitation process and sand filter or ultrafiltration process, respectively. As demonstrated on this table, either process resulted in low effluent concentrations for many of the metal parameters such as cadmium, chromium, copper, iron, lead, mercury, and zinc. However, the most significant difference between the two systems is the removal of antimony (66.3 percent), arsenic (98.4 percent), and selenium (90.1 percent) in the secondary system for Episode # 4646. Episode # 4671, which employs a secondary treatment system consisting of hydroxide precipitation and ultrafiltration, did not achieve significant removals for antimony, arsenic, or selenium.

Overall both facilities achieved similar removals and/or treated to the same degree for many of the metal parameters which are readily removed by chemical precipitation using sodium hydroxide, including but not limited to cadmium, chromium, copper, iron, lead, mercury, and zinc. Both facilities utilized a two

Table 6-5. Primary Chemical Precipitation Treatment Technology Performance Comparison

		Episode #4646 First-Stage Chemical Precipitation Sample Points 1+2 to 4						Episode #4671 First-Stage Chemical Precipitation Sample Points 1 to 2					
Pollutant of Concern	**CAS #**	**DL**	**SP**	**Influent Conc. (ug/l)**	**SP**	**Effluent Conc. (ug/l)**	**% Removal**	**DL**	**SP**	**Influent Conc. (ug/l)**	**SP**	**Effluent Conc. (ug/l)**	**% Removal**
Conventional													
TSS	C-009	4,000	01+02	122,560	04	11,200	90.9	4,000	01	241,100	02	70,900	70.6
Non-Conventional													
COD	C-004	5,000	01+02	535,920	04	156,200	70.9	5,000	01	259,400	02	227,600	12.3
TDS	C-010		01+02	30,694,160	04	50,320,000	0.0		01	7,481,000	02	6,896,000	7.8
Metals													
Aluminum	7429905	200	01+02	1,104	04	170	84.6	200	01	1,575	02	266	83.1
Antimony	7440360	20.0	01+02	672	04	1,026	0.0	20.0	01	110	02	107	2.5
Arsenic	7440382	10.0	01+02	475	04	494	0.0	10.0	01	19.2	02	19.9	0.0
Boron	7440428	100	01+02	1,280	04	1,744	0.0	100	01	1,723	02	1,219	29.2
Cadmium	7440439	5.0	01+02	929	04	174	81.2	5.0	01	4.2	02	2.4	43.1
Chromium	7440473	10.0	01+02	220	04	53.4	75.8	10.0	01	124	02	3.2	97.4
Copper	7440508	25.0	01+02	5,228	04	321	93.9	25.0	01	121	02	33.8	72.0
Iron	7439896	100	01+02	7,066	04	254	96.4	100	01	1,217	02	79.8	93.4
Lead	7439921	50.0	01+02	4,691	04	117	97.5	50.0	01	149	02	14.3	90.4
Manganese	7439965	15.0	01+02	228	04	76.6	66.5	15.0	01	107	02	74.3	30.5
Mercury	7439976	0.2	01+02	59.2	04	21.4	63.9	0.2	01	0.7	02	0.4	33.8
Molybdenum	7439987	10.0	01+02	936	04	1,137	0.0	10.0	01	69.7	02	66.6	4.5
Selenium	7782492	5.0	01+02	240	04	263	0.0	9.7	01	ND	02	14.0	0.0
Silver	7440224	10.0	01+02	283	04	169	40.3	10.0	01	5.7	02	9.1	0.0
Strontium	7440246	100	01+02	408	04	328	19.7	100	01	1,382	02	1,582	0.0
Tin	7440315	30.0	01+02	1,882	04	45.9	97.6	30.0	01	49.5	02	39.0	21.2
Titanium	7440326	5.0	01+02	2,116	04	32.9	98.4	10.0	01	206	02	ND	95.1
Zinc	7440666	20.0	01+02	9,456	04	209	97.8	20.0	01	1,598	02	813	49.1
Pesticides/Herbicides													
Dichloroprop	120365	1.0	01+02	3.1	04	NS	NS	1.0	01	ND	02	NS	NS
MCPP	7085190	50.0	01+02	1,027	04	NS	NS	50.0	01	ND	02	NS	NS

Negative percent removal are recorded as 0.0

NS: Not Sampled

ND: Non-Detect

DL: Specific detection limits of sample when there is a non-detect, otherwise it is the method detection limit

SP: Sample Point

Table 6-6. Secondary Chemical Precipitation and Filtration Treatment Technology Performance Comparison

		Episode #4646 Second-Stage Chemical Precipitation & Sand Filtration Sample Points 4 to 6						Episode #4671 Second-Stage Chemical Precipitation & Ultrafiltration Sample Points 2 to 3					
Pollutant of Concern	CAS #	DL	SP	Influent Conc. (ug/l)	SP	Effluent Conc. (ug/l)	% Removal	DL	SP	Influent Conc. (ug/l)	SP	Effluent Conc. (ug/l)	% Removal
Conventional													
TSS	C-009	4,000	04	11,200	05	5,500	50.9	4,000	02	70,900	03	13,800	80.5
Non-Conventional													
COD	C-004	5,000	04	156,200	05	257,900	0.0	5,000	02	227,600	03	154,800	32.0
TDS	C-010		04	50,320,000	05	38,150,000	24.2		02	6,896,000	03	6,560,000	4.9
Metals													
Aluminum	7429905	200	04	170	05	160	5.9	6.5	02	266	03	ND	97.6
Antimony	7440360	20.0	04	1,026	05	346	66.3	20.0	02	107	03	94.2	12.2
Arsenic	7440382	10.0	04	494	05	8.1	98.4	10.0	02	19.9	03	25.6	0.0
Boron	7440428	100	04	1,744	05	1,731	0.7	100	02	1,219	03	1,069	12.3
Cadmium	7440439	5.0	04	174	05	19.9	88.6	5.0	02	2.4	03	0.4	83.6
Chromium	7440473	10.0	04	53.4	05	ND	81.3	10.0	02	3.2	03	1.0	67.7
Copper	7440508	25.0	04	321	05	10.1	96.9	25.0	02	33.8	03	18.8	44.4
Iron	7439896	100	04	254	05	128	49.6	100	02	79.8	03	50.1	37.1
Lead	7439921	50.0	04	117	05	ND	57.3	1.5	02	14.3	03	ND	89.5
Manganese	7439965	15.0	04	76.6	05	545	0.0	15.0	02	74.3	03	2.3	96.9
Mercury	7439976	0.2	04	21.4	05	ND	99.1	0.2	02	0.4	03	ND	54.5
Molybdenum	7439987	10.0	04	1,137	05	580	49.0	10.0	02	66.6	03	59.5	10.6
Selenium	7782492	5.0	04	263	05	26.0	90.1	11.5	02	14.0	03	ND	17.6
Silver	7440224	10.0	04	169	05	ND	94.1	10.0	02	9.1	03	2.0	77.7
Strontium	7440246	100	04	328	05	674	0.0	100	02	1,582	03	1,315	16.8
Tin	7440315	30.0	04	45.9	05	31.5	31.4	28.3	02	39.0	03	ND	27.4
Titanium	7440326	5.0	04	32.9	05	6.8	79.3	10.0	02	ND	03	ND	0.0
Zinc	7440666	20.0	04	209	05	24.2	88.4	20.0	02	813	03	239	70.7
Pesticides/Herbicides													
Dichloroprop	120365	1.0	04	NS	05	ND	NS	1.0	02	NS	03	ND	NS
MCPP	7085190	50.0	04	NS	05	1,482	NS	50.0	02	NS	03	ND	NS

Negative percent removal are recorded as 0.0

NS: Not Sampled

ND: Non-Detect

DL: Specific detection limits of sample when there is a non-detect, otherwise it is the method detection limit

SP: Sample Point

tiered approach in the design of their treatment system using some type of a chemical precipitation process to provide treatment. Primary treatment system designs are comparable at both facilities and are designed to remove similar pollutants. Both primary treatment systems are designed to remove those metals which readily precipitate out of solution at a high pH range using a sodium hydroxide precipitation treatment process. Based upon EPA sampling data, this treatment process was determined not to be very effective in treating antimony, arsenic, boron, selenium, silver, and strontium. The treatment system at Episode # 4671 uses a secondary treatment system targeted to achieve additional removals for the same parameters which receive initial removals in the primary system. Chemical precipitation by hydroxide precipitation is once again utilized with ultrafiltration as a polishing step in the secondary system. The design of this treatment system is primarily due to the characteristics of the wastewater at this facility, as well as a function of the discharge limitations in their NPDES permit. During the sampling episode, the facility for Episode # 4671 was permitted for antimony (2,000 ug/l daily maximum) and for arsenic (100 ug/l daily maximum). However, neither of these two parameters were observed in the influent at levels above their respective discharge limitation in EPA's sampling episode. Therefore, the design and operation of the treatment system at Episode # 4671 is not driven by the removals of parameters such as antimony or arsenic, but rather by other metals which are removed by hydroxide precipitation such as aluminum. Conversely, the facility for Episode # 4646 is designed to remove those metals in the secondary treatment process which are not readily removed by hydroxide precipitation. At the time of the sampling episode, this facility's NPDES permit contained discharge limitations for antimony (600 ug/l daily maximum), arsenic (100 ug/l daily maximum), selenium (100 ug/l daily maximum), and silver (100 ug/l daily maximum). Each of these parameters were observed in the influent to the treatment system at concentrations above their respective discharge limitation. Therefore, the wastewater treatment system used at Episode # 4646 is designed and operated with a secondary treatment system consisting of chemical precipitation at a low pH range facilitated by ferric chloride and multimedia filtration aimed at removing these additional metal parameters which are not removed by hydroxide precipitation in the primary treatment system.

Based upon the results of the above comparative analysis of chemical precipitation and filtration processes used at CHWC facilities sampled by EPA, the regulatory option utilizes unit treatment processes such as those found at Episode # 4646. Performance data from this facility indicates that a primary chemical precipitation system utilizing a sodium hydroxide precipitation process can readily achieve high removals for many metal parameters. A secondary system consisting of chemical precipitation using ferric chloride and sand filtration can effectively remove additional metals not readily removed by hydroxide precipitation, such as antimony, arsenic, and selenium, as well as achieve high additional removals for other metals which are removed by hydroxide precipitation. Therefore, the combining of these treatment processes results in a highly effective treatment operation which can readily accommodate the pollutants of concern for the CHWC industry.

6.4.3 *Performance at Facilities Added Post-Proposal*

Following proposal of the CHWC rule, the Agency decided to revise its effluent limitations by including the data gathered by industry at two new CHWC facilities. Both facilities conducted sampling events using analytical methods agreed upon by EPA at its five-day sampling episodes, and analyzed influent and effluent samples for regulated pollutants. Both facilities employed a two-stage chemical precipitation treatment system. Examples of treatment technologies found include hydroxide precipitation and ferric chloride precipitation, as illustrated in Table 6-7. Summaries of the treatment system performance data collected are presented below. Performance data for Episodes # 6181 and # 6183 were evaluated to determine if the effluent data could be included in the calculation of effluent limitations for the CHWC industry (See Section 8 for limitations). Flow diagrams of the CHWC wastewater treatment systems found at Episodes # 6181 and # 6183 are presented in Figure 6-17 and Figure 6-18, respectively.

6.4.3.1 Treatment Performance for Episode #6181

The wastewater treatment system used at this CHWC facility treats water from the air pollution control system. The wastewater treatment system is comprised of two separate systems: a primary system that is part of the primary water circulation loop that serves the incinerator and consists of lime/hydroxide

Table 6-7. Description of CHWC Sampling Episodes

Episode	Influent Sample Point	Effluent Sample Point	Description
6181	1	2	Overall treatment system- equalization, first-stage chemical precipitation, second-stage precipitation, neutralization
6183	1	2	Overall treatment system- equalization, first-stage chemical precipitation, pressure filtration, second-stage precipitation, sand filtration, bag filtration

Figure 6-17. EPA Sampling Episode 6181 - CHWC Wastewater Treatment System Block Flow Diagram with Sampling Locations

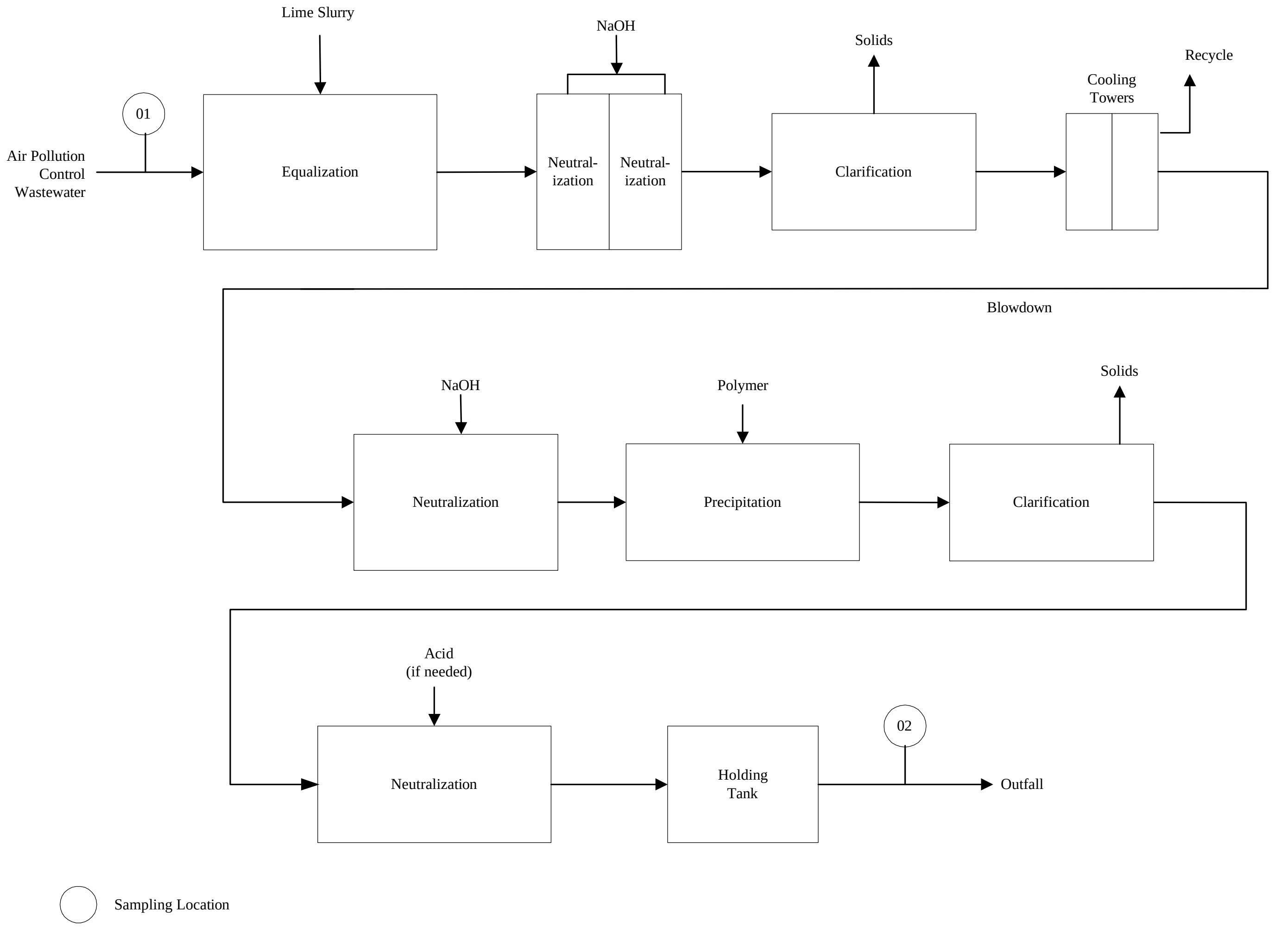
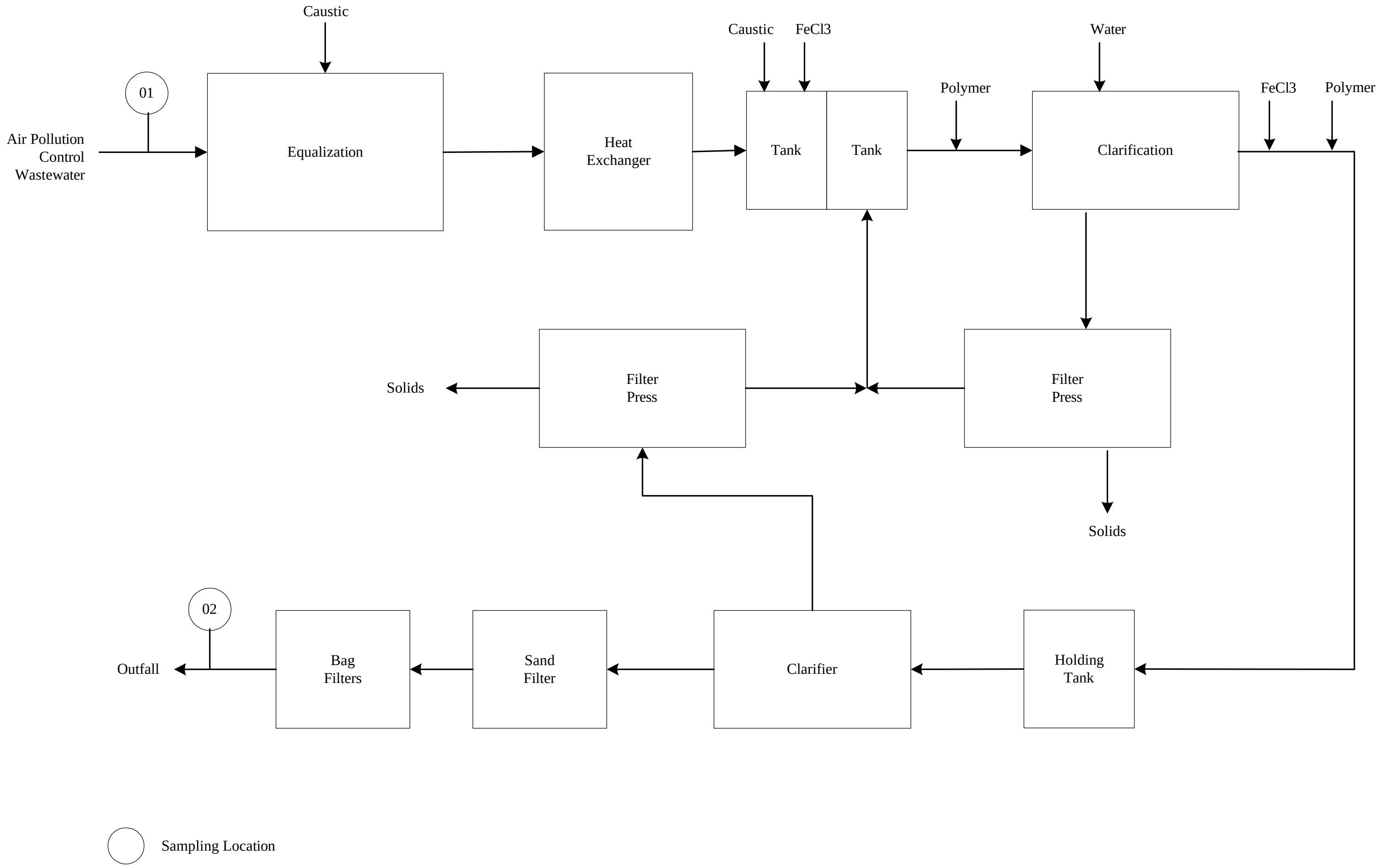


Figure 6-18. EPA Sampling Episode 6183 - CHWC Wastewater Treatment System Block Flow Diagram with Sampling Locations



precipitation treatment followed by sedimentation, and a secondary system that treats the blowdown from the primary system and is comprised of precipitation using ferric chloride followed by sedimentation. Table 6-8 presents a summary of percent removal data at Episode # 6181, measuring the treatment performance of the entire system, both the primary and secondary systems.

The treatment efficiency of the entire treatment system, both primary and secondary treatment systems, was evaluated using the data obtained from sampling points 01 and 02 (see Figure 6-17). Influent concentration data was obtained using sample point 01. Effluent from the entire treatment system was represented by sample point 02. As demonstrated on Table 6-8, the treatment system achieved good overall removals for TSS (94 percent). Many of the metals observed in the influent were removed to levels exceeding 95 percent, these include aluminum, copper, iron, lead, titanium, and zinc. Other metals also with high removals include cadmium (94.4 percent), mercury (93.4 percent), silver (63 percent), arsenic (60 percent), chromium (56.4 percent), and tin (52.3 percent). Poor removal efficiencies were observed for antimony, molybdenum, and selenium.

6.4.3.2 Treatment Performance for Episode #6183

The wastewater treatment system used at this CHWC facility treats water from the air pollution control system. The wastewater treatment system is comprised of a two-stage hydroxide and ferric chloride precipitation treatment followed by sedimentation and sand filtration. Table 6-9 presents a summary of percent removal data at Episode # 6183, measuring the treatment performance of the entire system, both the primary and secondary systems.

The treatment efficiency of the entire treatment system, both primary and secondary treatment systems, was evaluated using the data obtained from sampling points 01 and 02 (see Figure 6-18). Influent concentration data was obtained using sample point 01. Effluent from the entire treatment system was represented by sample point 02. As demonstrated on Table 6-9, the treatment system achieved fairly good overall removals for TSS (84 percent). Many of the metals observed in the influent were removed to levels at or exceeding 95 percent, these include aluminum, arsenic, cadmium, chromium, copper, iron,

Table 6-8. Treatment Technology Performance for Episode 6181

		Entire Treatment System Sample Points 1 to 2						
Pollutant of Concern	CAS #	unit	DL	SP	Influent Conc.	SP	Effluent Conc.	% Removal
Conventional								
TSS	C-009	mg/l	4	01	78.8	02	4.77	93.95
Metals								
Aluminum	7429905	ug/l	100	01	5,810	02	100	98.28
Antimony	7440360	ug/l	60	01	919	02	1,020	0.0
Arsenic	7440382	ug/l	10	01	129	02	51.6	60.00
Boron	7440428	ug/l		01		02		
Cadmium	7440439	ug/l	5	01	99.6	02	5.54	94.44
Chromium	7440473	ug/l	10	01	27.5	02	12	56.36
Copper	7440508	ug/l	10	01	522	02	12.9	97.53
Iron	7439896	ug/l	20	01	2,050	02	25.1	98.78
Lead	7439921	ug/l	10	01	1,160	02	10.6	99.09
Manganese	7439965	ug/l		01		02		
Mercury	7439976	ug/l	0.2	01	3.04	02	0.2	93.42
Molybdenum	7439987	ug/l	50	01	399	02	488	0.0
Selenium	7782492	ug/l	10	01	70.3	02	86.6	0.0
Silver	7440224	ug/l	5	01	16.2	02	6	62.96
Strontium	7440246	ug/l		01		02		
Tin	7440315	ug/l	50	01	135	02	64.4	52.30
Titanium	7440326	ug/l	10	01	204	02	10	95.10
Zinc	7440666	ug/l	20	01	2,120	02	24.3	98.85
Pesticides/Herbicides								
Dichloroprop	120365	ug/l		01		02		
MCPP	7085190	ug/l		01		02		

Negative percent removal are recorded as 0.0

NS: Not Sampled

ND: Non-Detect

DL: Specific detection limits of sample when there is a non-detect, otherwise it is the method detection limit

SP: Sample Point

Table 6-9. Treatment Technology Performance for Episode 6183

		Entire Treatment System Sample Points 1 to 2						
Pollutant of Concern	CAS #	unit	DL	SP	Influent Conc.	SP	Effluent Conc.	% Removal
Conventional								
TSS	C-009	mg/l	4	01	315	02	51.7	83.59
Metals								
Aluminum	7429905	ug/l	100	01	61,500	02	334	99.46
Antimony	7440360	ug/l	60	01	1,710	02	332	80.58
Arsenic	7440382	ug/l	10	01	1,210	02	27.8	97.70
Boron	7440428	ug/l		01		02		
Cadmium	7440439	ug/l	5	01	97.7	02	5	94.88
Chromium	7440473	ug/l	10	01	2,250	02	10	99.56
Copper	7440508	ug/l	10	01	1,970	02	10	99.49
Iron	7439896	ug/l	20	01	231,000	02	428	99.81
Lead	7439921	ug/l	10	01	1,600	02	10	99.38
Manganese	7439965	ug/l		01		02		
Mercury	7439976	ug/l	0.2	01	219	02	0.48	99.78
Molybdenum	7439987	ug/l	50	01	1,550	02	919	40.71
Selenium	7782492	ug/l	10	01	113	02	32.6	71.15
Silver	7440224	ug/l	5	01	69.8	02	5.54	92.06
Strontium	7440246	ug/l		01		02		
Tin	7440315	ug/l	50	01	1,330	02	134	89.92
Titanium	7440326	ug/l	10	01	4,030	02	10	99.75
Zinc	7440666	ug/l	20	01	8,300	02	62.8	99.24
Pesticides/Herbicides								
Dichloroprop	120365	ug/l		01		02		
MCPP	7085190	ug/l		01		02		

Negative percent removal are recorded as 0.0
NS: Not Sampled
ND: Non-Detect
DL: Specific detection limits of sample when there is a non-detect, otherwise it is the method detection limit
SP: Sample Point

lead, mercury, titanium, and zinc. All other metals analyzed had high removals: tin (89.9 percent), antimony (80.6 percent), selenium (71.2 percent), and molybdenum (40.7 percent).

6.4.3.3 Performance Comparison with Proposed BAT Facility

In order to decide whether it should include the effluent data from Episodes # 6181 and # 6183 in its calculation of the limitations and standards, the Agency compared the treatment performance at these two facilities with the treatment performance at Episode # 4646, whose performance was the basis for the proposed BAT limitations, to determine if the data generated at the two facilities was of acceptable quality for limitation calculations (see Section 8).

Table 6-10 presents a summary of the percent removal data collected at Episodes # 6181, # 6183, and # 4646 for their entire treatment systems. As the table demonstrates, all three systems achieved similarly high removals for many of the same metal parameters, especially those metals readily removed using hydroxide. All three facilities utilize a two-tiered approach in the design of their treatment systems using some type of two-stage precipitation process to achieve the high levels of removal. Each facility demonstrates high removals (above 90 percent) for pollutants that appear in high concentrations in the raw wastewater (often several mg/l).

EPA decided that it should include the effluent data from Episodes # 6181 and # 6183 into its limitations calculations because both new facilities: 1) employ a two-stage chemical precipitation wastewater treatment process similar to the proposed BAT facility, and 2) achieve comparable percent removals of relatively high concentrated raw wastewater to those achieved at the proposed BAT facility.

Table 6-10. Treatment Technology Performance Comparison

				Entire Treatment System Episode #6181 Sample Points 1 to 2					Entire Treatment System Episode #6183 Sample Points 1 to 2					Entire Treatment System Episode #4646 Sample Points 1+2 to 6				
Pollutant of Concern	**CAS #**	**unit**	**DL**	**SP**	**Inf Conc.**	**SP**	**Eff Conc.**	**% Rem**	**SP**	**Inf Conc.**	**SP**	**Eff Conc.**	**% Rem**	**SP**	**Inf Conc.**	**SP**	**Eff Conc.**	**% Rem**
Conventional																		
TSS	C-009	mg/l	4	01	78.8	02	4.77	93.95	01	315	02	51.7	83.59	01+02	122.56	06	5.5	95.5
Metals																		
Aluminum	7429905	ug/l	100	01	5,810	02	100	98.28	01	61,500	02	334	99.46	01+02	1,104	06	160	85.5
Antimony	7440360	ug/l	60	01	919	02	1,020	0.0	01	1,710	02	332	80.58	01+02	672	06	346	48.5
Arsenic	7440382	ug/l	10	01	129	02	51.6	60.00	01	1,210	02	27.8	97.70	01+02	475	06	8.1	98.3
Cadmium	7440439	ug/l	5	01	99.6	02	5.54	94.44	01	97.7	02	5	94.88	01+02	929	06	19.9	97.9
Chromium	7440473	ug/l	10	01	27.5	02	12	56.36	01	2,250	02	10	99.56	01+02	220	06	ND	95.5
Copper	7440508	ug/l	10	01	522	02	12.9	97.53	01	1,970	02	10	99.49	01+02	5,228	06	10.1	99.8
Iron	7439896	ug/l	20	01	2,050	02	25.1	98.78	01	231,000	02	428	99.81	01+02	7,066	06	128	98.2
Lead	7439921	ug/l	10	01	1,160	02	10.6	99.09	01	1,600	02	10	99.38	01+02	4,691	06	ND	99.0
Mercury	7439976	ug/l	0.2	01	3.04	02	0.2	93.42	01	219	02	0.48	99.78	01+02	59.2	06	ND	96.6
Molybdenum	7439987	ug/l	50	01	399	02	488	0.0	01	1,550	02	919	40.71	01+02	936	06	580	38.0
Selenium	7782492	ug/l	10	01	70.3	02	86.6	0.0	01	113	02	32.6	71.15	01+02	240	06	26.0	89.1
Silver	7440224	ug/l	5	01	16.2	02	6	62.96	01	69.8	02	5.54	92.06	01+02	283	06	ND	98.2
Tin	7440315	ug/l	50	01	135	02	64.4	52.30	01	1,330	02	134	89.92	01+02	1,882	06	31.5	98.3
Titanium	7440326	ug/l	10	01	204	02	10	95.10	01	4,030	02	10	99.75	01+02	2,116	06	6.8	99.7
Zinc	7440666	ug/l	20	01	2,120	02	24.3	98.85	01	8,300	02	62.8	99.24	01+02	9,456	06	24.2	99.7

Negative percent removal are recorded as 0.0
NS: Not Sampled
ND: Non-Detect
DL: Specific detection limits of sample when there is a non-detect, otherwise it is the method detection limit
SP: Sample Point

SECTION 7

ENGINEERING COSTS

This section of the Commercial Hazardous Waste Combustor (CHWC) Industry Development Document presents the following information: sources of cost data along with a benchmark analysis of models; engineering costing methodology and description of each type of additional cost to comply with options; individual treatment technology costs; and individual compliance costs for each facility in the database for each option.

This chapter contains the following sections:

- Section 7.1 presents a discussion of the various costing options that were evaluated. The criteria used to evaluate these costing options are presented, as well as a benchmark analysis to compare the accuracy of each of these options. The selected costing option is also presented in this section.
- Section 7.2 presents a discussion of the costing methodology used to develop regulatory costs. This section discusses the methodology used to cost treatment systems and components, as well as to develop regulatory option costs.
- Section 7.3 presents the costing method used to cost individual treatment technologies which comprise the regulatory options. Cost curves and equations developed for each treatment technology are presented in this section.
- Section 7.4 presents the approach to developing additional regulatory costs associated with the implementation of the CHWC regulation. Additional costs which were developed include retrofit, monitoring, RCRA permit modification, and land costs.
- Section 7.5 presents the wastewater off-site disposal costs used for facilities with very low flow rates of CHWC wastewater.

- Section 7.6 presents summary tables of the total compliance costs, by facility, for each of the CHWC Industry regulatory options, including BPT/BCT/BAT and PSES. Also presented in this section are the compliance costs for NSPS and PSNS.

7.1 COSTS DEVELOPMENT

This section presents a discussion of the various costing options which were evaluated in order to calculate compliance costs for the CHWC Industry. A discussion of the selection criteria used to evaluate these costing options are presented in this section, as well as a benchmark analysis to compare the accuracy of each of these options. The selected costing option is then presented.

7.1.1 *Sources of Cost Data*

The following sections present the various costing sources considered in developing regulatory costs for the CHWC Industry, including computer models, vendor quotes, the 1992 Waste Treatment Industry Phase II: Incinerators 308 Questionnaire, and other effluent guidelines.

7.1.1.1 Cost Models

Cost estimates of wastewater treatment systems are required to be developed in order to evaluate the economic impact of the regulation. Mathematical cost models were used to assist in developing estimated costs. In a mathematical cost model, various design and vendor data are combined to develop cost equations which describe costs as a function of system parameters, such as flow. Using such models readily allows for iterative costing to be performed to assist in option selection.

For developing costs for the CHWC Industry regulation, two commonly used cost models were evaluated:

- Computer-Assisted Procedure for the Design and Evaluation of Wastewater Treatment Systems (CAPDET), developed by the U.S. Army Corps of Engineers.
- W/W Costs Program (WWC), Version 2.0, developed by CWC Engineering Software.

CAPDET is intended to provide planning level cost estimates to analyze alternate design technologies for wastewater treatment systems. It was developed to estimate treatment system costs primarily for high flow, municipal wastewater applications. Modules are used which represent physical, chemical, and biological treatment unit processes. Equations in each of these modules are based upon engineering principles historically used for wastewater treatment plant design. Modules can be linked together to represent entire treatment trains. CAPDET designs and costs various treatment trains and ranks them with respect to present worth, capital, operating, or energy costs.

WWC is a cost model developed by Culp/Wesner/Culp from a variety of engineering sources, including vendor supplied data, reported plant construction data, unit takeoffs from empirical and conceptual designs, and published data. The program allows for the costing of various unit processes. As with CAPDET, this program allows for these unit processes to be strung together to develop cost for treatment trains. WWC does not perform the design of the unit process, but rather prompts the user to provide design input parameters which form the basis for the costing. The WWC program is provided with a separate spreadsheet program entitled Design Criteria Guidelines to assist in developing the input parameters to the costing program. The Design Criteria Guidelines is a spreadsheet of treatment component design equations which is supplied using default parameters to assist in designing particular treatment units. Default parameters are based upon commonly accepted design criteria used in wastewater treatment. Flexibility is provided with this spreadsheet, in that particular design parameters can be modified to best satisfy given situations. Once design inputs are entered into the program, the WWC costing program yields both construction and operation and maintenance (O&M) costs for the system.

7.1.1.2 Vendor Data

For certain treatment processes, the cost models do not yield acceptable and valid treatment costs. In these instances, it was more reliable to obtain equipment and maintenance costs directly from treatment system or component manufacturers. Information on the wastewater characteristics was provided to the vendor in order to determine accurately the appropriate treatment unit and sizing. Vendor quotes were used to determine cost curves for sand filtration and for sludge dewatering using plate and frame technology. The cost curves used are based on the vendor quotes and information obtained as part of the Centralize Waste Treatment (CWT) effluent guidelines effort.

7.1.1.3 1992 Waste Treatment Industry Phase II: Incinerators 308 Questionnaire Costing Data

The 1992 Waste Treatment Industry Phase II: Incinerators 308 Questionnaire costing data was only utilized in the benchmark analysis to compare the accuracy of the costing models and is discussed further in Section 7.1.2.

7.1.1.4 Other EPA Effluent Guideline Studies

Other EPA effluent studies, such as the Organic Chemicals and Plastics and Synthetic Fibers (OCPSF) industry effluent guidelines, were reviewed in order to obtain additional costing background and supportive information. However, costs developed as part of other industrial effluent guidelines were not used in costing for this industry, with the exception of the CWT effluent guideline data referenced in Section 7.1.1.2 above.

7.1.2 *Benchmark Analysis and Evaluation Criteria*

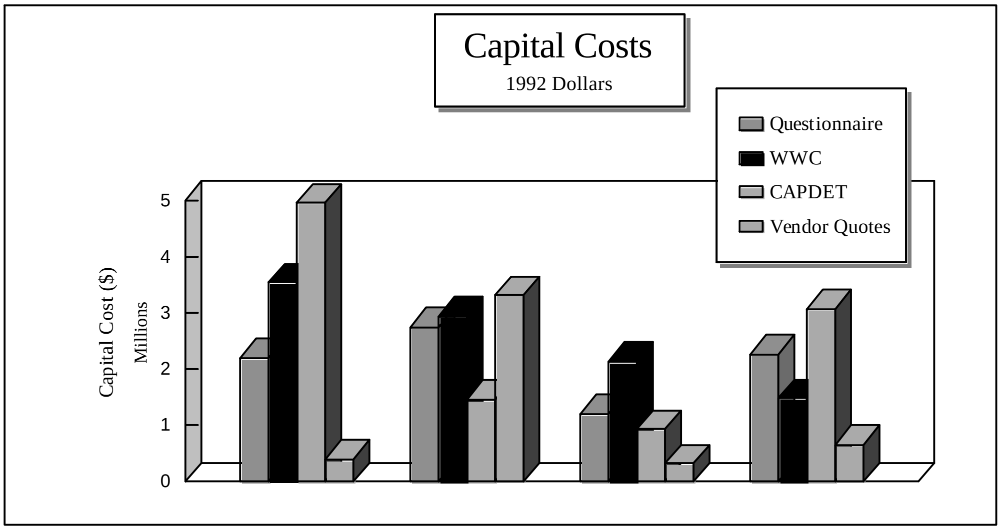
A benchmark analysis was performed to gauge the accuracy of the costing models presented above. This benchmark analysis used reported costs provided in the Incinerator 308 Questionnaires as compared to costs generated using various costing options. Two facilities (Episodes # 4646 and 4671) were selected to be used in the benchmark analysis. The facilities had installed treatment systems similar to the BPT/BCT/BAT/PSES options. Treatment technologies which were used in the benchmark analysis include:

- equalization
- chemical precipitation
- sedimentation
- sand filtration

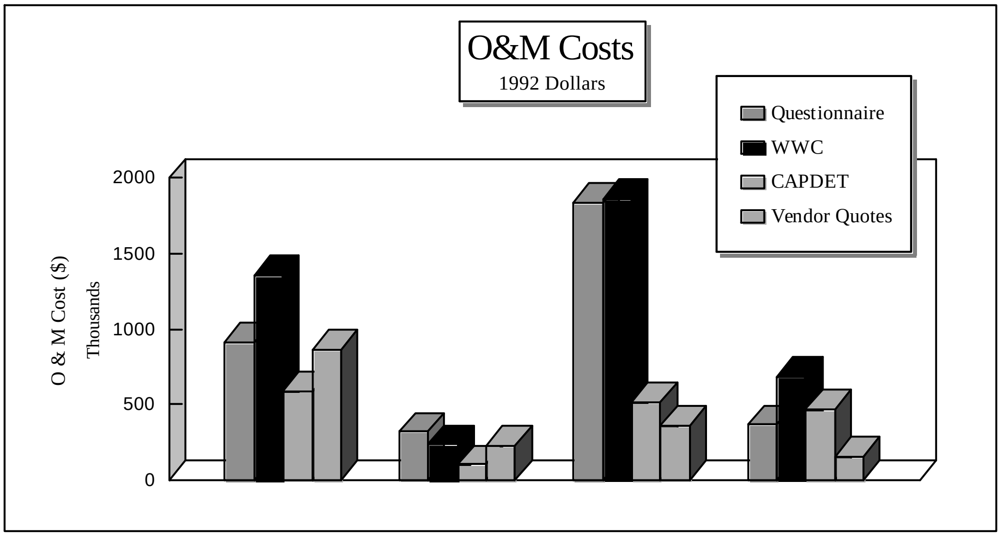
Table 7-1 presents a cost comparison of capital and O&M costs for the above technologies. Costs were developed using the average design flow of the selected facilities and average pollutant loadings (see Section 4). This table presents costs developed using the WWC program, CAPDET, and vendor quotes, as compared to industry provided treatment system capital and O&M costs provided in the Incinerator 308 Questionnaires for the facilities.

Capital costs provided in the Incinerator 308 Questionnaire for chemical precipitation systems installed at facilities 4646 and 4671 were $2,207,000 and $1,215,000, respectively. Questionnaire capital cost for the second-stage chemical precipitation system and filtration process at facility 4646 was $2,751,000, whereas, the capital cost for the second-stage chemical precipitation at facility 4671 was $2,265,000. As demonstrated on Table 7-1, capital costs developed by the WWC program for the various treatment technologies were typically close to the reported costs as provided in the questionnaire. For the WWC program, the range of accuracy in predicting treatment component capital costs ranged from plus 76.6 percent for the chemical precipitation system for facility 4671 to a minus 34.8 percent for the second-stage chemical precipitation system also for facility 4671. The range of accuracy for the CAPDET program capital costs was greater than that of the WWC program and ranged from a positive 110.6 percent for the chemical precipitation system for facility 4646 to a minus 46.6 percent for the

Table 7-1. Costing Source Comparison



	4646 ChemPrecip	4646 2-stage ChemPrecip and Sand Filtration	4671 ChemPrecip	4671 2-stage ChemPrecip
Questionnaire	2,206,980	2,751,204	1,214,563	2,265,009
WWC	3,543,264	2,950,035	2,144,446	1,476,821
CAPDET	4,948,779	1,475,480	942,216	3,072,253
Vendor Quotes	399,878	3,314,930	319,206	670,158



	4646 ChemPrecip	4646 2-stage ChemPrecip and Sand Filtration	4671 ChemPrecip	4671 2-stage ChemPrecip
Questionnaire	910,000	315,000	1,837,000	363,000
WWC	1,355,505	231,728	1,864,219	686,360
CAPDET	585,855	99,036	515,859	466,848
Vendor Quotes	860,867	222,135	361,623	151,889

second-stage chemical precipitation and filtration system at the same facility. Vendor quotes consistently had a large variability from reported questionnaire costs and were typically much lower.

O&M costs provided in the Incinerator 308 Questionnaire for chemical precipitation systems installed at facilities 4646 and 4671 were $910,000 and $1,837,000, respectively. Questionnaire O&M costs for the second-stage chemical precipitation system and filtration process at facility 4646 was $315,000, whereas, the O&M cost for the second-stage chemical precipitation at facility 4671 was $363,000. As demonstrated on Table 7-1, O&M costs developed by the WWC program for the various treatment technologies were typically close to the reported costs as provided in the questionnaire. For the WWC program, the range of accuracy in predicting treatment component O&M costs ranged from plus 89.1 percent for the second-stage chemical precipitation system for facility 4671 to a minus 26.4 percent for the second-stage chemical precipitation and filtration system for facility 4646. The ranges of accuracy for the CAPDET program and vendor quotes in predicting O&M costs were typically greater than the WWC program costs or were significantly lower than questionnaire provided costs.

Therefore, the benchmark analysis demonstrated that the WWC cost program consistently developed capital and O&M costs which are considered acceptable estimates of the reported costs from the questionnaire responses. Whereas, both CAPDET and vendor quotes were determined not to be as accurate or consistent in estimating capital and O&M costs for these technologies.

The following criteria was used in order to evaluate the costing options and to select the appropriate option for developing the CHWC Industry costing methodology:

- Does the model contain costing modules representative of the various wastewater technologies in use or planned for use in the CHWC Industry?
- Can the program produce costs in the expected flow range experienced in this industry?
- Can the model be adapted to cost entire treatment trains used in the CHWC Industry?
- Is sufficient documentation available regarding the assumptions and sources of data so that costs are credible and defensible?

- Is the model capable of providing detailed capital and operation and maintenance costs with unit costing breakdowns?
- Is the program capable of altering the default design criteria in order to accurately represent actual design criteria indicative of the CHWC Industry?

7.1.3 *Selection of Final Cost Models*

Based upon the results of the benchmark analysis and an evaluation using the criteria above, the WWC costing program was selected for costing the majority of the treatment technologies. It was determined that the WWC produces reliable capital and O&M costs for a wide range of treatment technologies. As demonstrated on Table 7-1, WWC program costs were consistently accurate in predicating both capital and O&M costs for those wastewater treatment systems at the selected facilities. Capital costs predicted by CAPDET for these various treatment systems were typically less consistent and were either much higher or lower than Questionnaire provided costs. O&M costs developed with CAPDET were typically low compared to Questionnaire costs. In addition, CAPDET could not cost all of the technologies needed for the CHWC Industry and was determined not to be as accurate in predicting costs in the low flow range that characterize the CHWC Industry. Vendor quotes for both capital and O&M costs in general were much lower than Questionnaire costs. Therefore, CAPDET and vendor quotes (except as provided for below) were not used for costing.

The WWC computer-based costing program best satisfied the selection criteria presented above. The program cost a wide range of typical and innovative treatment unit operations and combined these unit operations to develop system costs. Since the WWC program is a computer based program, it readily allowed for the repeated development of costs for a number of facilities. The program utilizes cost modules which accommodated the range of flows and design input parameters needed to cost the CHWC Industry. Costs developed by this program are based upon a number of sources, including reported construction and operation costs, as well as published data. Costs are presented in a breakdown summary table which contains unit costs and totals. Finally, the WWC program is adaptable to costing unit operations based upon specified design criteria, as well as flow rate. Certain unit operations are costed strictly based upon the input of flow rate, whereas other unit operations are costed based upon a combination of flow rate and design loadings or component size. The Design Criteria Guidelines spreadsheet is used in conjunction with the program to aid in determining particular treatment component design input parameters. This spreadsheet is based upon design default values, which can readily be modified in order to develop costs based upon particular design parameters common in the CHWC Industry.

However, there were particular instances where the WWC program did not produce reliable cost information, such as for sand filtration and sludge dewatering facilities. WWC program costs for these technologies were excessively high as compared to industry provided costs in the Questionnaire. For these technologies, vendor quotes were more accurate in predicating costs and, therefore, were used to provide costs.

7.2 ENGINEERING COSTING METHODOLOGY

This section presents the costing methodology used to develop treatment technology and BPT/BCT/BAT and PSES option costs for the CHWC Industry. Additional costs to comply with this regulation, such as monitoring costs, are presented in Section 7.4 of this chapter.

7.2.1 *Treatment Costing Methodology*

The following discussion presents a detailed summary of the technical approach used to estimate treatment technology costs for each in-scope facility in the CHWC database. For each facility in the database and for each option, EPA developed total capital and annual O & M treatment costs to upgrade existing wastewater treatment systems, or to install new treatment technologies, in order to comply with the long term averages (LTAs). Facilities were costed primarily using the WWC costing program. Vendor cost curves, as developed in the CWT industry study, were used for sand filtration and sludge dewatering costing. Table 7-2 presents a breakdown of the costing method used for each treatment technology.

Table 7-2. Breakdown of Costing Method by Treatment Technology

Treatment Technology	Cost Using WWC Program	Cost Using Vendor Quotes[1]	Key Design Parameter(s)
Flocculation, Mixing & Pumping	X		Flow rate
Chemical Feed System	X		Flow rate & POC Metals
Primary & Secondary Clarification	X		Flow rate
Sand Filtration		X	Flow rate
Sludge Filter Press		X	Flow rate

(1) Cost curves developed using vendor quotes in the CWT guideline effort.

In using the WWC computer model to develop treatment technology costs, the first step was to use the Design Criteria Guidelines spreadsheet to develop input parameters for the computer costing program. Reported pollutant loadings from the facility were used whenever possible. If pollutant loadings were not available for a particular parameter, EPA used an estimated concentration developed based on combined waste stream loadings or loadings from similar facilities. The facility's baseline flow rate and the regulatory option LTAs were also used in the design of the unit operation. Certain key design parameters, such as total suspended solids (TSS), are used directly in the WWC program, and accompanying Design Criteria Guidelines spreadsheet, to design the various treatment unit operations, such as a clarifier. Selected pollutant of concern (POC) metals were used to assist in the design of BPT/BCT/BAT chemical precipitation systems. These metals typically impose a large requirement for the various precipitating agents, thereby governing the chemical feed system design. A more detailed discussion of individual treatment technology costing and their design parameters is presented in Section 7.3. The design parameters from the Design Criteria Guidelines spreadsheet were next used as input for the WWC costing program to develop the installed capital and O&M costs.

Individual treatment component costs were developed by the WWC program by using the corresponding module provided by the program for that particular technology. Technology-specific design parameters were input into the WWC program. The WWC program then calculated both installed capital costs and annual O&M costs. Treatment technology costs developed by the WWC costing program were corrected to 1992 costs using the Engineering News Record (ENR) published indexes. After the installed capital and annual O&M costs were developed for each facility, selected cost factors, as shown in Table 7-3, were applied to the results to develop total capital and O&M costs. Capital costs developed by the program include the cost of the treatment unit and some ancillary equipment associated with that technology (see Section 7.3 for further information on particular items costed for each technology). O&M costs for treatment chemicals, labor, materials, electricity, and fuel are included in the computer program O&M costs.

Table 7-3. Additional Cost Factors

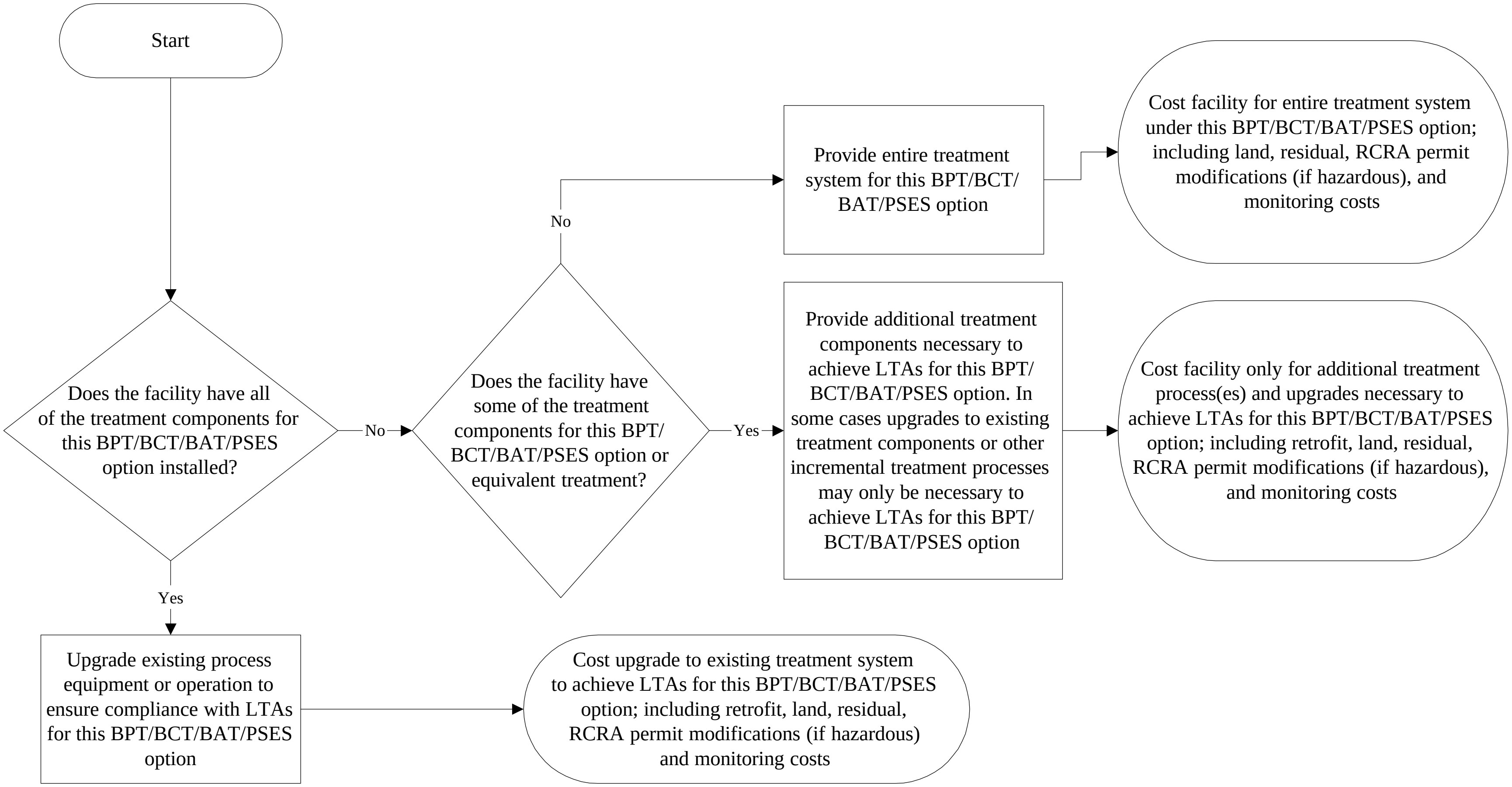
Type	Factor	% of Capital Cost
Capital	Site Work & Interface Piping	18
	General Contractor Overhead	10
	Engineering	12
	Instrumentation & Controls	13
	Buildings	6
	Site Improvements	10
	Legal, Fiscal, & Administrative	2
	Interest During Construction	9
	Contingency	8
	Retrofit (if necessary)	20
O&M	Taxes & Insurance	2[1]

(1) 2 percent of total capital costs, which includes WWC computer costs and capital costs listed above.

7.2.2 *Option Costing Methodology*

The following discussion presents a detailed summary of the technical approach used to estimate the BPT/BCT/BAT and PSES option costs for each in-scope facility in the CHWC database. Zero discharge facilities were not costed for any of the regulatory options. The costing methodology used to develop facility-specific BPT/BCT/BAT and PSES option compliance costs is presented graphically on the flow diagram in Figure 7-1.

Figure 7-1. Option-Specific Costing Logic Flow Diagram



For each BPT/BCT/BAT and PSES regulatory option, it was first determined whether a facility was complying with the LTAs for each pollutant considered for regulation. None of the facilities were in compliance with the LTAs, and were therefore assigned additional equipment and/or upgrade costs to achieve compliance with that option. The next step was to determine whether a facility had already installed treatment unit operations capable of complying with the LTAs. If a facility already had BPT/BCT/BAT, PSES or equivalent treatment installed, the facility was only assigned costs for treatment system upgrades.

For facilities that did not have BPT/BCT/BAT or PSES treatment systems or equivalent, costs were developed for the additional unit operations and/or system upgrades necessary to meet each LTA. Facilities which were already close to compliance with the LTAs were costed for upgrades in order to achieve BPT/BCT/BAT levels. Upgrade costs were developed using the WWC costing program whenever possible, and included either additional equipment to be installed on existing unit processes, expansion of existing equipment, or operational changes. Examples of upgrade costs include such items as a new or expanded chemical feed system, or improved or expanded sedimentation capabilities. If a facility had no treatment system, or one that could not achieve desired levels with upgrades or minor additions, an entire BPT/BCT/BAT treatment system was costed for that facility.

Once all of the individual treatment technology requirements for each facility were established, individual capital and O&M treatment technology costs were developed as previously described above in Section 7.2.1. In order to estimate the total compliance cost for a regulatory option it is necessary to sum all of the individual component treatment technology costs. Table 7-4 presents the regulatory option in the CHWC Industry and the corresponding treatment technologies costed.

Table 7-4. Regulatory Option Wastewater Treatment Technology Breakdown

BPT/BCT/BAT/PSES Option Description	Treatment Code Components	WWC #
Two-Stage Chemical Precipitation, Sand Filtration & Sludge Dewatering	Pumping	92
	Rapid Mix Tank	104
	Sodium Bisulfite Feed System	42
	Flocculation	72

BPT/BCT/BAT/PSES Option Description	Treatment Code Components	WWC #
Two-Stage Chemical Precipitation, Sand Filtration & Sludge Dewatering (cont.)	Sodium Hydroxide Feed System	45
	Primary Clarification	118
	Pumping	92
	Rapid Mix Tank	104
	Hydrochloric Acid Feed System	46
	Flocculation	72
	Ferric Chloride Feed System	40
	Polymer Feed	43
	Rapid Mix Tank	104
	Sodium Hydroxide Feed System	45
	Secondary Clarification	118
	Sand Filter	NA
	Sludge Dewatering	NA

NA = Technology costed using vendor cost curves from CWT study.

7.3 TREATMENT TECHNOLOGIES COSTING

The following sections describe how costs were developed for the BPT/BCT/BAT/PSES treatment technologies. Specific assumptions are discussed for each treatment technology regarding the equipment used, flow ranges, input and design parameters, and design and cost calculations. Table 7-2, previously referenced, presented the selected costing method which was used to cost each of the treatment technologies used in the BPT/BCT/BAT and PSES options. The following subsections present a detailed discussion on how each of the treatment technologies presented in Table 7-3 were costed. Costs are presented as physical/chemical wastewater treatment costs, and sludge treatment and disposal costs.

7.3.1 *Physical/Chemical Wastewater Treatment Technology Costs*

Table 7-4 presents a breakdown of the WWC treatment modules used in costing each treatment technology for the regulatory option. The following sections present a description of costs for each physical/chemical wastewater treatment technology used in the regulation. Capital and O&M cost curves were developed for specific technologies and system components. These curves, which represent cost as a function of flow rate or other system design parameters, were developed using a commercial statistical software package (SlideWrite Plus Version 2.1). First, costs were developed using the WWC program for each technology or component using as a design basis five different flow rates or other system design parameters (depending upon the governing design parameter). For instance, a technology costed on the basis of flow would have costs developed by the WWC program at 0.01 million gallons per day (MGD), 0.05 MGD, 0.1 MGD, 0.5 MGD, and 1.0 MGD. Ranges for the five selected points to cost were based upon a review of the flow or technology design parameters for all facilities in the database and were selected in order to bracket the range from low to high. Next, these five data points (flow/design parameter and associated cost) were entered into the commercial statistical software program . Cost curves to model the total capital and O&M costs were then developed by the program using curve fitting routines. A second order natural log equation format was used to develop all curves. All cost curves yielded total capital and O&M costs, unless otherwise noted.

7.3.1.1 Chemical Feed Systems

The following section presents the methodology used to calculate the chemical addition feed rates used with each applicable regulatory option. Table 7-5 presents a breakdown of the design process used for each type of chemical feed. Chemical costs presented in Table 7-6 were taken from the September 1992 Chemical Marketing Reporter.

For facilities with existing chemical precipitation systems, an evaluation was made as to whether the system was achieving the regulatory option LTAs. If the existing system was achieving LTAs, no additional chemical costs were necessary. However, if the facility was not achieving the LTAs for an option, the facility was costed for an upgrade to the chemical precipitation system. First, the stoichiometric requirements were determined for each metal to be removed to the LTA level. If the current feed rates were within the calculated feed rates no additional costs were calculated. For facilities currently feeding less than the calculated amounts, the particular facility was costed for an upgrade to add additional precipitation chemicals, such as a coagulant, or expand their existing chemical feed system to accommodate larger dosage rates.

Table 7-5. Chemical Addition Design Method

Chemical	Basis for Design	
	Stoichiometry	Reference[1] (mg/l)
Hydrochloric Acid	X	
Sodium Hydroxide	X	
Polymer		2.0
Sodium Bisulfate	X	
Ferric Chloride		75

(1) Source: Industrial Water Pollution Control, 2nd Edition.

Table 7-6. Treatment Chemical Costs

Treatment Chemical	Cost[1]
Ferric Chloride	\$200/ton
Hydrochloric Acid	\$72/ton
Polymer	\$2.25/lb
Sodium Bisulfate	\$230/ton
Sodium Hydroxide	\$350/ton

(1) Source: 1992 Chemical Marketing Reporter.

Facilities without an installed chemical precipitation system were costed for an entire metals precipitation system. The chemical feed rates used at a particular facility for either an upgrade or a new system were based upon stoichiometric requirements, pH adjustments, and buffering ability of the raw influent.

In developing the CWT industry guideline, EPA's analysis led the agency to conclude that the stoichiometric requirements for chemical addition far outweighed the pH and buffer requirements. It was determined that 150 percent of the stoichiometric requirement would sufficiently accommodate for pH adjustment and buffering of the solution. An additional 50 percent of the stoichiometric requirement was included to react with metals not on the POC list. Finally, an additional 10 percent was added as excess. Therefore, a total of 210 percent of the stoichiometric requirement was used in developing costs.

<u>Sodium Hydroxide Feed Systems</u>

The stoichiometric requirement for sodium hydroxide to remove a particular metal is based upon the generic equation:

$$lb_{treatment\ chemical} = \left(\frac{lb_{M\ removed}}{year}\right)\left(\frac{valence_{M}}{MW_{M}}\right)\left(\frac{MW_{treatment\ chemical}}{valence_{Na/Ca}}\right)$$

where, M is the target metal and MW is the molecular weight.

The calculated amounts of sodium hydroxide to remove a pound of each of the selected metal pollutants of concern are presented in Table 7-7. For indirect dischargers, only those metals which were determined to pass through a POTW were used in determining the stoichiometric requirements. The other metals present in the wastewater will be accommodated for by the additional 110 percent of the stoichiometric requirement. Sodium hydroxide chemical feed system costs were developed for many facilities using the WWC costing program. Reported facility loadings were used to establish the sodium hydroxide dosage requirement. WWC unit process 45 was used to develop capital and O&M costs for sodium hydroxide feed systems. The capital and O&M cost curves developed for sodium hydroxide feed systems, based upon the calculated dosages, are presented as Equations 7-1 and 7-2, respectively.

Table 7-7. Sodium Hydroxide Requirements for Chemical Precipitation

Pollutant	Dosage Rate Sodium Hydroxide (lb/lb metal removed)
Aluminum	4.45
Antimony	1.64
Arsenic	2.67
Boron	11.10
Cadmium	0.71
Chromium	2.31
Copper	1.26
Iron	2.15
Lead	0.77
Manganese	2.91
Mercury	0.40
Molybdenum	2.50
Selenium	2.03
Silver	0.74
Tin	1.35
Titanium	3.34

$$\ln(Y) = 10.653 - 0.184\ln(X) + 0.040\ln(X)^2 \qquad (7\text{-}1)$$

$$\ln(Y) = 8.508 - 0.0464\ln(X) + 0.014\ln(X)^2 \qquad (7\text{-}2)$$

where:

X = Dosage Rate (lb/day), and

Y = Cost (1992 $)

Figures 7-2 and 7-3 graphically present the sodium hydroxide feed system capital and O&M cost curves, respectively.

Costs for a sodium hydroxide feed system are estimated using the WWC unit process cost number 45. Costs are based on sodium hydroxide dosage rates between 10-10,000 lb/day, with dry sodium

Figure 7-2

Sodium Hydroxide Capital Cost Curve

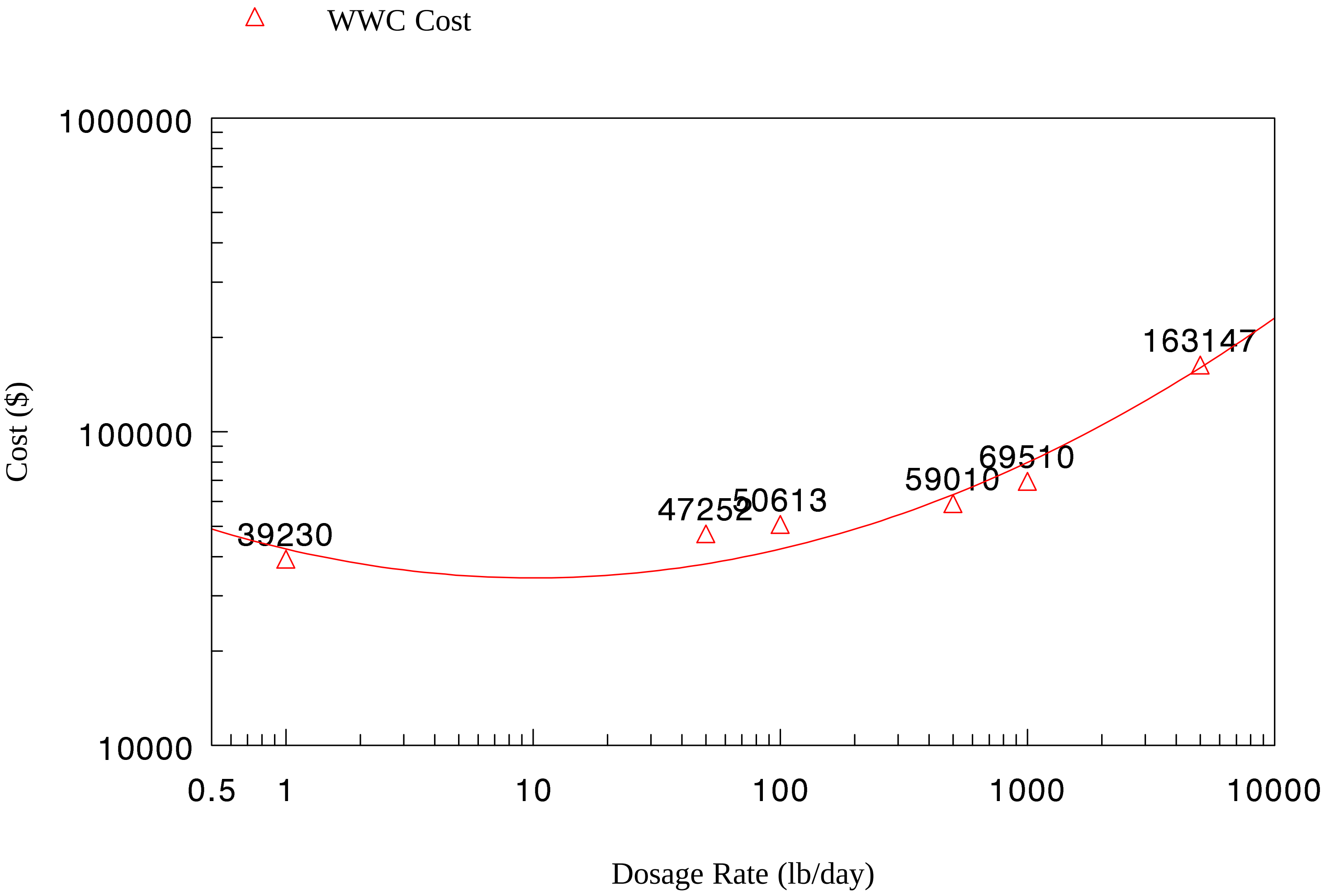
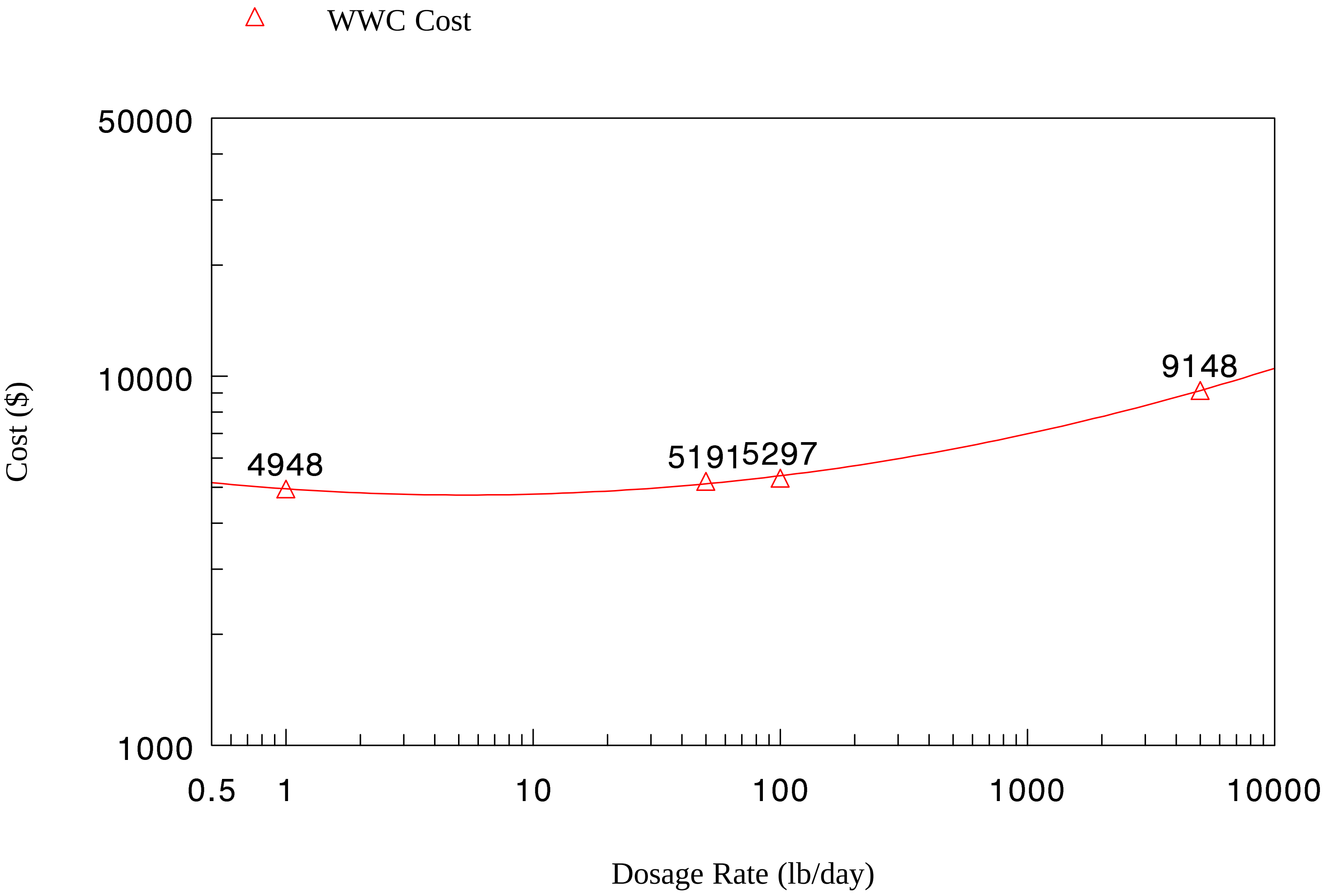


Figure 7-3
Sodium Hydroxide O&M Cost Curve



hydroxide used at rates less than 200 lb/day, and liquid sodium hydroxide used at higher feed rates. The costing program assumes that dry sodium hydroxide (98.9 percent pure) is delivered in drums and mixed to a 10 percent solution on-site. A volumetric feeder is used to feed sodium hydroxide to one of two tanks; one for mixing the 10 percent solution, and one for feeding. Two tanks are necessary for this process because of the slow rate of sodium hydroxide addition due to the high heat of solution. Each tank is equipped with a mixer and a dual-head metering pump, used to convey the 10 percent solution to the point of application. Pipe and valving is required to convey water to the dry sodium hydroxide mixing tanks and between the metering pumps and the point of application.

A 50 percent sodium hydroxide solution is purchased, premixed and delivered by bulk transport for feed rates greater than 200 lb/day. The 50 percent solution contains 6.38 pounds of sodium hydroxide per gallon, which is stored in fiberglass reinforced polyester tanks designed to a hold 15 day capacity. Dual-head metering pumps are used to convey the liquid solution to the point of application, and a standby metering pump is provided in all systems. The storage tanks are located indoors, since 50 percent sodium hydroxide begins to crystallize at temperatures less than 54EF.

Ferric Chloride Feed Systems

Ferric chloride feed systems were costed using the WWC unit process 40. Costs were based upon a dosage rate of 75 mg/l of ferric chloride. The capital and O&M cost curves developed for ferric chloride feed systems are based upon the calculated dosage and are presented as Equations 7-3 and 7-4, respectively.

$$\ln(Y) = 11.199 - 0.136\ln(X) + 0.054\ln(X)^2 \tag{7-3}$$

$$\ln(Y) = 8.808 - 0.408\ln(X) + 0.074\ln(X)^2 \tag{7-4}$$

where:

X = Dosage Rate (lb/hr), and

Y = Cost (1992 $)

Figures 7-4 and 7-5 graphically present the ferric chloride feed system capital and O&M cost curves, respectively. Costs for ferric chloride feed facilities are based on storage and feeding a 43 percent solution of ferric chloride with a weight of 12 pounds per gallon (5.2 lbs dry ferric chloride/gallon). The solution is stored in covered fiberglass reinforced polyester tanks designed to hold a 15 day supply. Cost estimates include dual-head metering pumps (one standby) with materials suitable for ferric chloride and 150 feet of stainless steel pipe and associated valves. Automatic or feed back controls are excluded.

Sodium Bisulfite Feed Systems

Sodium bisulfite feed systems were costed using the WWC unit process 42. Costs were based upon a stoichiometric requirement of 2.81 mg/l of sodium bisulfite per 1 mg/l of total chromium. The capital and O&M cost curves developed for sodium bisulfite feed systems are based upon the calculated dosage and are presented as Equations 7-5 and 7-6, respectively.

$$\ln(Y) = 10.822452 - 0.010997\ln(X) + 0.038691\ln(X)^2 \qquad (7\text{-}5)$$

$$\ln(Y) = 8.418772 + 0.51824\ln(X) + 0.039838\ln(X)^2 \qquad (7\text{-}6)$$

where:

X = Dosage Rate (lb/hr), and

Y = Cost (1992 $)

Figures 7-6 and 7-7 graphically present the sodium bisulfite feed system capital and O&M cost curves, respectively.

A five minute detention period is provided in the dissolving tank. Fifteen days of storage is included using mild steel storage hoppers which are located indoors. Sodium bisulfite is conveyed pneumatically from bulk delivery trucks to the hoppers, with the blower located on the delivery truck. Hopper costs include dust collectors. Bag loaders are used on the feeder in systems too small for bulk systems. Volumetric feeders are used for all installations. Solution tanks are located directly beneath the storage

Figure 7-4

Ferric Chloride Capital Cost Curve

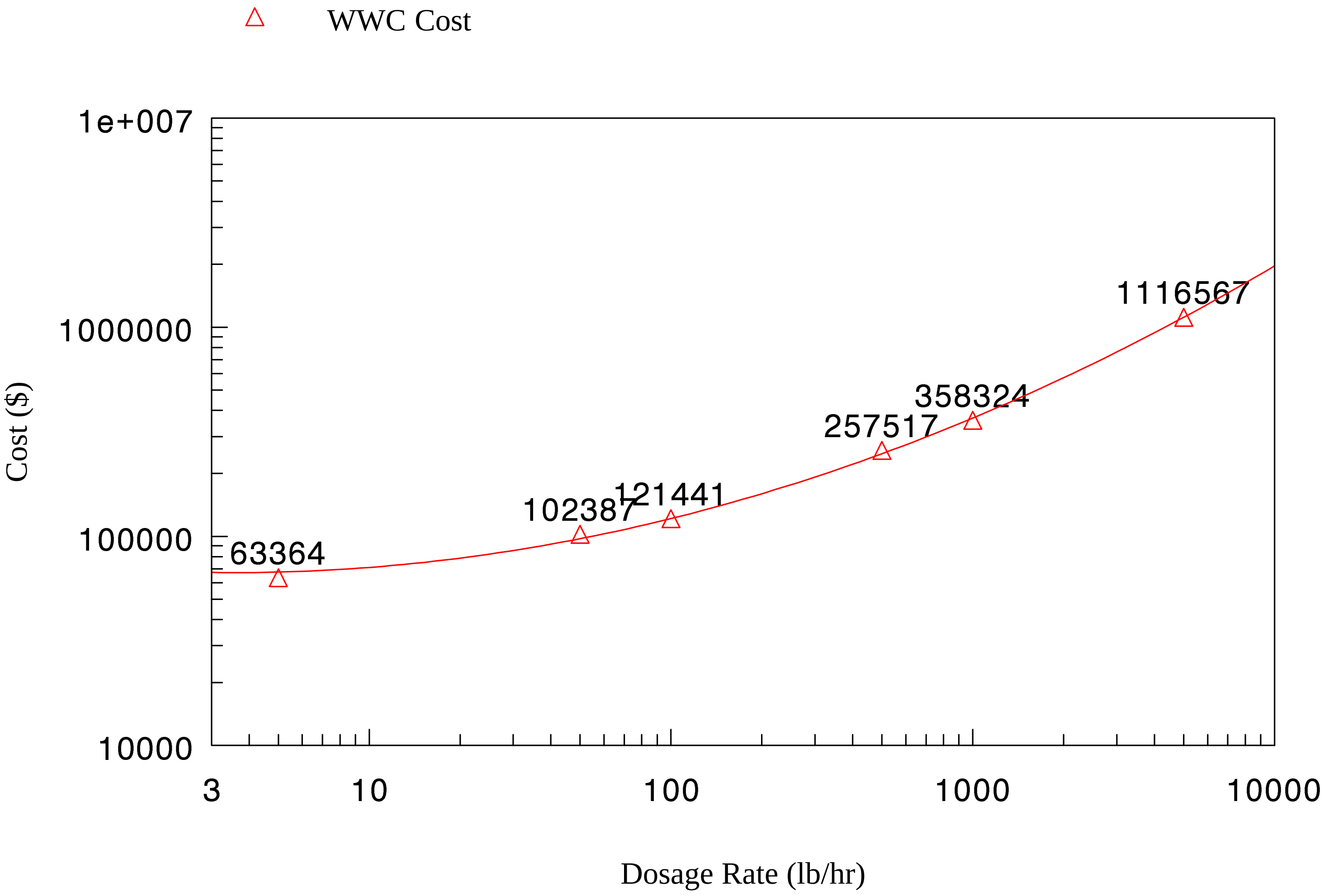


Figure 7-5
Ferric Chloride O&M Cost Curve

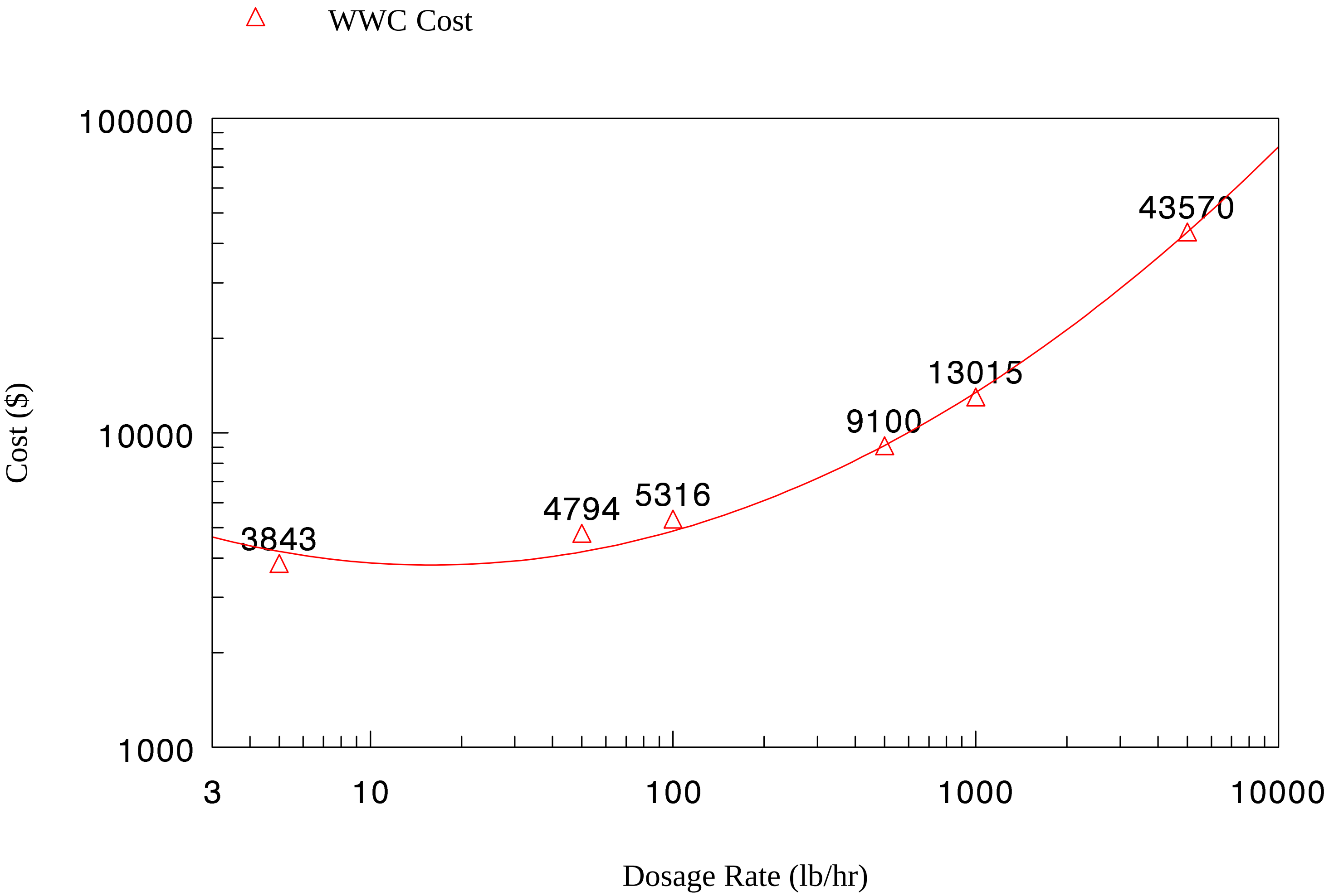


Figure 7-6

Sodium Bisulfite Capital Cost Curve

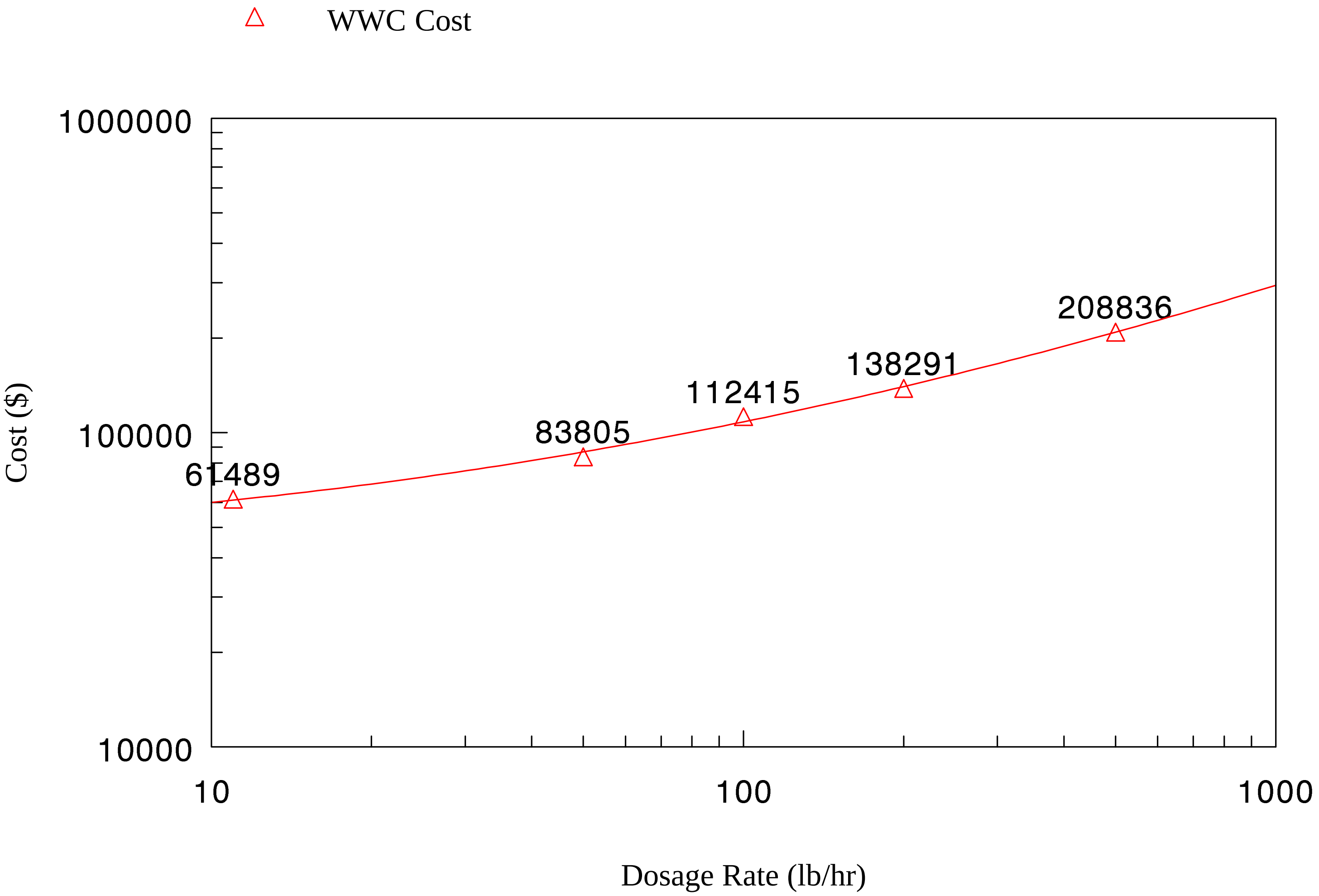
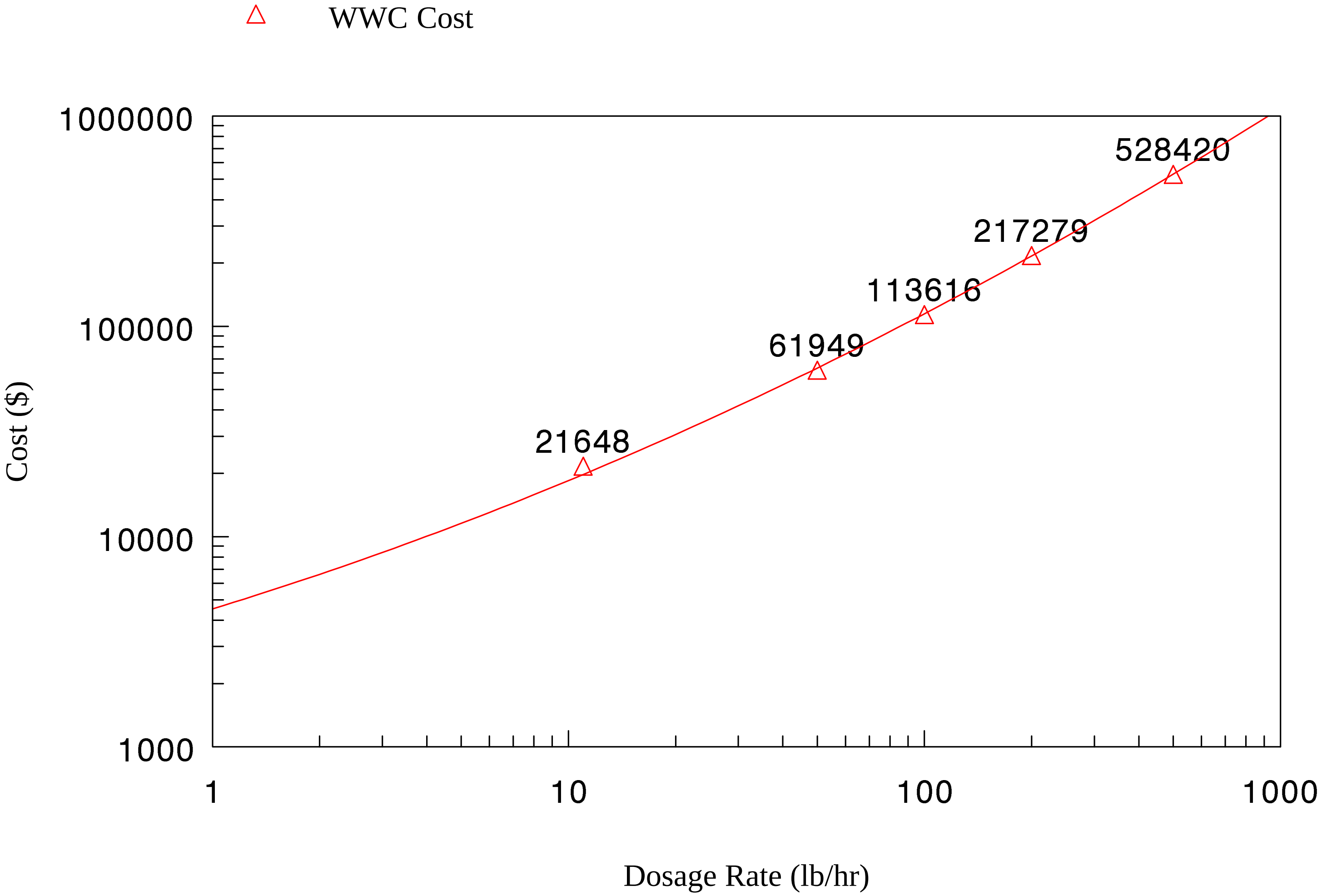


Figure 7-7

Sodium Bisulfite O&M Cost Curve



hoppers. Conveyance from the solution tanks to the point of application is by dual-head diaphragm metering pumps.

Hydrochloric Acid Feed Systems

Hydrochloric acid is necessary to neutralize the waste stream or adjust the waste stream for chemical treatment. The amount necessary was calculated using the following equation.

$$mg/L\ H_2SO_4 = \left(10^{-initial\ pOH} - 10^{-final\ pOH}\right)\left(\frac{mol\ OH^-}{1L}\right)\left(\frac{1\ mol\ H_2SO_4}{2\ mol\ H^+}\right)\left(\frac{98{,}000\ mg}{1\ mol\ H_2SO_4}\right)$$

To allow for solution buffering, 10 percent excess acid was added.

Hydrochloric acid feed systems were costed using the WWC unit process 46. The capital and O&M cost curves developed for hydrochloric acid feed systems, based upon the calculated feed rate, are presented as Equations 7-7 and 7-8, respectively.

$$\ln(Y) = 10.431273 - 0.196812\ln(X) + 0.044247\ln(X)^2 \qquad (7\text{-}7)$$

$$\ln(Y) = 7.630396 + 0.312305\ln(X) - 0.002419\ln(X)^2 \qquad (7\text{-}8)$$

where:

X = Feed Rate (gpd), and

Y = Cost (1992 \$)

Figures 7-8 and 7-9 graphically present the hydrochloric acid feed system capital and O&M cost curves, respectively.

Costs are based on systems capable of metering concentrated acid from a storage tank directly to the point of application. For feed rates up to 200 gpd, the concentrated acid is delivered in drums and stored indoors. At higher flow rates, the acid is delivered in bulk and stored outdoors in fiberglass

Figure 7-8
Hydrochloric Acid Capital Cost Curve

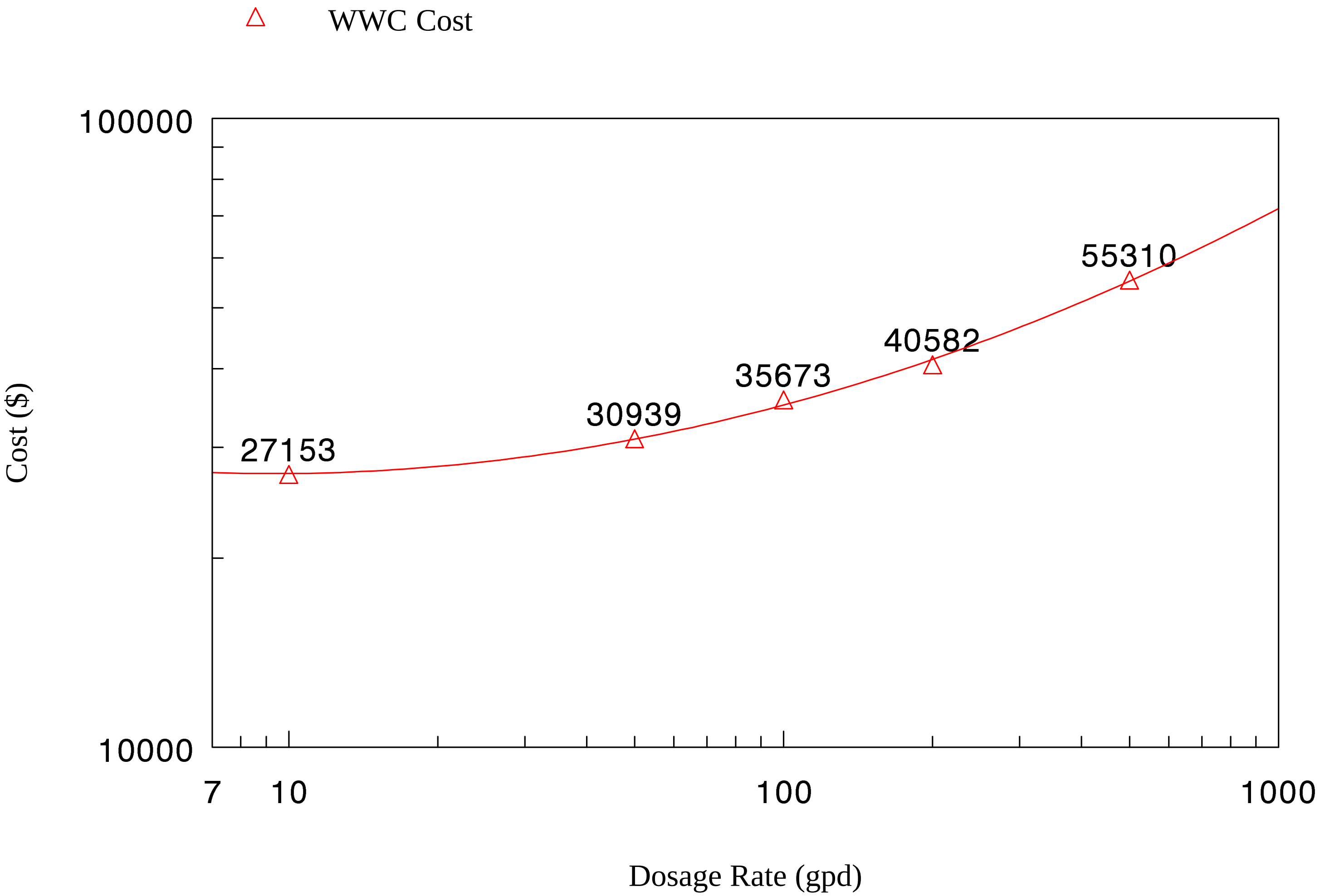
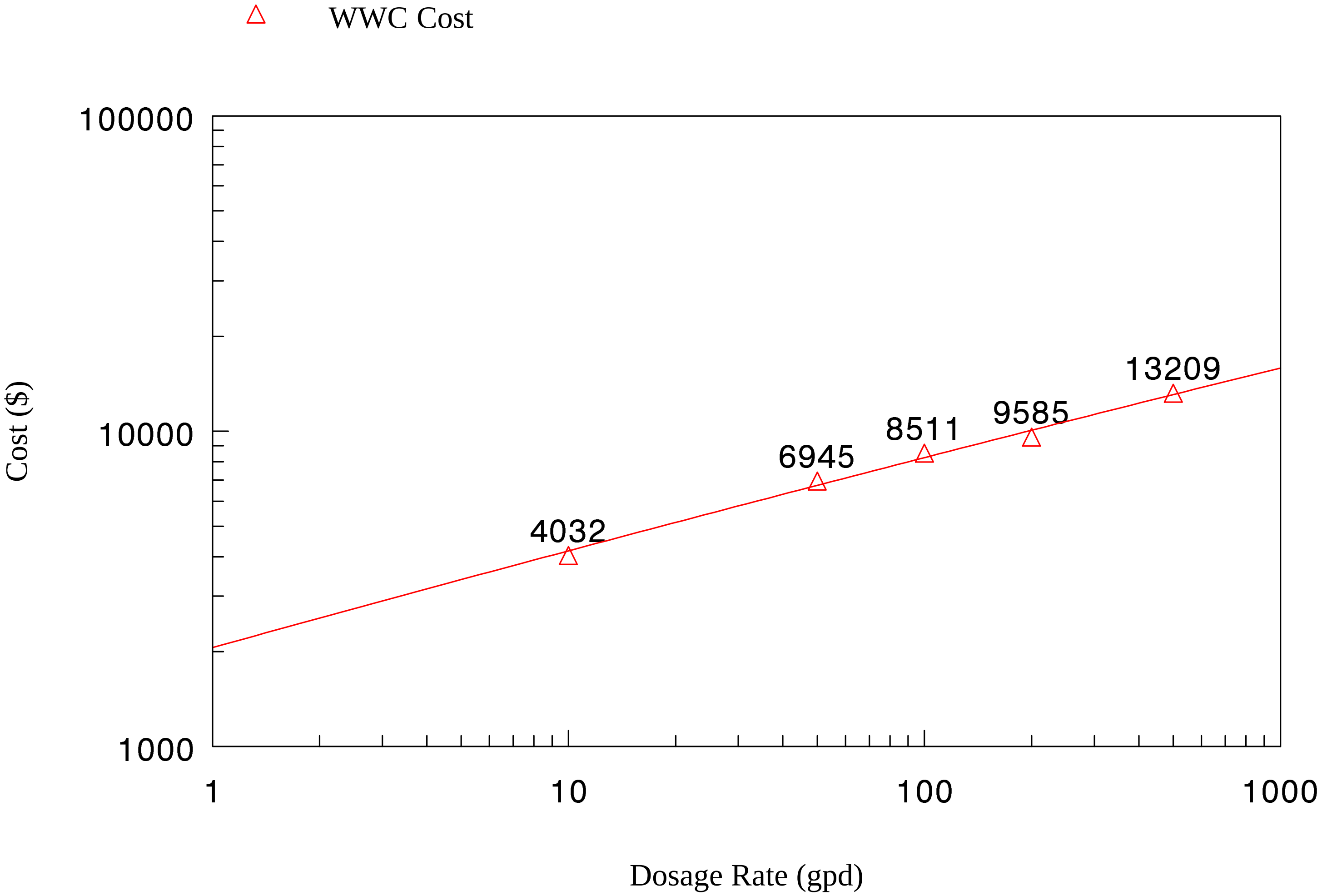


Figure 7-9
Hydrochloric Acid O&M Cost Curve



reinforced polyester tanks. Acid is stored for 15 days, and a standby metering pump is included for all installations.

Polymer Feed Systems

WWC unit process 34 was used to cost polymer feed systems. Polymer dosage rate in lb/hr was calculated based upon a target concentration of 2 mg/l using the facility's flow rate. Although this module is designed to cost for a liquid alum feed system, costs generated by this module were determined to be more reasonable and accurate in developing polymer system costs than the WWC unit process 43 for polymer feed systems. The capital and O&M unloaded cost curves developed for polymer feed systems are presented as Equations 7-9 and 7-10, respectively.

$$\ln(Y) = 10.539595 - 0.13771\ln(X) + 0.052403\ln(X)^2 \tag{7-9}$$

$$\ln(Y) = 9.900596 + 0.99703\ln(X) + 0.00019\ln(X)^2 \tag{7-10}$$

where:

X = Dosage Rate (lb/hr), and
Y = Cost (1992 $)

Figures 7-10 and 7-11 graphically present the polymer feed system capital and O&M cost curves, respectively.

Polymer is stored for 15 days in fiberglass reinforced polyester tanks. For smaller installations, the tanks are located indoors and left uncovered, and for larger installations the tanks are covered and vented, with insulation and heating provided. Dual-head metering pumps deliver the polymer from the storage tank and meter the flow to the point of application. Feed costs include 150 feet of 316 stainless steel pipe, along with fittings and valves, for each metering pump. A standby metering pump is included for each installation.

Figure 7-10

Polymer Feed Capital Cost Curve

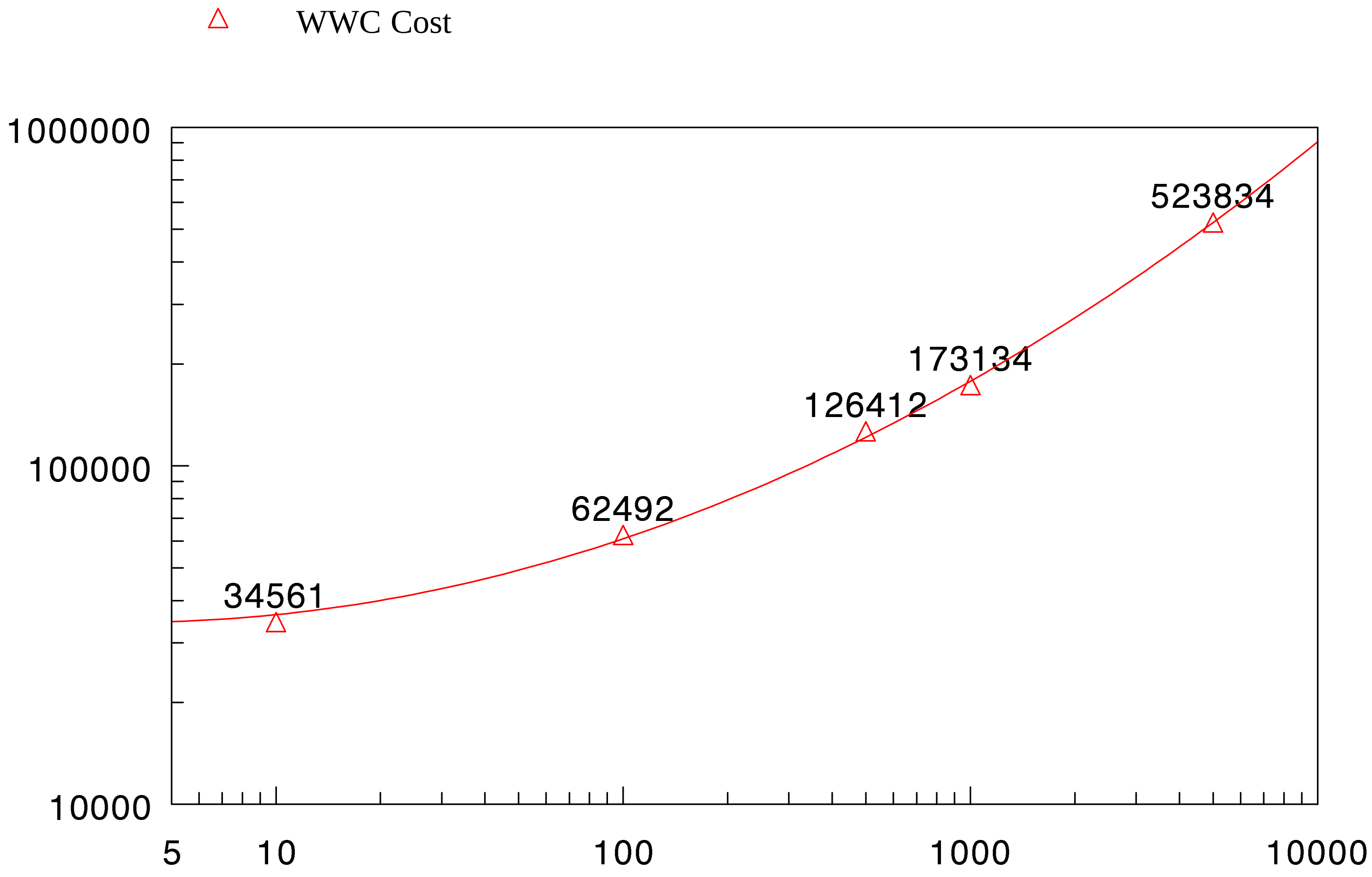
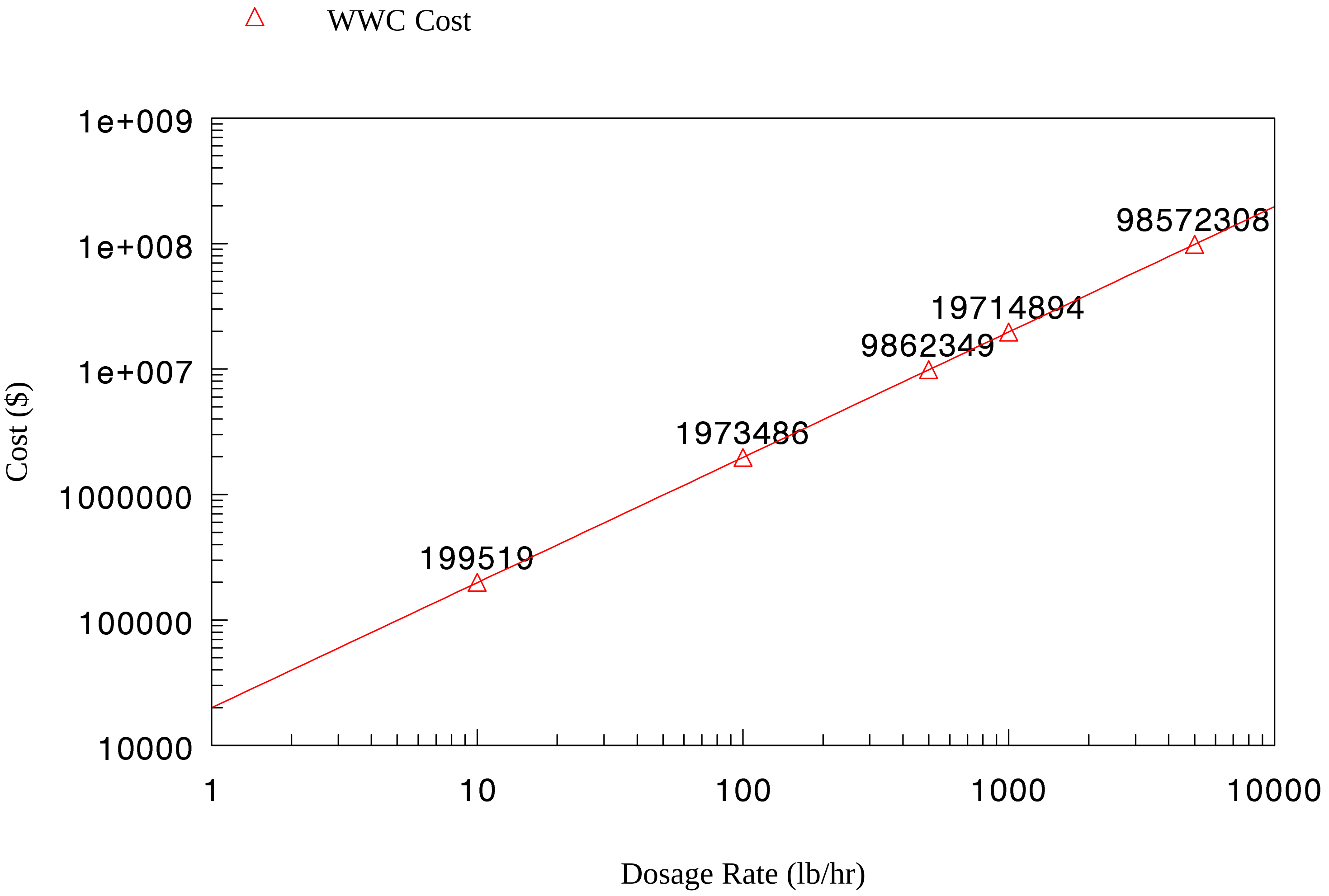


Figure 7-11
Polymer Feed O&M Cost Curve



7.3.1.2 Pumping

Wastewater pumping costs were estimated using WWC unit process 92, and are based on flow rate. The capital and O&M cost curves developed for pumping are presented as Equations 7-11 and 7-12, respectively.

$$\ln(Y) = 10.048 + 0.167\ln(X) - 0.001\ln(X)^2 \qquad (7\text{-}11)$$

$$\ln(Y) = 7.499 + 0.024\ln(X) + 0.0429\ln(X)^2 \qquad (7\text{-}12)$$

where:

X = Flow Rate (gpm), and
Y = Cost (1992 $)

Figures 7-12 and 7-13 graphically present the pumping capital and O&M cost curves, respectively.

7.3.1.3 Rapid Mix Tanks

Capital and O&M costs for rapid mix tanks were estimated using the WWC unit process 104 and are based on reinforced concrete basins. The capital and O&M cost curves developed for rapid mix tanks based upon flow rate are presented as Equations 7-13 and 7-14, respectively.

$$\ln(Y) = 12.234467 - 0.677898\ln(X) + 0.078143\ln(X)^2 \qquad (7\text{-}13)$$

$$\ln(Y) = 10.730231 + 0.614141\ln(X) + 0.083221\ln(X)^2 \qquad (7\text{-}14)$$

where:

X = Flow Rate (MGD), and
Y = Cost (1992 $)

Figures 7-14 and 7-15 graphically present the rapid mix tank capital and O&M cost curves, respectively.

Figure 7-12

Wastewater Pumping Capital Cost Curve

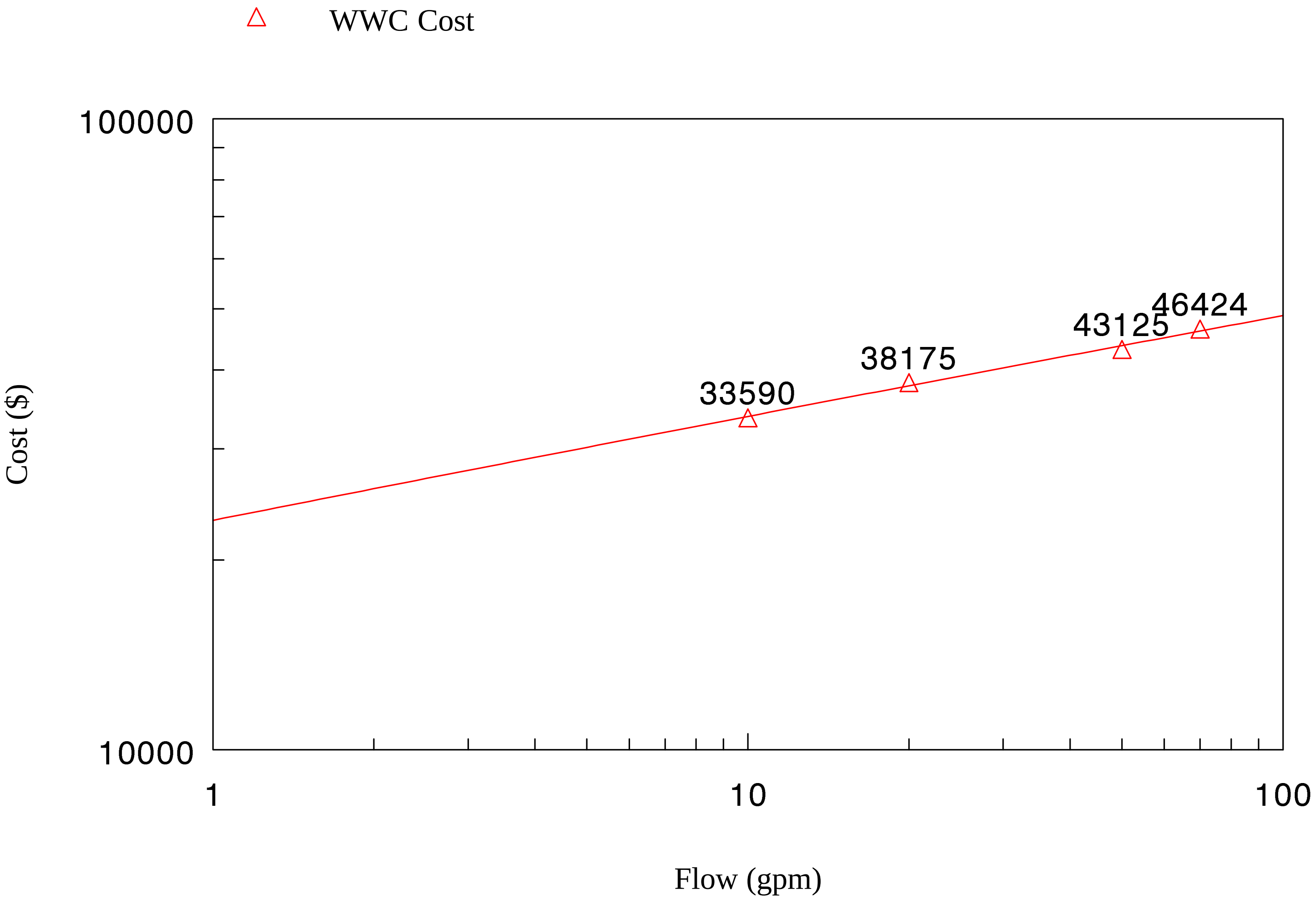


Figure 7-13
Wastewater Pumping O&M Cost Curve

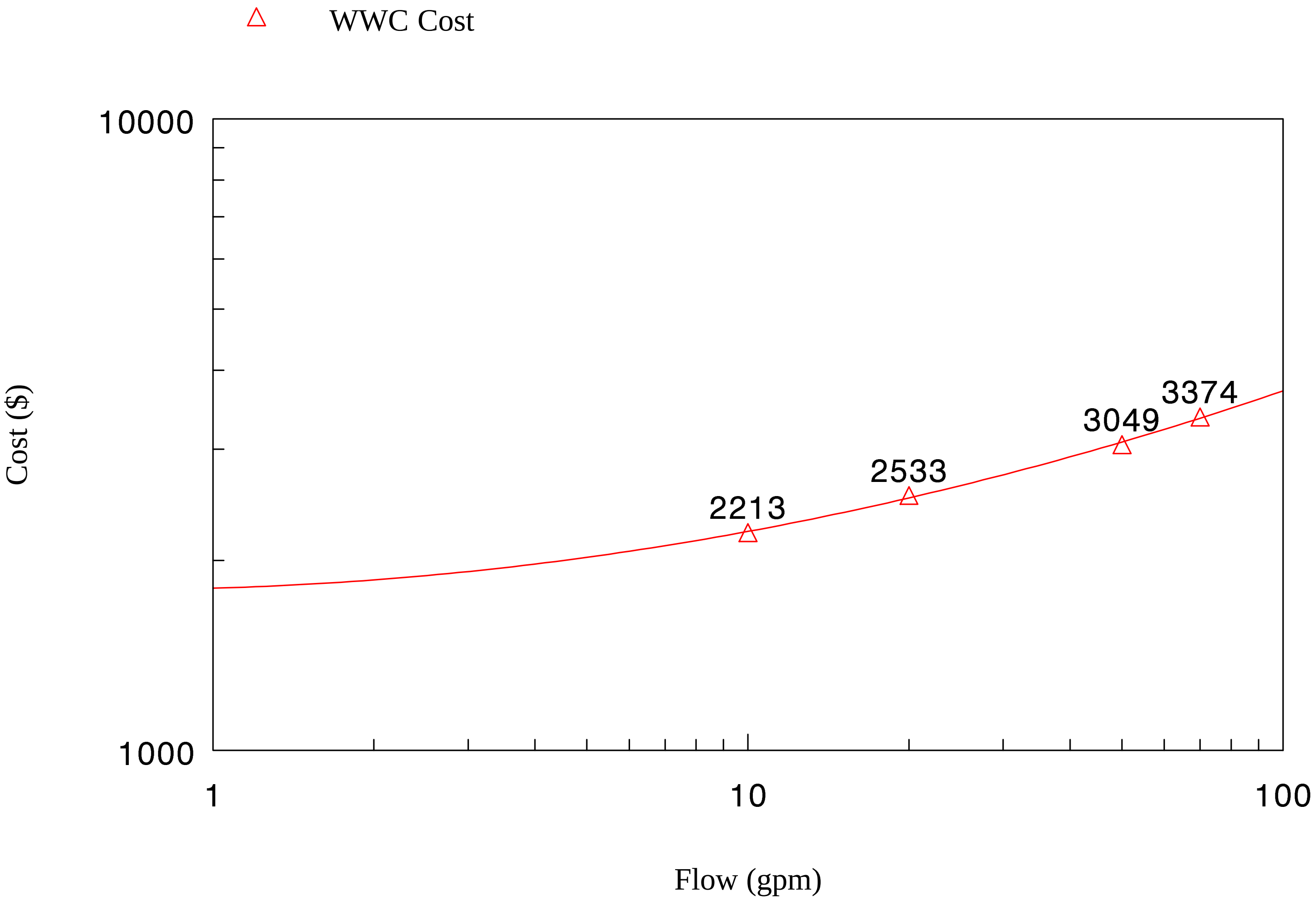


Figure 7-14

Mix Tank Capital Cost Curve

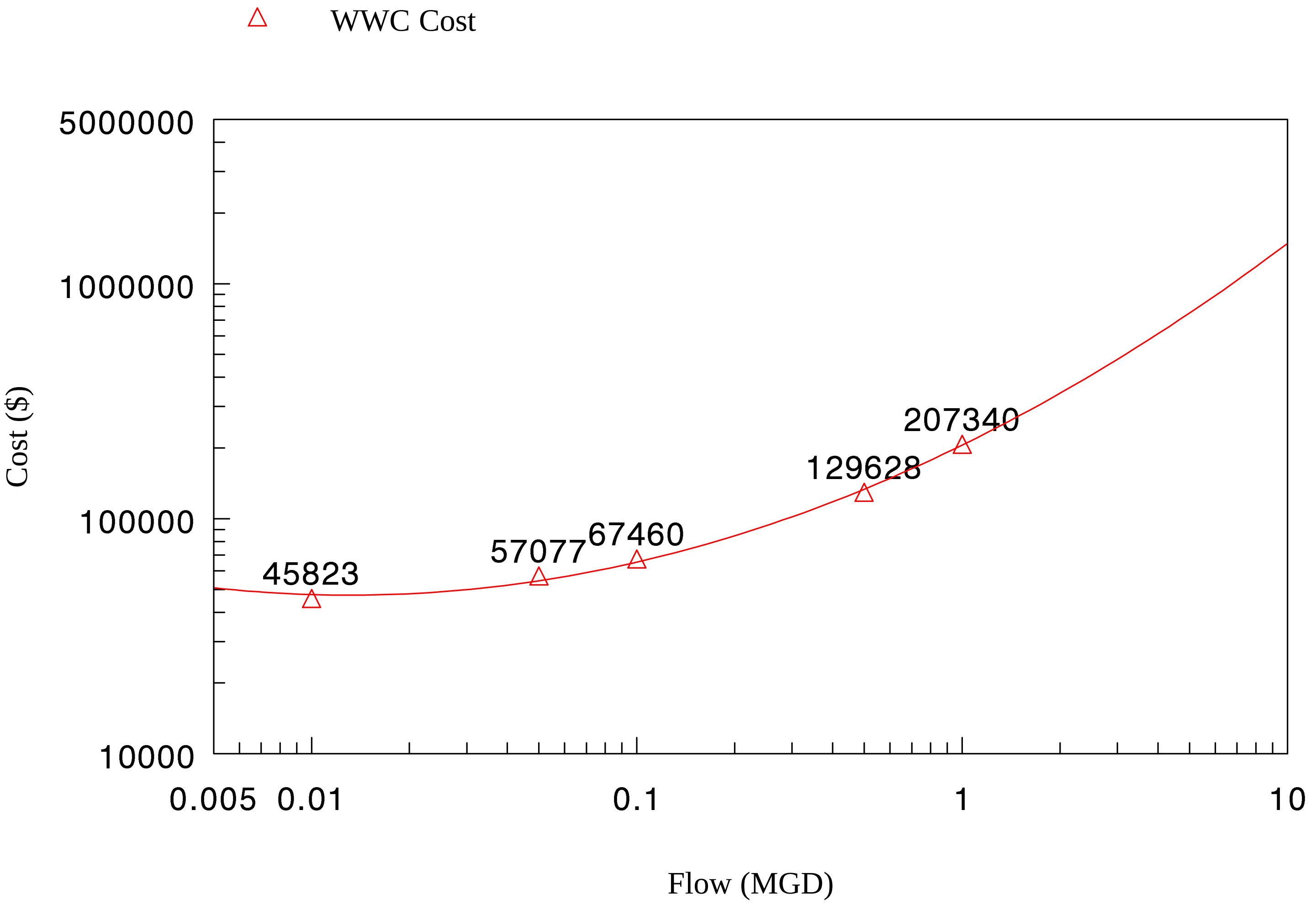
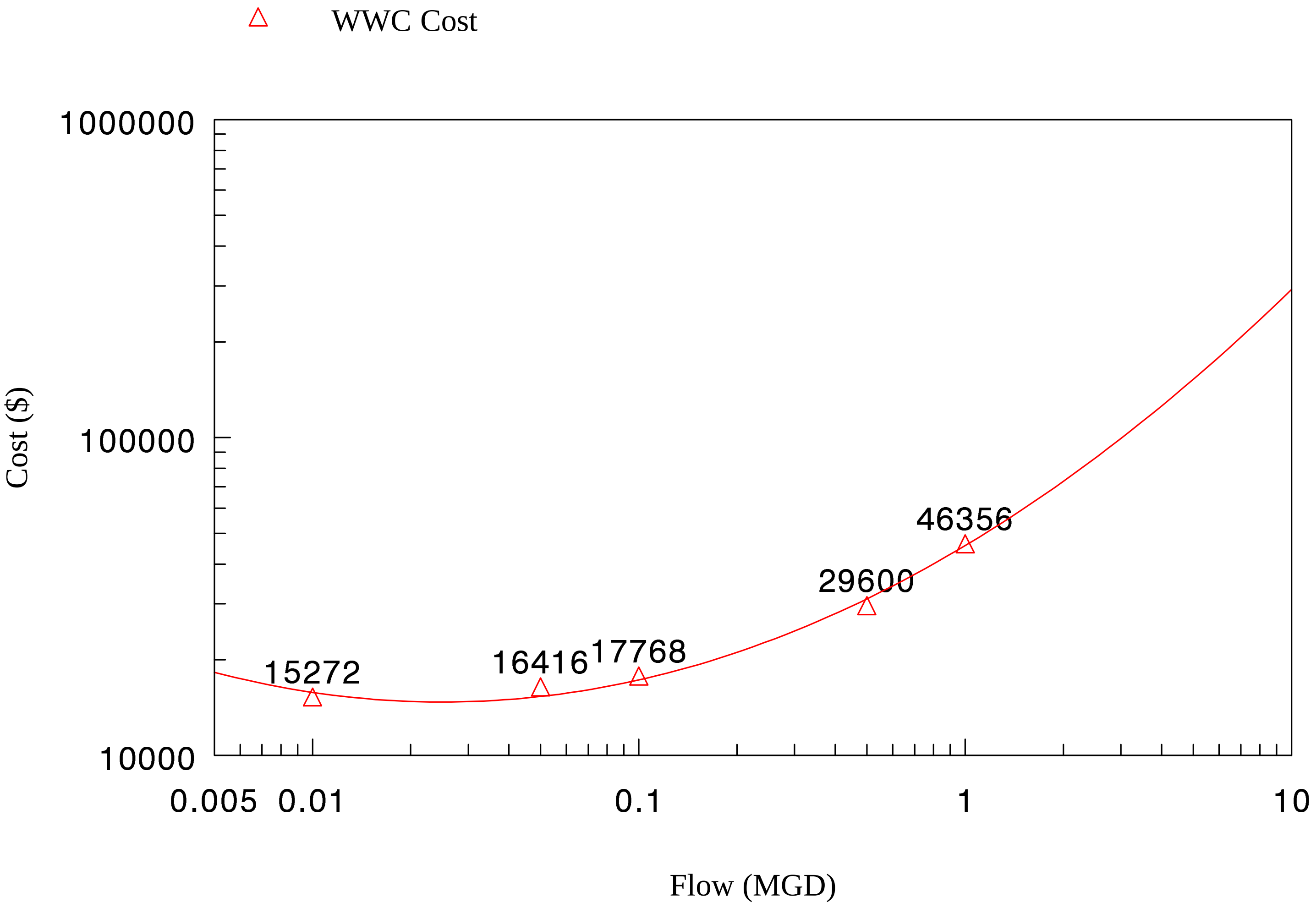


Figure 7-15

Mix Tank O&M Cost Curve



Common wall construction is assumed for multiple basins. Costs include vertical shaft, variable speed turbine mixers with 304 stainless steel shafts, paddles, and motors. Costs are based on a G value (G is the mean temporal velocity gradient which describes the degree of mixing; i.e., the greater the value of G the greater the degree of mixing) of 300 (3 ft-lbs/sec/cu. ft.) and a water temperature of 15EC. The energy requirements are a function of G value, water temperature, and an overall mechanism efficiency of 70 percent.

7.3.1.4 Flocculation

A cost curve was developed for flocculation using the WWC cost program. WWC unit process 72 was used. Costs for flocculation were based upon a function of flow at a hydraulic detention time of 20 minutes. The capital and O&M cost curves developed for flocculation are presented as Equations 7-15 and 7-16, respectively.

$$\ln(Y) = 11.744579 + 0.633178\ln(X) - 0.015585\ln(X)^2 \qquad (7\text{-}15)$$

$$\ln(Y) = 8.817304 + 0.533382\ln(X) + 0.002427\ln(X)^2 \qquad (7\text{-}16)$$

where:

X = Flow Rate (MGD), and
Y = Cost (1992 $)

Figures 7-16 and 7-17 graphically present the flocculation capital and O&M cost curves, respectively. Cost estimates for flocculation basins are based on rectangular-shaped, reinforced concrete structures with a depth of 12 feet and length-to-width ratio of 4:1. Horizontal paddle flocculators were used in costing because they are less expensive and more efficient. Manufactured equipment costs are based on a G value of 80. Cost estimates for drive units are based on variable speed drives for maximum flexibility, and although common drives for two or more parallel basins are often utilized, the costs are based on individual drives for each basin.

Figure 7-16
Flocculation Capital Cost Curve

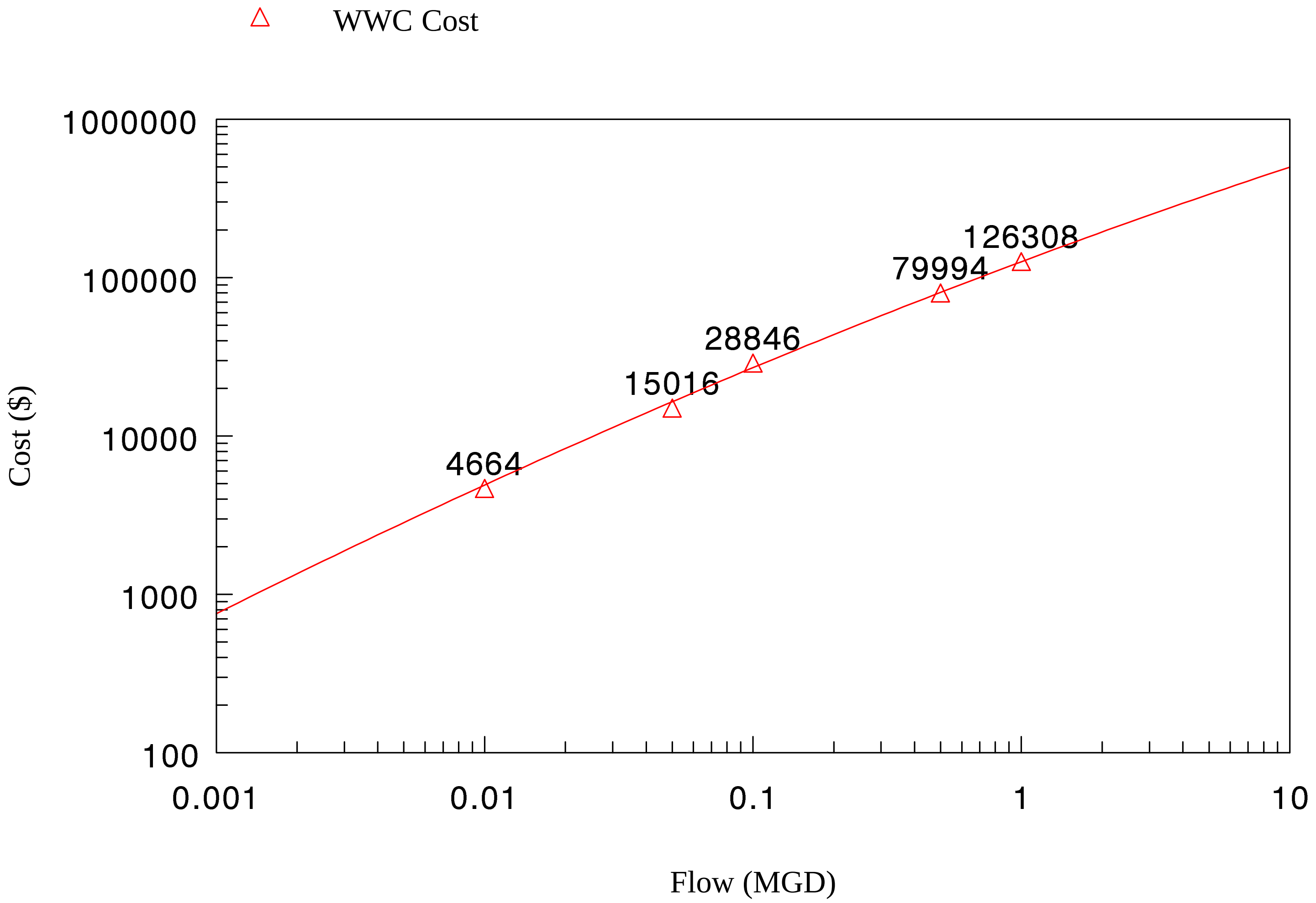
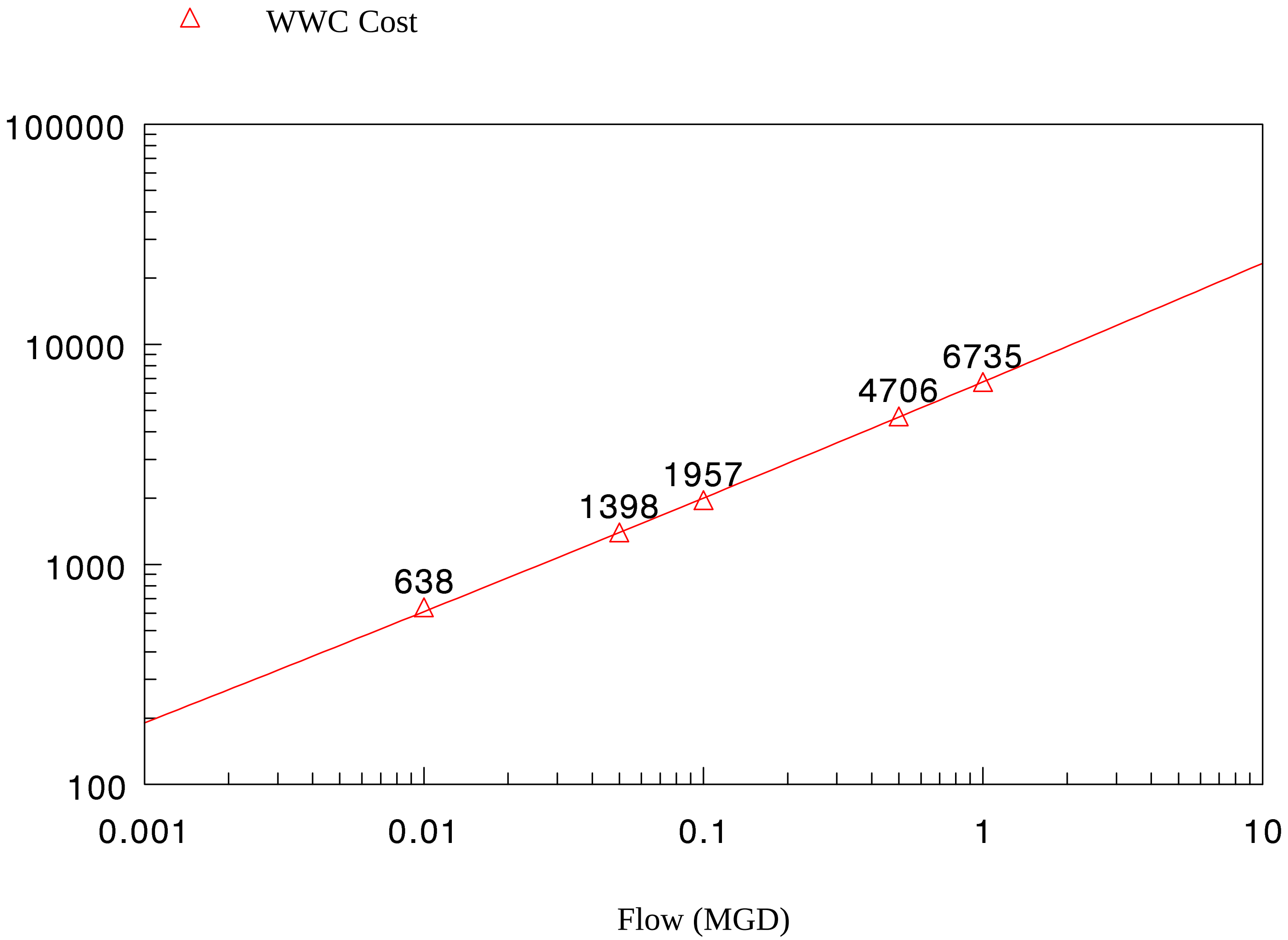


Figure 7-17

Flocculation O&M Cost Curve



Energy requirements are based on a G value 80 and an overall motor/mechanism efficiency of 60 percent. Labor requirements are based on routine operation and maintenance of 15 min/day/basin and a 4 hour oil change every 6 months.

7.3.1.5 Primary Clarification

Cost curves were developed for primary clarification using the WWC cost program. WWC unit process 118 for a rectangular basin with a 12 foot side wall depth was used. Costs for primary clarification were based upon a function of flow rate, using an overflow rate of 900 gallons per day per square feet in calculating tank size. The capital and O&M cost curves developed for primary clarification are presented as Equations 7-17 and 7-18, respectively.

$$\ln(Y) = 12.517967 + 0.575652\ln(X) + 0.009396\ln(X)^2 \tag{7-17}$$

$$\ln(Y) = 10.011664 + 0.268272\ln(X) + 0.00241\ln(X)^2 \tag{7-18}$$

where:

X = Flow Rate (MGD), and

Y = Cost (1992 \$)

Figures 7-18 and 7-19 graphically present the primary clarification capital and O&M cost curves, respectively.

Estimated costs are based on rectangular basins with a 12 foot side water depth (SWD), and chain and flight sludge collectors. Costs for the structure assumed common wall construction, and include the chain and flight collector, collector drive mechanism, weirs, the reinforced concrete structure complete with inlet and outlet troughs, a sludge sump, and sludge withdrawal piping.

7.3.1.6 Secondary Clarification

Cost curves were developed for secondary clarification using the WWC cost program. WWC unit process 118 for a rectangular basin with a 12 foot side wall depth, and chain and flight collectors was used.

Figure 7-18

Primary Clarifier Capital Cost Curve

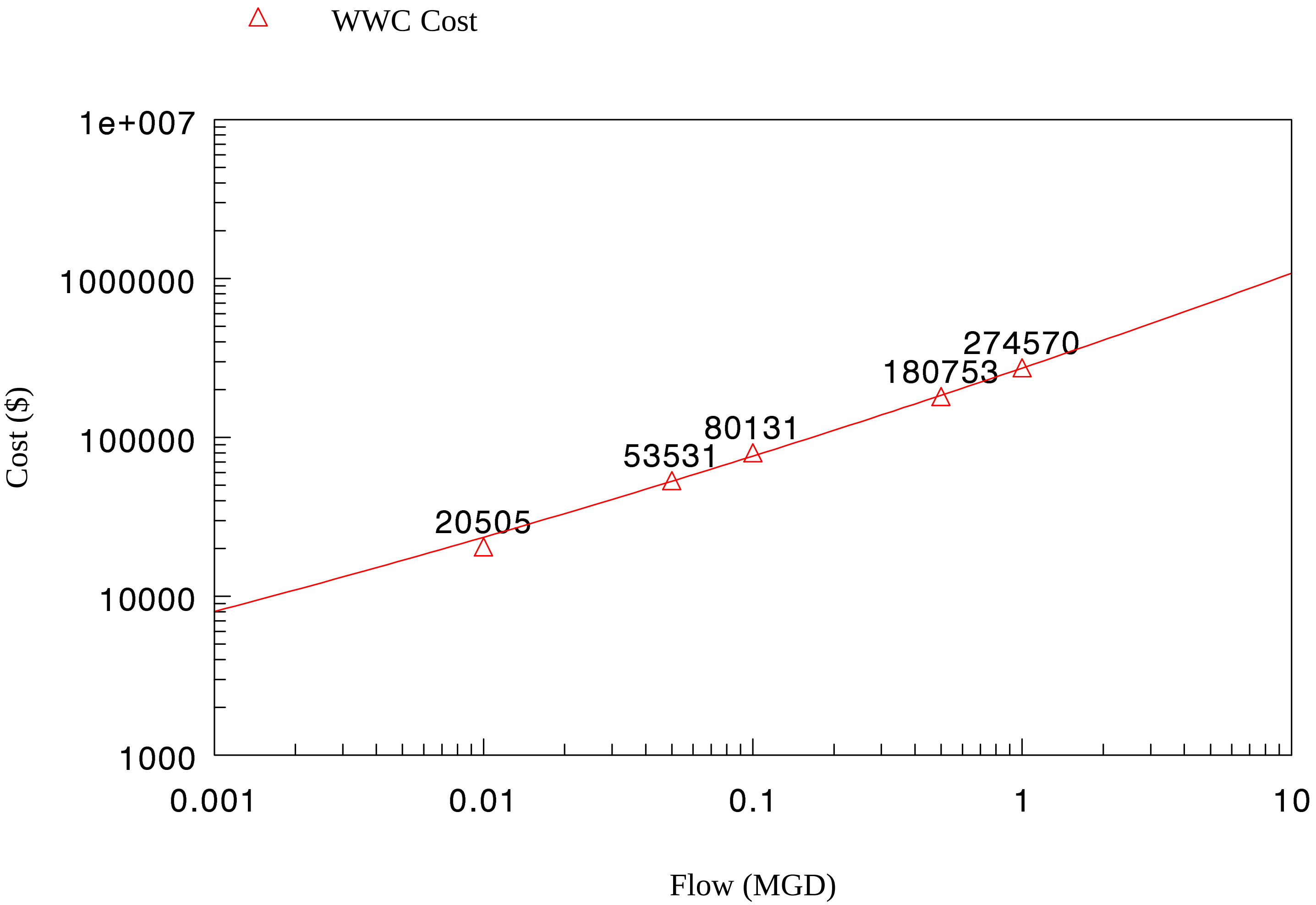
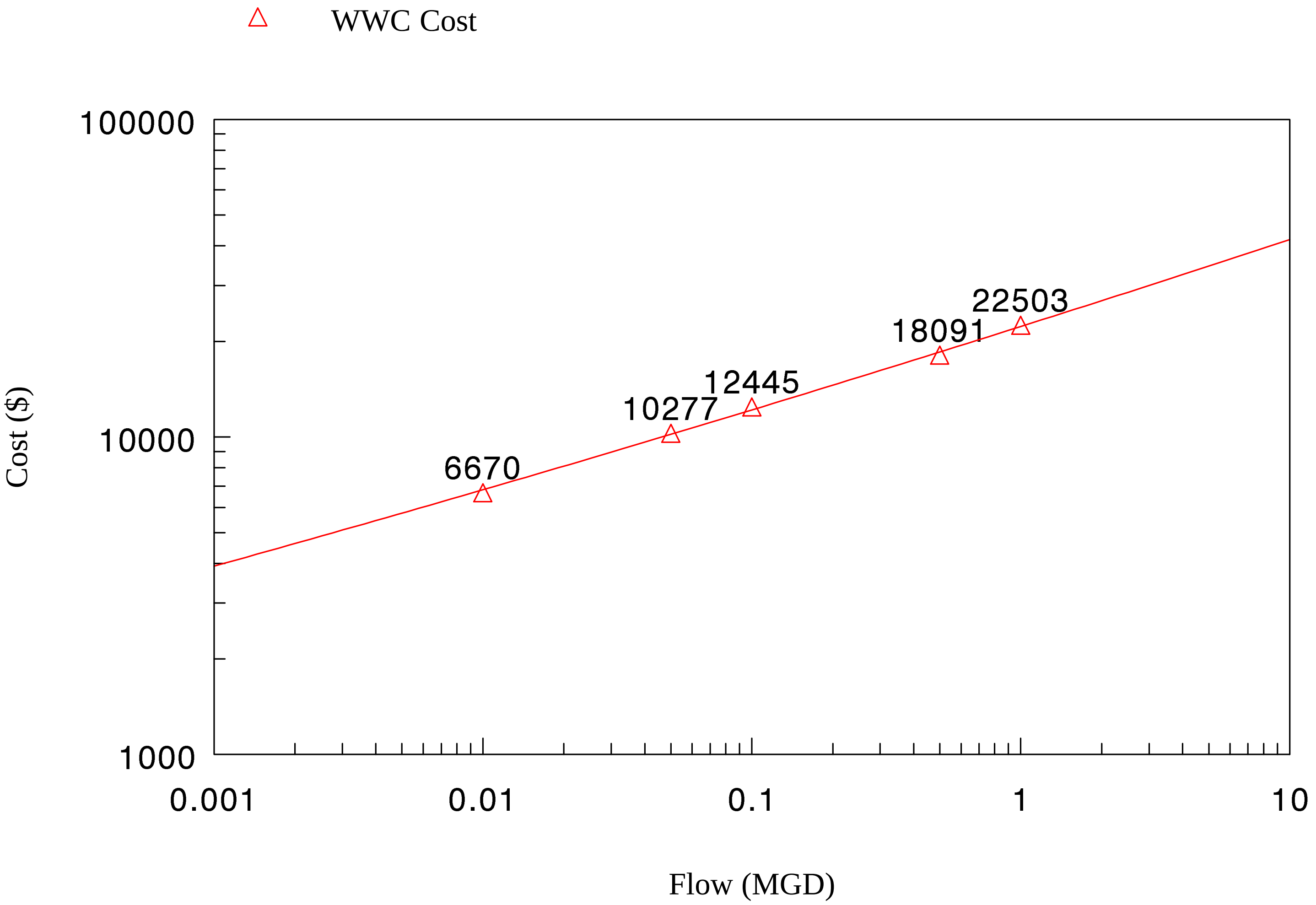


Figure 7-19
Primary Clarifier O&M Cost Curve



Costs for secondary clarification were based upon a function of flow rate, using an overflow rate of 600 gallons per day per square feet in calculating tank size. The capital and O&M cost curves developed for secondary clarification are presented as Equations 7-19 and 7-20, respectively.

$$\ln(Y) = 12.834601 + 0.688675\ln(X) + 0.035432\ln(X)^2 \tag{7-19}$$

$$\ln(Y) = 10.197762 + 0.339952\ln(X) + 0.015822\ln(X)^2 \tag{7-20}$$

where:

X = Flow Rate (MGD), and

Y = Cost (1992 $)

Figures 7-20 and 7-21 graphically present the secondary clarification capital and O&M cost curves, respectively. Costs for the structure assumed common wall construction, and include the chain and flight collector, collector drive mechanism, weirs, the reinforced concrete structure complete with inlet and outlet troughs, a sludge sump, and sludge withdrawal piping. Yard piping to and from the clarifier is not included in the above costs, but accounted for by the engineering cost factors.

7.3.1.7 Sand Filtration

A capital cost curve, as a function of flow rate, was developed for a sand filtration system using vendor supplied quotes. The cost curve used in this study was developed as part of the CWT effluent guidelines effort. The capital cost curve developed for sand filtration is presented as Equation 7-21.

$$\ln(Y) = 12.265 + 0.658\ln(X) + 0.036\ln(X)^2 \tag{7-21}$$

where:

X = Flow Rate (MGD), and

Y = Capital Cost (1992 $)

O&M costs for filter operation were estimated as 50 percent of the capital cost. Figure 7-22 graphically presents the sand filtration capital cost curve.

Figure 7-20

Secondary Clarifier Capital Cost Curve

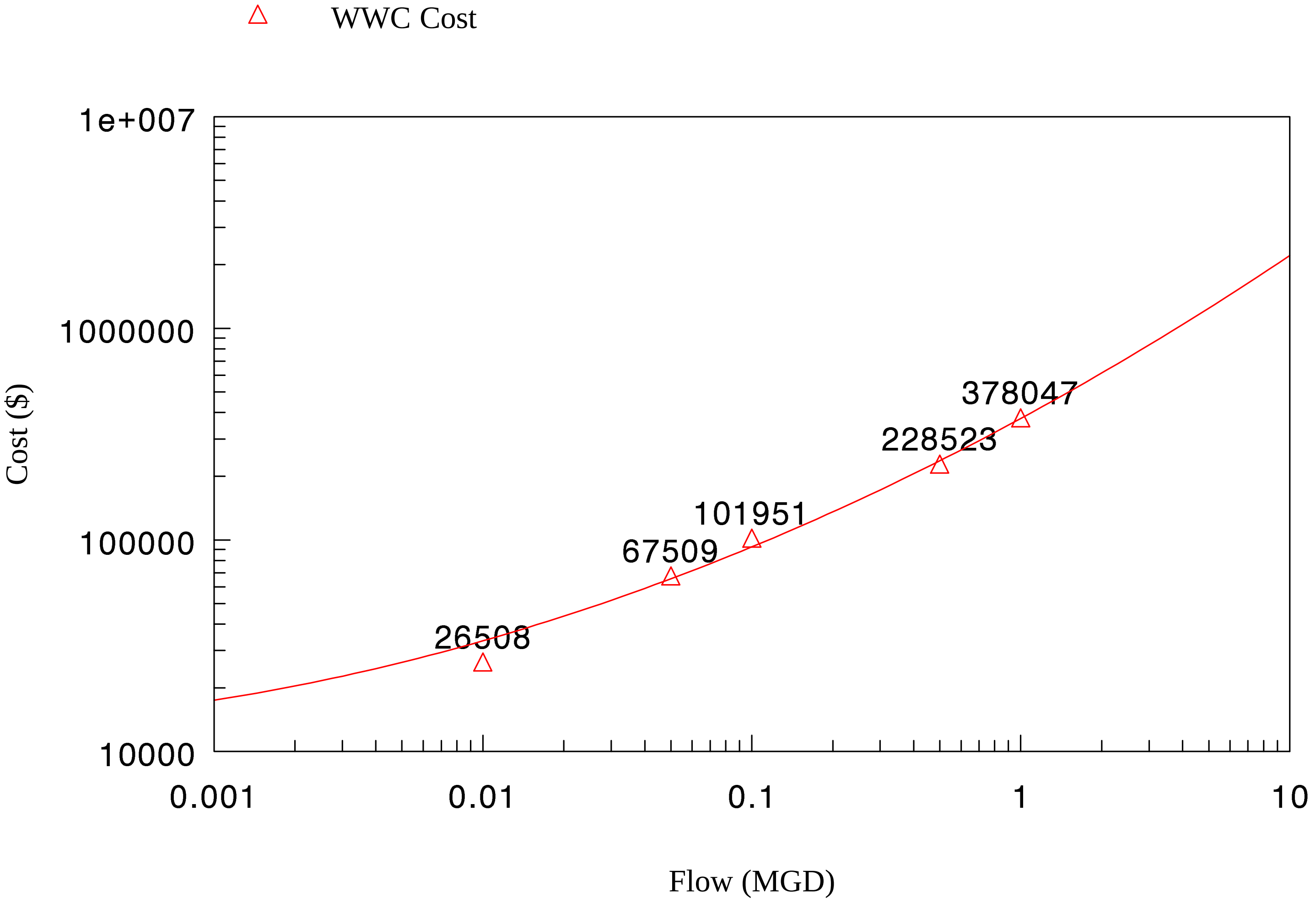


Figure 7-21

Secondary Clarifier O&M Cost Curve

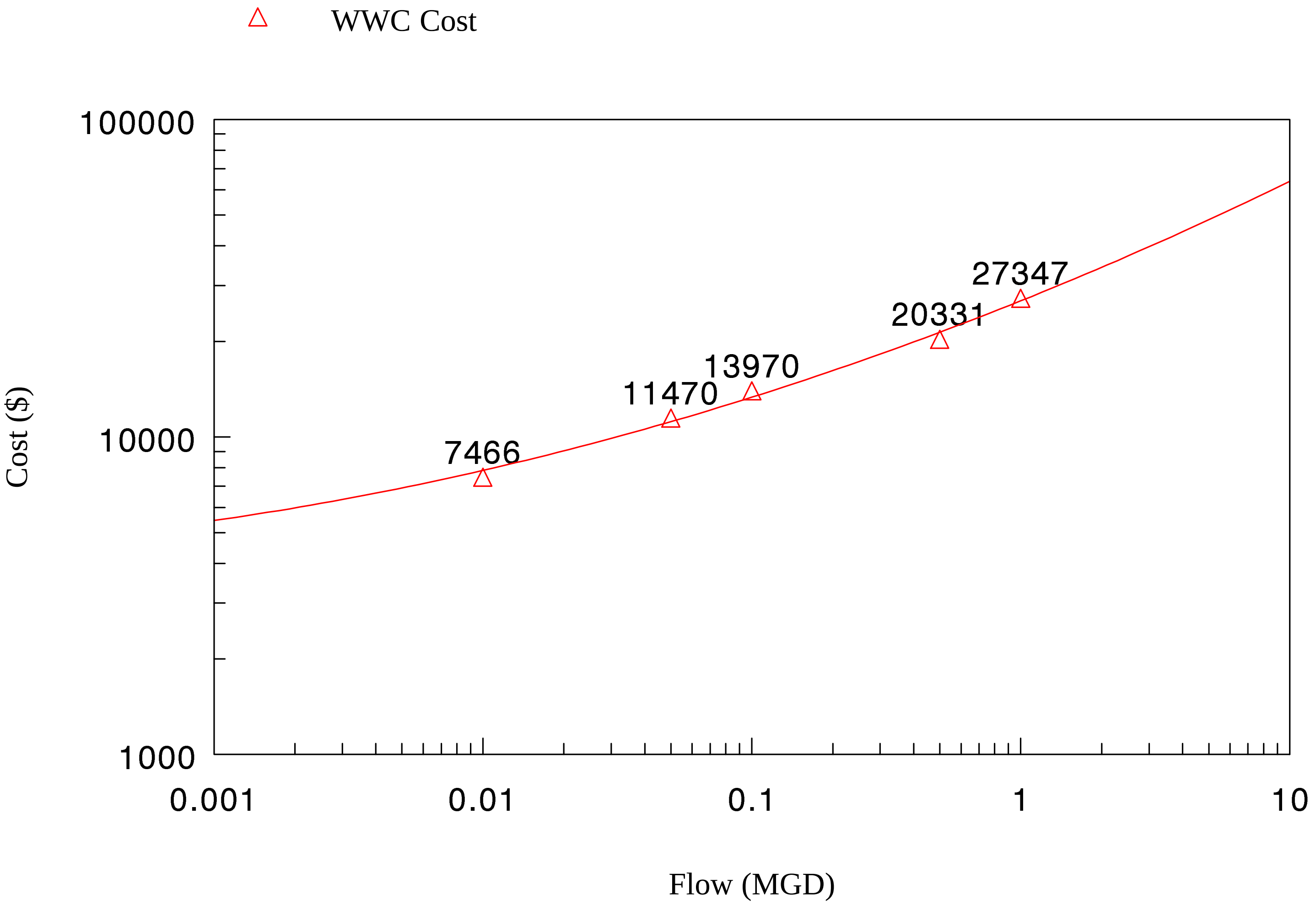
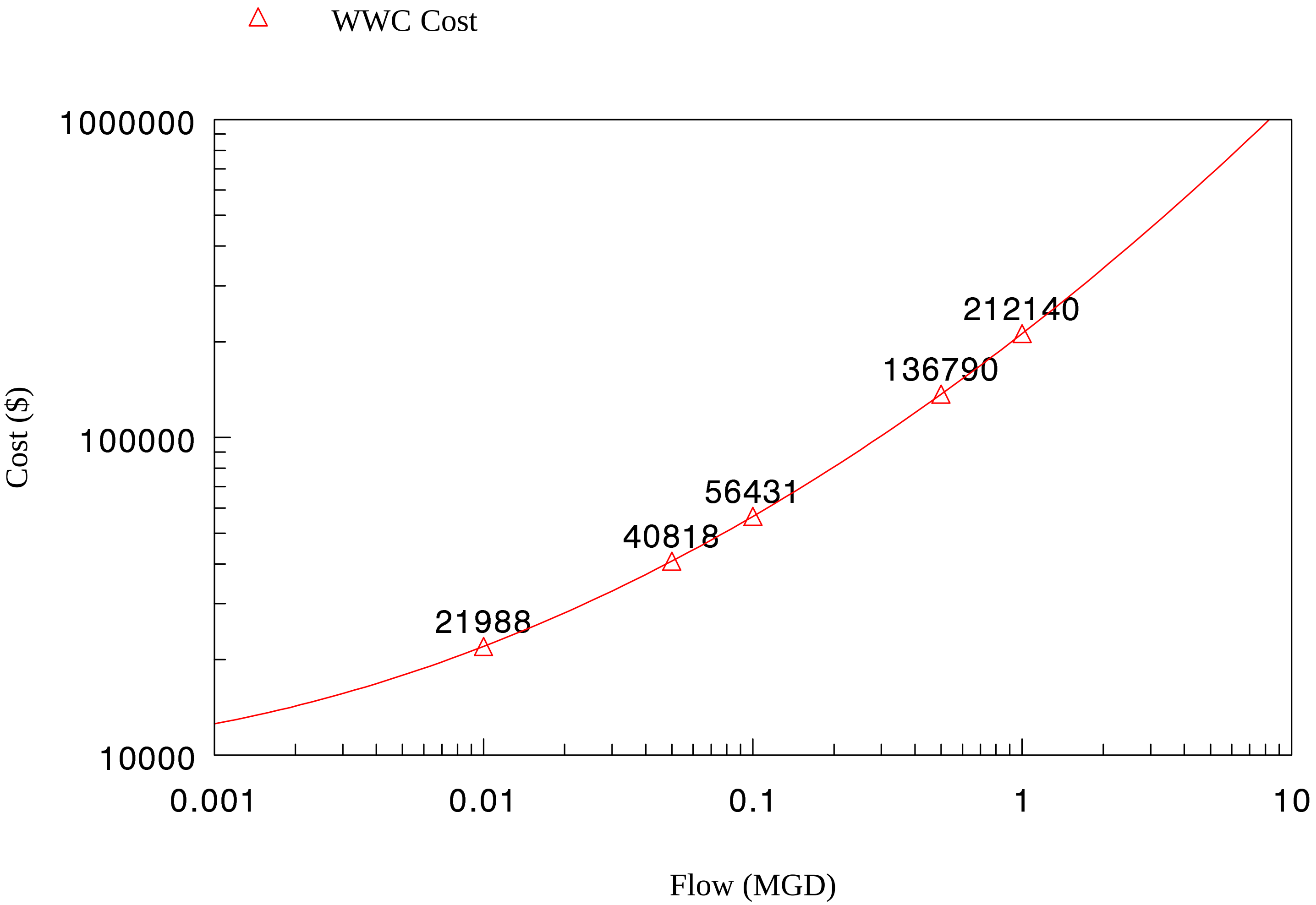


Figure 7-22

Sand Filtration Capital Cost Curve



The total capital costs for the sand filtration systems represent equipment and installation costs. The total construction cost includes the costs of the filter, instrumentation and controls, pumps, piping, and installation. The operation and maintenance costs include energy usage, maintenance, labor, taxes, and insurance.

7.3.2 *Sludge Treatment and Disposal*

The method of developing sludge treatment and disposal costs are presented in the following sections.

7.3.2.1 Plate and Frame Pressure Filtration

Regulatory costs for sludge dewatering were developed using cost curves from the CWT effluent guideline effort. Costs are for a sludge dewatering system using a plate and frame pressure filter, and are based upon flow rate. Only facilities without installed sludge treatment were costed.

The capital and O&M cost curves developed for a plate and frame filter press sludge dewatering are presented as Equations 7-22 and 7-23, respectively.

$$\ln(Y) = 15.022877 + 1.1199216\ln(X) + 0.063001\ln(X)^2 \tag{7-22}$$

$$\ln(Y) = 12.52046 + 0.713233\ln(X) + 0.066701\ln(X)^2 \tag{7-23}$$

where:

X = Flow (MGD), and

Y = Cost (1992 $)

Figures 7-23 and 7-24 graphically present the plate and frame sludge dewatering capital and O&M cost curves, respectively. For facilities with a flow rate of less than 1,500 gallons per day, the O&M costs were estimated as 50 percent of the capital cost.

The components of the plate and frame pressure filtration system include: filter plates, filter cloth, hydraulic pumps, pneumatic booster pumps, control panel, connector pipes, and support platform.

Figure 7-23

Sludge Dewatering Capital Cost Curve

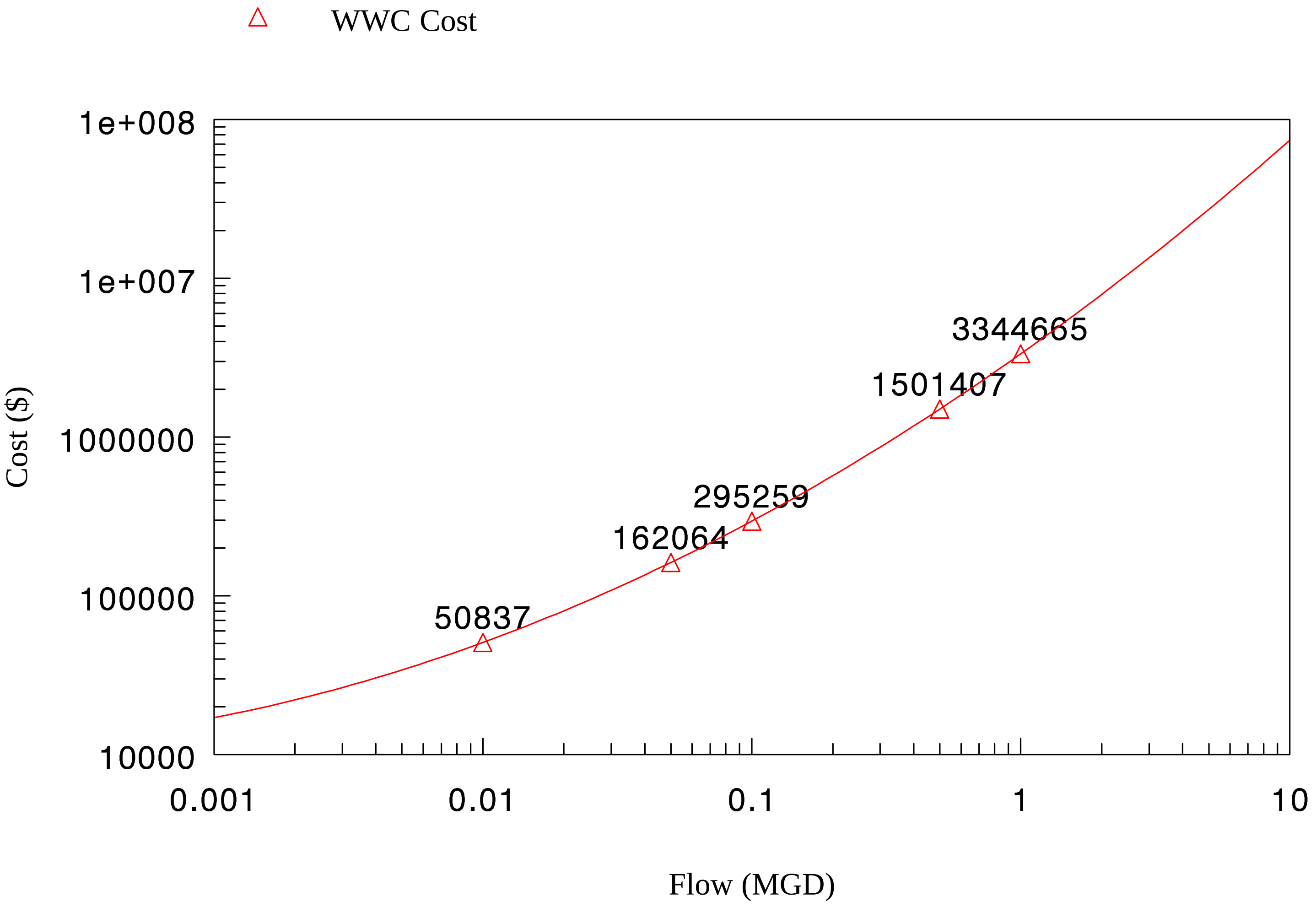
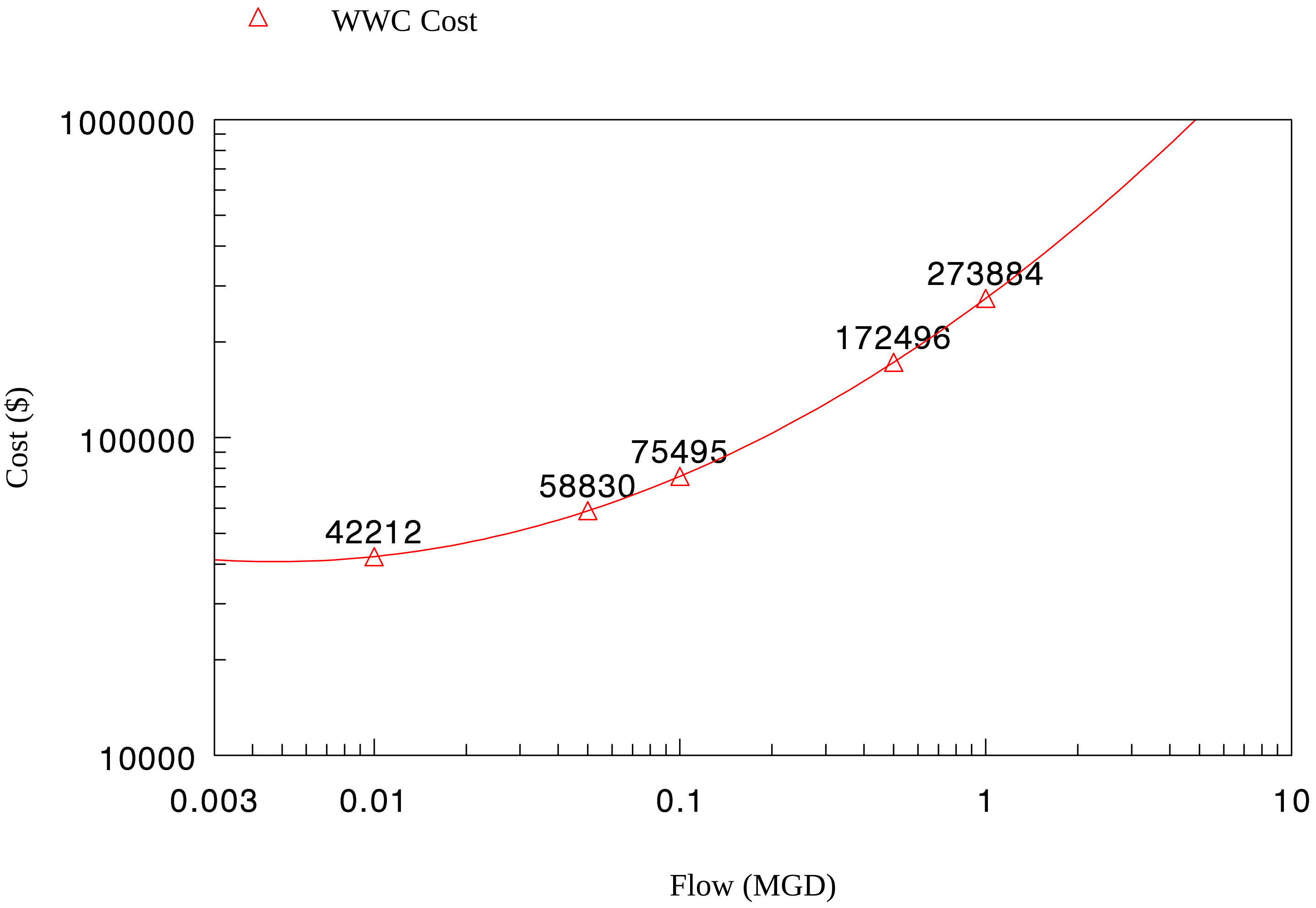


Figure 7-24

Sludge Dewatering O&M Cost Curve



Equipment and operational costs were obtained from manufacturers' recommendations. The capital cost equation was developed by adding installation, engineering, and contingency costs to the vendors' equipment costs. The O&M costs were based on estimated electricity usage, maintenance, labor, taxes and insurance, and filter cake disposal costs. The labor requirement for the plate and frame pressure filtration system was approximated at 30 minutes per cycle per filter press.

7.3.2.2 Filter Cake Disposal Costs

Filter cake was costed for off-site disposal at a landfill. A facility's filter cake generation was calculated using the difference between the facility's loadings and allowable effluent concentration. A facility's total influent loading was calculated by taking the sum of the average metals and TSS concentrations multiplied by the baseline flow. Effluent concentrations were developed similarly using the LTAs for each option. Then, the sludge generation in the treatment system was calculated as the influent loading minus the amount in effluent loading, converted to an annual amount (lbs/yr). The amount of treatment chemicals added to the system (based upon BPT/PSES option) was also included in the calculation of sludge generation. The amount of total sludge generated in the treatment system was then converted to a wet weight basis assuming 35 percent solids filter cake. Off-site disposal costs were estimated at $0.19/lb and was based upon the median cost reported by CHWC facilities in the Questionnaire responses. This cost includes transportation, handling, conditioning, and disposal of the cake. Costs are based upon a filter cake of 35 percent solids.

7.4 ADDITIONAL COSTS

In order to complete the costing for each regulatory option, costs other than treatment component costs were developed. These additional costs are required in order to accommodate for other costs associated with the development of the guideline. The following additional costs were included in the total guideline option costs for each facility, as needed:

- retrofit
- monitoring
- RCRA permit modifications
- land costs

Each of these additional costs are further discussed and defined in the following sections. Total facility compliance costs under each BPT/BCT/BAT and PSES option were developed by adding individual treatment technology costs with these additional costs.

Final capital costs developed for each facility were then amortized using a 7 percent interest rate over 15 years. This annualized capital cost was then added to the annual O&M cost to develop a total annual cost for each guideline option.

7.4.1 *Retrofit and Upgrade Costs*

A retrofit cost factor was applied when additional equipment or processes were needed to be added to existing systems. Retrofit costs cover the need for system modifications and components, such as piping, valves, controls, etc., which are necessary in order to connect new treatment units and processes to an existing treatment facility. An upgrade cost factor was also applied to allow for existing treatment systems to be enhanced to provide sufficient treatment capability. The combined retrofit and upgrade cost factor was estimated at 25 percent of the installed capital cost of the equipment.

7.4.2 *Land Costs*

Land costs provide for the value of the land requirements needed for the installation of the BPT/BCT/BAT/PSES treatment technology. Land costs were estimated based upon the expected land requirements for the new treatment units. Land size increments of either 0.5, 1 or 2 acres were used depending on the expected size of the required treatment system.

Land costs vary greatly across the country depending upon the region and state. Therefore, a national average would not be appropriate for costing purposes. State-specific unit land costs ($/acre) were developed for each state. These state-specific unit land costs were based upon the average land costs for suburban sites in each state and were obtained from the 1990 Guide to Industrial and Real Estate Office Markets Survey. Costs were corrected to 1992 dollars using engineering cost factors.

According to the survey, unimproved sites are the most desirable location for development and are generally zoned for industrial usage. State-specific unit land costs were developed by averaging the reported unimproved site survey data for the various size ranges (zero to 10 acres, 10 to 100 acres, and greater than 100 acres). Regional averages were used for states which did not have data provided. Hawaii was not used in developing regional average costs, due to extremely high costs. Table 7-8 presents the developed state-specific unit land costs used in costing. Facility land costs for this rule varied from $11,500 to $237,628.

7.4.3 *RCRA Permit Modification Costs*

No cost associated with the modification of an existing RCRA Part B permit was included for any hazardous waste facilities requiring an upgrade or additional treatment processes. The wastewater treatment unit exemption (40 CFR 264.1(g)(6), 40 CFR 265.1(c)(10)) exempts wastewater treatment units that are subject to NPDES or pretreatment requirements under the Clean Water Act from certain RCRA requirements, such as permitting modifications. Wastewater treatment units that are exempt from certain RCRA requirements are defined in 40 CFR 260.10. Since all units costed under this rule fall under this exemption, no costs were assumed to be associated for the CHWC Industry.

Table 7-8. State Land Costs[1]

State	Land Cost (1992 $/acre)	State	Land Cost (1992 $/acre)
Alabama	24,595	Nebraska	26,659
Alaska[2]	87,593	Nevada	39,204
Arizona	49,790	New Hampshire	57,238
Arkansas	17,170	New Jersey	96,598
California	325,000	New Mexico	29,083
Colorado	47,045	New York	118,814

State	Land Cost (1992 $/acre)
Connecticut	58,570
Delaware	58,806
Florida	68,335
Georgia	78,408
Hawaii	1,176,120
Idaho[2]	87,593
Illinois	39,204
Indiana	22,764
Iowa	9,670
Kansas	7,605
Kentucky	31,363
Louisiana	61,158
Maine	21,170
Maryland	121,532
Massachusetts	64,687
Michigan	14,740
Minnesota	22,738
Mississippi	14,113
Missouri	43,124
Montana[2]	87,593
North Carolina	36,590
North Dakota[2]	22,127
Ohio	15,744
Oklahoma	26,267
Oregon	54,886
Pennsylvania	34,892
Rhode Island[2]	64,608
South Carolina	23,000
South Dakota[2]	22,127
Tennessee	22,543
Texas	51,488
Utah[2]	87,593
Vermont[2]	64,608
Virginia	43,124
Washington	68,764
West Virginia[2]	51,133
Wisconsin	18,818
Wyoming[2]	87,593
Washington, DC	188,179

(1) Source: 1990 Guide to Industrial and Real Estate Office Markets Survey.
(2) No data available for State, regional average used.

7.4.4 *Monitoring Costs*

Costs were developed for the monitoring of treatment system effluent. Costs were developed for both direct and indirect dischargers and were based upon the following assumptions:

- Monitoring costs are based on the number of outfalls through which wastewater is discharged. The costs associated with a single outfall is multiplied by the total number of outfalls to arrive at the total cost for a facility. The estimated monitoring costs are incremental to the costs already incurred by the facility.
- The capital costs for flow monitoring equipment are included in the estimates.

- Sample collection costs (equipment and labor) and sample shipment costs are not included in the estimates because it is assumed that the facility is already conducting these activities as part of its current permit requirements.

Based upon a review of current monitoring practices at CHWC facilities, many conventional and non-conventional parameters, as well as metals, are already being monitored on a routine basis. Therefore, monitoring costs were developed based upon daily monitoring of TSS and weekly monitoring of metals. Current compliance monitoring for existing facilities is generally less than the frequency used for estimating the monitoring costs of this rule. Table 7-9 presents the monitoring costs per sample type for the CHWC Industry.

Table 7-9. Analytical Monitoring Costs

Pollutants	Cost/Sample ($)[1]
TSS	6.00
Metals	40.00/metal

(1) Cost based on 1998 analytical laboratory costs adjusted to 1992 dollars.

7.5 WASTEWATER OFF-SITE DISPOSAL COSTS

An evaluation was conducted to determine whether it would be more cost effective for low flow facilities to have their CHWC wastewaters hauled off-site and treated/disposed at a CWT facility, as opposed to on-site wastewater treatment. Total annual costs for new or upgraded wastewater treatment facilities were compared to the costs for off-site treatment at a CWT facility. Off-site disposal costs were estimated at $0.25 per gallon of wastewater treated. Transportation costs were added to the off-site treatment costs at a rate of $3.00 per loaded mile using an average distance of 250 miles to the treatment facility. Transportation costs were based upon the use of a 5,000 gallon tanker truck load. Facilities which treat their wastewaters off-site are considered zero dischargers and hence would not incur ancillary costs such as residual disposal, monitoring and land, except for permit modification costs. After review and comparison of costs, EPA found off-site disposal costs to be cost prohibitive because it was more expensive than on-site treatment. Therefore none of the eight facilities were costed for off-site disposal.

7.6 COSTS FOR REGULATORY OPTIONS

The following sections present the treatment costs for complying with the CHWC guideline for the BPT/BCT/BAT, PSES, NSPS, and PSNS options.

7.6.1 *BPT/BCT/BAT Costs*

One BPT/BCT/BAT option was selected based upon the treatment technology sampled at a selected facility. Engineering costs for this BPT/BCT/BAT option is presented below.

7.6.1.1 BPT/BCT/BAT Option: Two-Stage Chemical Precipitation and Sand Filtration

The BPT/BCT/BAT option consists of a two-stage chemical precipitation treatment system using sodium hydroxide in the first precipitation stage with ferric chloride and sodium hydroxide in the second stage. Sodium bisulfite is used at the head of the treatment system for hexavalent chromium removal. A sand filter is provided at the end of the treatment system to polish the effluent. Sludge dewatering is also provided in this option. Table 7-10 presents the total capital and O&M costs for this option. This table also presents the total amortized annual cost for each facility.

7.6.2 *PSES Costs*

One PSES option was selected based upon the technology sampled at a selected facility. This PSES option is equivalent to the BPT/BCT/BAT option presented above. Engineering costs for this PSES option is presented below.

7.6.2.1 PSES Option: Two-Stage Chemical Precipitation and Sand Filtration

The PSES option consists of a two-stage chemical precipitation treatment system using sodium hydroxide in the first precipitation stage with ferric chloride and sodium hydroxide in the second stage. Sodium bisulfite is used at the head of the treatment system for hexavalent chromium removal. A sand filter is provided at the end of the treatment system. Sludge dewatering is also provided in this option. This PSES option is equivalent to the BPT/BCT/BAT option. Table 7-10 (previously referenced) presents the total capital and O&M costs for this option. This table also presents the total amortized annual cost for each facility.

7.6.3 *New Source Performance Standards Costs*

The New Source Performance Standards (NSPS) for the CHWC Industry are equivalent to the limitations for the BPT/BCT/BAT option. Therefore, NSPS consists of a two-stage chemical precipitation treatment system using sodium hydroxide in the first precipitation stage with ferric chloride and sodium hydroxide in the second stage. Sodium bisulfite is used at the head of the treatment system for hexavalent chromium reduction. A sand filter is provided at the end of the treatment system to polish the effluent. Sludge dewatering is also provided in this option. NSPS costs were estimated using an industry average flow rate of approximately 280,948 gpd and loadings similar to the representative BPT/BCT/BAT facility (see Section 6). The total NSPS amortized annual cost is $550,248 assuming an average facility daily flow of 280,948 gpd. A breakdown of the NSPS capital and O&M costs are presented on Table 7-11.

7.6.4 *Pretreatment Standards for New Sources Costs*

The Pretreatment Standards for New Sources (PSNS) for the CHWC Industry is equivalent to the limitations for the PSES option. This option is also equivalent to the BPT/BCT/BAT option. Therefore, PSNS consists of a two-stage chemical precipitation treatment system using sodium hydroxide in the first precipitation stage with ferric chloride and sodium hydroxide in the second stage. Sodium bisulfite is used

Table 7-10. Summary of Costs - BPT/BCT/BAT/PSES Final

	AVERAGE FLOWRATE (gpd)	CAPITAL COSTS ($)					AMORTIZED TOTAL CAPITAL* ($/YR)	O & M COSTS ($/YR)				TOTAL ANNUAL COST ($/YR)
ID#		EQUIPMENT	RETROFIT & UPGRADE	PERMIT MODIFICATION	LAND	TOTAL CAPITAL		EQUIPMENT	SOLIDS DISPOSAL	MONITORING	TOTAL O & M	
5736	144,290	611,635	152,909	0	61,158	825,701	90,658	140,834	6,715	32,454	180,003	270,661
5737	174,360	0	0	0	0	0	0	0	0	31,078	31,078	31,078
5761	510,490	880,521	220,130	0	193,198	1,293,849	142,058	178,681	23,586	30,678	232,945	375,002
5765	47,340	757,143	0	0	237,628	994,771	109,221	184,273	29,186	20,010	233,469	342,690
5782	114,010	496,348	124,087	0	23,000	643,435	70,646	100,143	6,606	20,628	127,377	198,023
5797	135,580	528,301	132,075	0	51,488	711,864	78,159	104,742	6,116	20,910	131,768	209,927
5798	1,007,640	874,679	218,670	0	102,976	1,196,325	131,350	244,830	47,994	30,686	323,510	454,860
5720	113,870	1,183,603	0	0	45,530	1,229,133	134,952	285,533	76,606	35,470	397,610	532,562
TOTALS	2,247,580	5,332,230	847,871	0	714,978	6,895,079	757,043	1,239,035	196,810	221,914	1,657,759	2,414,802

*Assuming 7% interest over a fifteen year period.

NOTE: Due to low flow, costs for 5037 and 5624 were calculated based on off-site disposal cost

Table 7-11. Summary of Costs - NSPS/PSNS

	AVERAGE FLOWRATE (gpd)	CAPITAL COSTS ($)					AMORTIZED TOTAL CAPITAL* ($/YR)	O & M COSTS ($/YR)				TOTAL ANNUAL COST ($/YR)
TYPE		EQUIPMENT	RETROFIT & UPGRADE	PERMIT MODIFICATION	LAND	TOTAL CAPITAL		EQUIPMENT	SOLIDS DISPOSAL	MONITORING	TOTAL O & M	
NSPS	280,948	1,693,819	0	0	149,176	1,842,995	202,351	298,300	14,128	35,470	347,897	550,248
PSNS	280,948	1,693,819	0	0	149,176	1,842,995	202,351	298,300	14,128	35,470	347,897	550,248

*Assuming 7% interest over a fifteen year period.

at the head of the treatment system for hexavalent chromium reduction. Sludge dewatering is also provided in this option. PSNS costs were estimated using an industry average flow rate of approximately 280,948 gpd and loadings similar to the representative BPT/BCT/BAT facility (see Section 6.0). The total PSNS amortized annual cost is $550,248 assuming an average facility flow of 280,948 gpd. A breakdown of the PSNS capital and O&M costs are presented on Table 7-11, referenced above.

SECTION 8

DEVELOPMENT OF LIMITATIONS AND STANDARDS

This section describes various waste treatment technologies and their costs, pollutants chosen for regulation, and pollutant reductions associated with the different treatment technologies evaluated for the final effluent limitations guidelines and standards for the Commercial Hazadous Waste Combustor (CHWC) Industry. The limitations and standards discussed in this section are Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), Best Available Technology Economically Achievable (BAT), New Source Performance Standards (NSPS), Pretreatment Standards for Existing Sources (PSES), and Pretreatment Standards for New Sources (PSNS).

For this rule, EPA has combined the presentation of the final regulatory option for direct and indirect dischargers. EPA has combined these because there are no differences between direct and indirect discharges with respect to the characteristics of wastewater generated or the model process technologies considered to develop the final limitations and standards, as well as to prevent the disclosure of confidential business information.

8.1 ESTABLISHMENT OF BPT/BCT/BAT/PSES

Generally, EPA bases BPT upon the average of the best current performance (in terms of pollutant removals in treated effluent) by facilities of various sizes, ages, and unit processes within an industry subcategory. The factors considered in establishing BPT include: (1) the total cost of applying the technology relative to pollutant reductions, (2) the age of process equipment and facilities, (3) the processes employed and required process changes, (4) the engineering aspects of the control technology, (5) non-water quality environmental impacts such as energy requirements, air pollution, and solid waste generation, and (6) such other factors as the Administrator deems appropriate (Section 304(b)(2)(B) of the Act.) As noted, BPT technology represents the average of the best existing performances of facilities within the industry. EPA looks at the performance of the best operated treatment systems and calculates limitations from some level of average performance of these "best" facilities. For example, in the BPT limitations for the Oragnic Chemicals, Plastics, and Synthetic Fibers (OCPSF) Category, EPA identified "best" facilities on a BOD performance criteria of achieving a 95 percent BOD removal or a BOD effluent level of 40 mg/l (52 FR 42535, November 5, 1987). When existing performance is uniformly inadequate, EPA may require a higher level of control than is currently in place in an industrial category if EPA determines that the technology can be practically applied. BPT may be transferred from a different subcategory or category. However, BPT normally focuses on end-of-process treatment rather than process changes or internal controls, except when these technologies are common industry practice.

The cost/effluent reduction inquiry for BPT is a limited balancing one, committed to EPA's discretion, that does not require the Agency to quantify effluent reduction benefits in monetary terms. (See, e.g., American Iron and Steel v. EPA, 526 F. 2d 1027 (3rd Cir., 1975.)) In balancing costs against the effluent reduction benefits, EPA considers the volume and nature of discharges expected after application of BPT, the general environmental effects of pollutants, and the cost and economic impacts of the required level of pollution control. In developing guidelines, the Act does not require or permit consideration of water quality problems attributable to particular point sources, or water quality improvements in particular bodies of water. Therefore, EPA has not considered these factors in developing the final limitations. (See Weyerhaeuser Company v. Costle, 590 F. 2d 1011 (D.C. Cir. 1978.))

EPA set BAT effluent limitations for the CHWC Industry based upon the same technologies evaluated for BPT. The final BAT effluent limitations control identified priority and non-conventional pollutants discharged from facilities. EPA has not identified any more stringent treatment technology option which it considered to represent BAT level of control applicable to facilities in this industry.

EPA considered and rejected zero discharge as possible BAT technology for the following reasons. EPA determined that combustors have two main options for achieving zero discharge -- off-site disposal or on-site incineration. Facilities will likely choose off-site disposal where the cost of on-site incineration is greater than the cost of off-site disposal. But off-site disposal ultimately results in some pollutant discharge to surface waters which will exceed the level achieved by BPT unless the limitations and standards applicable to the off-site treater are equivalent to this guideline. EPA is concerned that adopting a BAT zero discharge requirement may, in actuality, result in fewer effluent reductions than expected from today’s limitations and standards. The second option for zero discharge is on-site disposal/elimination. In this case, a facility must either incinerate its scrubber water or replace its wet scrubbing system with a dry scrubber. EPA has determined that on-site incineration would be more expensive than off-site disposal and therefore would result in off-site treatment. Similarly, EPA believes, but cannot confirm, that the cost of changing air pollution control systems is probably so high that a combustor would send its scrubber water off-site for treatment. Moreover, even if the cost is not greater, EPA found that replacement of wet scrubbing systems with dry scrubbers may result in an unstable solid (as opposed to the stable solids generated in wastewater treatment systems) that must be disposed of in a landfill, with potentially adverse, non-water quality effects. Consequently, EPA determined that zero discharge is not, in fact, the best available technology. EPA is promulgating BAT limitations equal to the BPT limitations for the non-conventional and priority pollutants covered under BPT.

Section 307(b) requires EPA to promulgate pretreatment standards to prevent the introduction into POTWs of pollutants that are not susceptible to treatment or which would interfere with the operation of POTWs. EPA is establishing PSES for this industry to prevent pass through of the same pollutants controlled by BAT from POTWs to waters of the U.S.

EPA considered the same regulatory options as in the BPT analysis to reduce the discharge of pollutants by CHWC facilities. The Agency is proposing to adopt PSES pretreatment standards based on the same technology as BAT.

As discussed in Sections 2 and 6, EPA concluded that three of the facilities it surveyed are using best practicable, currently available technology. Thus, the final BPT/BCT/BAT/PSES effluent limitations are based on the data from three treatment systems.

As pointed out previously, CHWC facilities burn highly variable wastes that, in many cases, are process residuals and sludges from other point source categories. The wastewater produced in combustion of these wastes contains a wide variety of metals. Chemical precipitation for these metals at a single pH is not adequate treatment for metals removal from such a highly variable waste stream. EPA's review of existing permit limitations for the direct dischargers show that, in most cases, the dischargers are subject to "best professional judgment" (BPJ) concentration limitations which were developed from guidelines for facilities treating and discharging much more specific waste streams (e.g. Metal Finishing limitations).

Specifically, EPA has based the final BPT/BCT/BAT/PSES effluent limitations on data from the CHWC facility used in the development of the proposed IWC limitations as well as data from two other CHWC facilities that submitted sampling data to EPA (See 64 FR 26714, May 17, 1999) following proposal of the IWC rule. Based on a thorough analysis of the sampling data, EPA considered only one option for the final BPT/BCT/BAT/PSES limitations. EPA concluded that a two-stage precipitation process with or without a sand filtration polishing step provided the greatest overall pollutant removals at a cost that is economically achievable at most CHWC facilities. Consequently, EPA has based the final limitations on this treatment technology.

In determining BPT/BCT/BAT/PSES, EPA evaluated metals precipitation as the principal treatment practice within the CHWC Industry. Seven of the eight facilities in the CHWC Industry currently use some type of metals precipitation as a means for waste treatment. The precipitation techniques used by facilities varied in the treatment chemicals used and in the number of stages of precipitation used.

The currently available treatment system for which the EPA assessed performance for BPT/BCT/BAT/PSES is:

- *Option 1 - Chromium Reduction (as necessary), Primary Precipitation, Solid-Liquid Separation, Secondary Precipitation, Solid-Liquid Separation, with (or without) Sand Filtration.* Under Option 1, BPT/BCT/BAT/PSES limitations and standards would be based upon two stages of chemical precipitation, each followed by some form of separation and sludge dewatering. The pHs used for the two stages of chemical precipitation would be different in order to promote optimal removal of metals because different metals are preferentially removed at different pH levels. In addition, the first stage of chemical precipitation is preceded by chromium reduction, when necessary. Also, sand filtration is used at the end of the treatment train, when necessary. In some cases, BPT/BCT/BAT/PSES limitations and standards would require the current treatment technologies in place to be improved by use of increased quantities of treatment chemicals and additional chemical precipitation/sludge dewatering systems.

The Agency is promulgating BPT/BCT/BAT effluent limitations for 11 pollutants and PSES for 10 pollutants for the CHWC Industry. These limitations and standards were developed based on an engineering evaluation of the average level of pollutant reduction achieved through application of the best practical control technology currently available for the discharges of the regulated pollutants. The daily maximum and monthly average BPT/BCT/BAT limitations and PSES standards for the CHWC Industry are presented in Tables 8-1 and 8-2, respectively. Long-term averages, daily variability factors and monthly variability factors for the selected technology are also presented in Tables 8-1 and 8-2. A combination of two different methodologies was used in the development of the variability factors (monthly and daily). Specifically, pollutant-specific variability factors were calculated and used when a metal pollutant was detected a sufficient number of times in the effluent sampling data. However, when a metal pollutant could not be calculated using the effluent sampling data due to the fact that too few points were detected above the minimum level, a group-level variability factor was used. The group-level variability factor is the mean of the pollutant-level variability factors calculated for the entire group of metals found in significant concentrations in the facility used to estimate variability for the CHWC Industry. These metals are: aluminum, antimony, arsenic, boron, cadmium, copper, iron, manganese, molybdenum, selenium, titanium and zinc. The *Statistical Support Document of Proposed Effluent Limitations Guidelines and Standards for Industrial Waste Combustors* (EPA 821-B-99-010) provides more detailed information on the development of the limitations for this option.

Table 8-1. BPT/BCT/BAT Effluent Limitations (ug/l)

Pollutant or Pollutant Parameter	Long-Term Average (ug/l)	Daily Variability Factor (Rounded)	Monthly Variability Factor (Rounded)	Maximum for Any One Day (ug/l)	Monthly Average (ug/l)
Conventional Pollutants					
TSS	27,200	4.2	1.3	113,000	34,800
pH					(1)
Priority and Non-Conventional Pollutants					
Arsenic	41.8	2.0	2.0	84	72
Cadmium	11.4	6.2	2.2	71	26

Pollutant or Pollutant Parameter	Long-Term Average (ug/l)	Daily Variability Factor (Rounded)	Monthly Variability Factor (Rounded)	Maximum for Any One Day (ug/l)	Monthly Average (ug/l)
Chromium	10	2.5	1.5	25	14
Copper	10.7	2.2	1.3	23	14
Lead	22.4	2.5	1.5	57	32
Mercury	0.899	2.5	1.5	2.3	1.3
Silver	5.27	2.5	1.5	13	8
Titanium	10.0	6.0	2.2	60	22
Zinc	37.3	2.2	1.5	82	54

(1)Within the range 6.0 to 9.0 pH units.

Table 8-2. PSES Pretreatment Standards (ug/l)

Pollutant or Pollutant Parameter	Long-Term Average (ug/l)	Daily Variability Factor (Rounded)	Monthly Variability Factor (Rounded)	Maximum for Any One Day (ug/l)	Monthly Average (ug/l)
Priority and Non-Conventional Pollutants					
Arsenic	41.8	2.0	2.0	84	72
Cadmium	11.4	6.2	2.2	71	26
Chromium	10	2.5	1.5	25	14
Copper	10.7	2.2	1.3	23	14
Lead	22.4	2.5	1.5	57	32
Mercury	0.899	2.5	1.5	2.3	1.3
Silver	5.27	2.5	1.5	13	8
Titanium	10.0	6.0	2.2	60	22
Zinc	37.3	2.2	1.5	82	54

EPA's decision to base BPT limitations on the selected treatment reflects primarily an evaluation of three factors: the degree of effluent reduction attainable, the total cost of the proposed treatment technologies in relation to the effluent reductions achieved, and potential non-water quality benefits. No basis could be found for identifying different BPT limitations based on age, size, process or other engineering factors. Neither the age nor the size of the CHWC facility will significantly affect either the character or treatability of the wastes or the cost of treatment. Further, the treatment process and engineering aspects of the technologies considered have a relatively insignificant effect because in most cases they represent fine tuning or add-ons to treatment technology already in use. These factors consequently did not weigh heavily in the development of these guidelines.

The Agency has concluded that this treatment system represents the best practicable technology currently available and should be the basis for the BPT limitations for the following reasons. First, the demonstrated effluent reductions attainable through this control technology represent performance that may be achieved through the application of demonstrated treatment measures currently in operation in this industry. Three facilities employing the identified BPT technology were used in the database to calculate the effluent limitations. This database reflects technology and removals readily applicable to all facilities. Second, the adoption of this level of control would represent a significant reduction in pollutants discharged into the environment (approximately 94,000 pounds of TSS and metals). Third, the Agency assessed the total cost of water pollution controls likely to be incurred, in relation to the effluent reduction benefits and found those costs were reasonable. The pretax total estimated annualized cost in 1998 dollars is approximately $2.9 million at the eight direct and indirect discharging facilities. EPA's assessment shows that one of the eight CHWC facilities will experience a line closure as a result of the installation of the necessary technology.

EPA set BCT equivalent to the BPT guidelines for the conventional pollutants covered under BPT. In developing BCT limits, EPA considered whether there are technologies that achieve greater removals of conventional pollutants than for BPT, and whether those technologies are cost-reasonable according to the BCT Cost Test. EPA identified no technologies that can achieve greater removals of conventional pollutants than for BPT that are also cost-reasonable under the BCT Cost Test, and accordingly, EPA set BCT effluent limitations equal to the BPT effluent limitations guidelines and pretreatment standards.

8.2 NSPS

As previously noted, under Section 306 of the Act, new industrial direct dischargers must comply with standards which reflect the greatest degree of effluent reduction achievable through application of the best available demonstrated control technologies. Congress envisioned that new treatment systems could meet tighter controls than existing sources because of the opportunity to incorporate the most efficient processes and treatment systems into plant design. Therefore, Congress directed EPA to consider the best demonstrated process changes, in-plant controls, operating methods and end-of-pipe treatment technologies that reduce pollution to the maximum extent feasible.

EPA proposed to establish NSPS equal to BPT/BCT/BAT for all conventional, non-conventional and priority pollutants covered under BPT. EPA has decided that it should not promulgate NSPS based on any more stringent technology. EPA considered basing NSPS on zero discharge but has rejected this technology. As explained above, EPA has concluded that zero discharge may not ultimately result in any reduction in effluent discharges relative to BPT/BCT/BAT levels or it may have unacceptable non-water quality effects.

EPA is promulgating NSPS that would control the same conventional, priority, and non-conventional pollutants as the BPT effluent limitations. The technologies used to control pollutants at existing facilities are fully applicable to new facilities. Therefore, EPA is promulgating NSPS limitations that are identical to BPT/BCT/BAT/PSES.

EPA considered the cost of the NSPS technology for new facilities. EPA concluded that such costs are not so great as to present a barrier to entry, as demonstrated by the fact that currently operating facilities are using these technologies. The Agency considered energy requirements and other non-water quality environmental impacts and found no basis for any different standards than the selected NSPS.

8.3 PSNS

Section 307(c) of the Act requires EPA to promulgate pretreatment standards for new sources (PSNS) at the same time it promulgates new source performance standards (NSPS). New indirect discharging facilities, like new direct discharging facilities, have the opportunity to incorporate the best available demonstrated technologies, process changes, in-facility controls, and end-of-pipe treatment technologies.

As set forth in Section 5.3 of this document, EPA determined that all of the pollutants selected for regulation for the CHWC Industry pass through POTWs. The same technologies discussed previously for BPT, BCT, BAT, NSPS, and PSES are available as the basis for PSNS.

EPA promulgated pretreatment standards for new sources equal to PSES for priority and non-conventional pollutants. The Agency is establishing PSNS for the same priority and non-conventional pollutants as for PSES. EPA considered the cost of the proposed PSNS technology for new facilities. EPA concluded that such costs are not so great as to present a barrier to entry, as demonstrated by the fact that currently operating facilities are using these technologies. The Agency considered energy requirements and other non-water quality environmental impacts and found no basis for any different standards than the selected PSNS.

8.4 COST OF TECHNOLOGY OPTIONS

The Agency estimated the cost for CHWC facilities to achieve each of the proposed effluent limitations and standards. All cost estimates in this section are presented in 1998 dollars. The cost components reported in this section represent estimates of the investment cost of purchasing and installing equipment, the annual operating and maintenance costs associated with that equipment and additional costs for discharge monitoring. The following sections present costs for BPT/PSES and BCT/BAT

8.4.1 *BPT and PSES Costs*

The Agency estimated the cost of implementing the BPT/PSES effluent limitations guidelines and pretreatment standards by calculating the engineering costs of meeting the required effluent limitations for each direct and indirect discharging CHWC. This facility-specific engineering cost assessment for BPT began with a review of present waste treatment technologies. For facilities without a treatment technology in place equivalent to the BPT technology, the EPA estimated the cost to upgrade its treatment technology, and to use additional treatment chemicals to achieve the new discharge standards. The only facilities given no cost for compliance were facilities with the treatment in place prescribed for the option. Details pertaining to the development of the technology costs are included in Section 7. The capital expenditures for the process change component of BPT/PSES are estimated to be approximately $8.2 million with annual O&M costs of approximately $2.0 million for the eight CHWC facilities under the selected regulatory technology option.

8.4.2 *BCT and BAT Costs*

The Agency estimated that there would be no cost of compliance for implementing BCT or BAT, because the technology is identical to BPT and the costs are included with BPT.

8.5 POLLUTANT REDUCTIONS

8.5.1 *Conventional Pollutant Reductions*

EPA has calculated how much the total quantity of conventional pollutants that are discharged would be reduced due to the adoption of the final BPT/BCT/BAT limitations. To do this, the Agency developed an estimate of the long-term average (LTA) loading of TSS that would be discharged after the implementation of BPT. Next, the BPT/BCT/BAT LTA for TSS was multiplied by 1992 wastewater flows for each direct discharging facility in the industry to calculate BPT/BCT/BAT mass discharge loadings for TSS for each facility. The BPT/BCT/BAT mass discharge loadings were subtracted from the estimated current loadings to calculate the pollutant reductions for each facility. The Agency estimates that the final regulations will reduce TSS discharges by approximately 80,000 pounds per year for the CHWC facilities. The current discharges and BPT/BCT/BAT discharges for TSS are listed in Table 8-3.

8.5.2 *Priority and Non-conventional Pollutant Reductions*

8.5.2.1 Methodology

The proposed BPT, BCT, BAT and PSES will also reduce discharges of priority and non-conventional pollutants. Applying the same methodology used to estimate conventional pollutant reductions attributable to application of BPT/BCT/BAT control technology, EPA has also estimated priority and non-conventional pollutant reductions for each facility.

Current loadings were estimated using the questionnaire data supplied by the industry, data collected by the Agency in the field sampling program, facility POTW permit information and facility NPDES permit information. For many facilities, data were not available for all pollutants of concern or without the addition of other non-CHWC wastewater. Therefore, methodologies were developed to estimate current performance for the industry (see Section 4.4 of this document).

In the construction of the plant-specific pollutant by pollutant loadings, in any case where the technology option generated an estimated pollutant loading in excess of the current loading, the option loading was set equal to the current loading. The rationale for the adoption of this methodology is consistency with and similarity to the "anti-backsliding" provisions. Also, a well designed and operated treatment system shouldn't increase pollutant loadings above current practice. (It should be noted in the situation described above, no removal of the specific pollutant at the specific plant is achieved under the technology option).

8.5.2.2 Direct and Indirect Discharges (BPT/BCT/BAT) and (PSES)

The Agency estimates that proposed BPT/BCT/BAT/PSES regulations will reduce direct and indirect discharges of priority and non-conventional pollutants by approximately 13,400 pounds per year for the eight CHWC facilities. The current discharges and BPT/BCT/BAT/PSES discharges for priority and non-conventional pollutants are listed in Table 8-3.

Table 8-3. Direct and Indirect Discharge Loads (in lbs.)

Pollutant Name	CAS NO	Current Load	BPT/BCT/BAT/PSES Option
Total Suspended Solids	C-009	157,364	76,898
Aluminum	7429905	1,479	1,003
Antimony	7440360	3,938	2,126

Pollutant Name	CAS NO	Current Load	BPT/BCT/BAT/PSES Option
Arsenic	7440382	776	108
Cadmium	7440439	379	63
Chromium	7440473	5,721	65
Copper	7440508	1,276	70
Iron	7439896	964	412
Lead	7439921	837	127
Mercury	7439976	32	5
Molybdenum	7439987	1,600	1,527
Selenium	7782492	197	88
Silver	7440224	195	34
Tin	7440315	484	272
Titanium	7440326	348	62
Zinc	7440666	1,361	236
Total		176,950	83,098

Note: One facility is projected to cease combustion operations while the facility will remain open (a line closure). The facility has been assigned 0 lbs. in the option loads.

SECTION 9
NON-WATER QUALITY IMPACTS

Section 304(b) and 306 of the Clean Water Act require EPA to consider non-water quality environmental impacts (including energy requirements) associated with effluent limitations and guidelines. Pursuant to these requirements, EPA has considered the possible effect of the Commercial Hazardous Waste Combustors (CHWC) BPT, BCT, BAT, NSPS, PSES, and PSNS regulations on air pollution, solid waste generation, and energy consumption. In evaluating the environmental impacts across all media, it has been determined that the impacts discussed below are minimal and are justified by the benefits associated with compliance with the CHWC regulations.

During CHWC wastewater treatment, the pollutants of concern are either removed from the wastewater stream or concentrated. If the pollutants are removed, they are either transferred from the wastewater stream to another medium (e.g., VOC emissions to the atmosphere) or end up as a treatment residual, such as sludge. Subsequent removal of pollutants to another media and the disposition of these wastewater treatment residuals result in non-water quality impacts. Non-water quality impacts evaluated for the CHWC Industry regulations include air pollution and solid waste generation.

Wastewater treatment also results in other, non-water, non-residual, impacts. These impacts are the consumption of energy used to power the wastewater treatment equipment.

9.1 AIR POLLUTION

CHWC facilities treat wastewater streams which contain very low concentrations of volatile organic compounds (VOCs). These concentrations for most organic pollutants are typically below treatable levels. This is due to the nearly total destruction of organic pollutants in the original wastes through the combustion process, which prevents many of these pollutants from being detected in wastewaters and from being released into the atmosphere and affecting air quality. Losses through fugitive emissions is not expected to be significant as most of the organics present in the CHWC wastewater typically have a low volatility. While the wastewater streams usually pass through collection units, cooling towers, and treatment units that are open to the atmosphere, this exposure is not expected to result in any significant volatilization of VOCs from the wastewater.

Since there are no significant air emissions generated by the selected BPT/BCT/BAT treatment technologies, EPA believes that there are essentially no adverse air quality impacts anticipated as a result of the CHWC regulations.

9.2 SOLID WASTE

Several of the wastewater treatment technologies used to comply with the CHWC regulations generate a solid waste. The costs for disposal of these waste residuals were included in the compliance cost estimates prepared for the regulatory options.

The solid waste treatment residual generated as a result of implementation of these regulations is filter cake from chemical precipitation processes. In the BPT/PSES wastewater treatment trains of the CHWC Industry, hydroxide and ferric chloride precipitation of metals generates a sludge residual. For the BPT/BCT/BAT option, backwash from the sand filter is recirculated back to the treatment system prior to the chemical precipitation processes, therefore all solids are removed from the treatment process in the clarifiers. This sludge is dewatered, and the resultant filter cake is typically disposed of off-site into a landfill. It is expected that the filter cake generated from chemical precipitation will contain high concentrations of metals. As a result, this filter cake may be a RCRA hazardous waste. Depending upon the wastewater usage and the resultant characteristics of the sludge, the sludge generated at a particular facility may be either a listed or characteristic hazardous waste, pursuant to 40 CFR 261 regulations (Identification and Listing of Hazardous Waste). These filter cakes are considered to be a characteristic hazardous waste based upon toxicity when the waste exceeds allowable standards based upon the Toxicity Characteristic Leaching Procedure or exhibits other hazardous characteristics as defined under 40 CFR 261 Subpart C (e.g., ignitability, corrosivity, or reactivity). Filter cake may also be considered a RCRA listed waste (e.g., wastes which are hazardous based upon definition as per 40 CFR 261 Subpart D) depending upon the types of wastewater produced by the combustion process and whether it is in contact with the wastes being combusted or residuals from the combustion process. EPA evaluated the cost of disposing hazardous and non-hazardous filter cake. In the CHWC economic evaluation, contract hauling for off-site disposal in a Subtitle C or D landfill was the method costed.

It is estimated that compliance with the BPT/PSES option would result in the disposal of 1.035 million pounds of hazardous and non-hazardous filter cake.

EPA believes that the disposal of this filter cake would not have an adverse effect on the environment or result in the release of pollutants in the filter cake to other media. The disposal of these wastes into controlled Subtitle D or C landfills are strictly regulated by the RCRA program. New landfills are required to meet lining requirements to prevent the release of contaminants and to capture leachate. Landfill capacity throughout the country can readily accommodate the additional solid waste expected to be generated by the institution of this regulation. For costing purposes, it was assumed that these solid wastes would be considered hazardous and will be disposed of into permitted RCRA landfills with appropriate treatment of these filter cakes prior to disposition to achieve compliance with applicable RCRA land-ban treatment requirements (e.g., stabilization) pursuant with 40 CFR 268 regulations, if necessary.

9.3 ENERGY REQUIREMENTS

In each of the regulatory options, operation of wastewater treatment equipment results in the consumption of energy. This energy is used to power pumps, mixers, and other equipment components, to power lighting and controls, and to generate heat. The CHWC BPT/BCT/BAT option would require the consumption of 1,672 thousand kilowatt-hours per year of electricity for both direct and indirect dischargers. This is the equivalent of 937 barrels per year of #2 fuel oil, as compared with the 1992 rate of consumption in the United States of 40.6 million barrels per year. The BPT/BCT/BAT option represents an increase in the production or importation of oil of 2.3×10^{-5} percent annually. Based upon this relatively low increase in oil consumption, EPA believes that the implementation of this regulation would cause no substantial impact to the oil industry.

In 1992, approximately 2,797.2 billion kilowatt hours of electric power were generated in the United States. The additional energy consumption requirements for the BPT/BCT/BAT option corresponds to approximately 5.9×10^{-7} percent of the national requirements. This increase in energy requirements to implement the BPT/PSES technologies will result in an air emissions impact from electric power generating facilities. It is expected that air emissions parameters generated by electric producing facilities, such as particulates, NO_X and SO_2, will be impacted. This increase in air emissions is expected to be directly proportional to the increase in energy requirements, or approximately 5.9×10^{-7} percent. EPA believes this additional increase in air emissions from electric generating facilities to be minimal and will result in no substantial impact to air emissions or detrimental results to air quality.

APPENDIX A

LISTING OF CHWC ANALYTES WITH AT LEAST ONE DETECT

Analyte	CAS_NO	Min. Level	Number of Obs.	Number of Detects	Mean	Min.	Max.
ACETOPHENONE	98862	10	27	1	16.7	10.0	86.0
ALUMINUM	7429905	200	27	21	2924.8	13.6	34800.0
AMENABLE CYANIDE	C-025	20	3	1	610.0	10.0	1810.0
AMMONIA AS NITROGEN	7664417	10	27	25	9244.1	100.0	75000.0
ANTIMONY	7440360	20	27	20	203.0	3.3	958.8
ARSENIC	7440382	10	27	15	236.1	1.1	1420.0
ATRAZINE	1912249	10	14	1	13.8	8.9	35.6
BARIUM	7440393	200	27	27	235.1	18.8	1158.8
BENZOIC ACID	65850	50	27	3	117041.1	50.0	3157556.0
BERYLLIUM	7440417	5	27	1	0.9	0.2	1.5
BIS(2-ETHYLHEXYL) PHTHALATE	117817	10	27	5	20.7	10.0	86.0
BISMUTH	7440699	100	25	7	164.1	0.1	887.0
BOD 5-DAY (CARBONACEOUS)	C-002	2000	27	17	491014.8	1000.0	10100000.0
BORON	7440428	100	27	26	10920.4	20.0	182000.0
BROMODICHLOROMETHANE	75274	10	27	2	12.4	10.0	58.7
CADMIUM	7440439	5	27	16	273.7	1.2	2616.0
CALCIUM	7440702	5000	27	27	181209.8	5299.0	1270000.0
CARBON DISULFIDE	75150	10	27	1	26.9	10.0	466.6
CERIUM	7440451	1000	25	4	479.6	1.0	1000.0
CHEMICAL OXYGEN DEMAND (COD)	C-004	5000	27	27	1206003.7	13000.0	19100000.0
CHLORIDE	16887006	1000	27	27	8331377.8	40000.0	28300000.0
CHLOROFORM	67663	10	27	1	10.2	10.0	15.6

APPENDIX A

LISTING OF CHWC ANALYTES WITH AT LEAST ONE DETECT

Analyte	CAS_NO	Min. Level	Number of Obs.	Number of Detects	Mean	Min.	Max.
CHROMIUM	7440473	10	27	22	222.7	3.6	1650.0
COBALT	7440484	50	27	13	21.7	2.3	221.0
COPPER	7440508	25	27	26	1390.0	8.5	10554.0
DALAPON	75990	0	11	3	0.7	0.2	1.8
DIBENZOTHIOPHENE	132650	10	27	1	16.6	10.0	86.0
DIBROMOCHLOROMETHANE	124481	10	27	2	17.1	10.0	115.5
DICAMBA	1918009	0	11	2	0.5	0.2	1.8
DICHLORPROP	120365	1	11	5	7.2	1.0	47.0
DINOSEB	88857	1	11	2	1.2	0.5	4.5
DYSPROSIUM	7429916	100	25	1	74.9	0.1	100.0
ERBIUM	7440520	100	25	1	73.9	0.1	100.0
EUROPIUM	7440531	100	25	4	73.4	0.1	100.0
FLUORIDE	16984488	100	27	27	436669.2	120.0	7500000.0
GADOLINIUM	7440542	500	25	3	209.1	0.5	500.0
GALLIUM	7440553	500	25	2	224.2	0.5	500.0
GERMANIUM	7440564	500	25	1	367.7	0.5	500.0
HAFNIUM	7440586	1000	25	1	468.6	1.0	1000.0
HEXANOIC ACID	142621	10	27	2	23.1	10.0	142.3
HEXAVALENT CHROMIUM	18540299	10	17	4	18.2	10.0	76.0
HOLMIUM	7440600	500	25	3	365.0	0.5	500.0
INDIUM	7440746	1000	25	4	489.4	1.0	1000.0
IODINE	7553562	1000	20	6	4301.3	500.0	20798.1

APPENDIX A

LISTING OF CHWC ANALYTES WITH AT LEAST ONE DETECT

Analyte	CAS_NO	Min. Level	Number of Obs.	Number of Detects	Mean	Min.	Max.
IRIDIUM	7439885	1000	25	7	539.7	1.0	1708.0
IRON	7439896	100	27	27	6241.6	149.0	50600.0
ISOPHORONE	78591	10	27	1	16.5	10.0	86.0
LANTHANUM	7439910	100	25	2	74.8	0.1	100.0
LEAD	7439921	50	27	18	1609.7	2.1	13248.0
LITHIUM	7439932	100	25	12	177.5	29.1	532.8
LUTETIUM	7439943	100	25	2	72.3	0.1	100.0
MAGNESIUM	7439954	5000	27	27	18968.0	1080.0	316000.0
MANGANESE	7439965	15	27	27	173.0	4.0	1534.6
MCPA	94746	50	11	4	334.0	50.0	1980.0
MCPP	7085190	50	11	4	383.7	50.0	2594.0
MERCURY	7439976	0	27	19	26.2	0.1	217.0
METHYLENE CHLORIDE	75092	10	27	2	10.1	10.0	12.5
MOLYBDENUM	7439987	10	27	19	245.4	4.0	1024.4
MONOCROTOPHOS	6923224	2	3	1	2.0	2.0	2.0
N-DECANE	124185	10	27	1	44.9	10.0	780.0
N-DOCOSANE	629970	10	27	1	17.0	10.0	86.0
N-DODECANE	112403	10	27	1	18.1	10.0	86.0
N-EICOSANE	112958	10	27	1	18.4	10.0	86.0
N-HEXACOSANE	630013	10	27	2	19.5	10.0	92.9
N-OCTACOSANE	630024	10	27	2	20.3	10.0	95.7
N-TETRADECANE	629594	10	27	1	17.0	10.0	86.0

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LISTING OF CHWC ANALYTES WITH AT LEAST ONE DETECT

Analyte	CAS_NO	Min. Level	Number of Obs.	Number of Detects	Mean	Min.	Max.
N-TRIACONTANE	638686	10	27	2	17.3	10.0	86.0
NEODYMIUM	7440008	500	25	7	214.4	0.5	500.0
NICKEL	7440020	40	27	19	166.6	4.5	872.0
NIOBIUM	7440031	1000	25	7	482.7	29.3	1000.0
NITRATE/NITRITE	C-005	50	27	27	3769.0	210.0	33280.0
NORFLURAZON	27314132	1	14	1	1.9	1.0	8.9
OCDD	3268879	0	27	11	0.0	0.0	0.0
OCDF	39001020	0	27	7	0.0	0.0	0.0
OIL AND GREASE	C-036	5000	24	3	63875.0	5000.0	1350000.0
OSMIUM	7440042	100	25	1	75.2	0.1	100.0
P-CRESOL	106445	10	27	1	425.5	10.0	11056.8
PHENOL	108952	10	27	3	4936.9	10.0	132818.0
PHOSPHORUS	7723140	1000	20	18	17222.9	204.7	225800.0
PLATINUM	7440064	1000	25	4	488.5	1.0	1000.0
POTASSIUM	7440097	1000	20	19	112658.6	478.6	805000.0
PRASEODYMIUM	7440100	1000	25	3	723.0	1.0	3910.0
RHENIUM	7440155	1000	25	5	530.6	19.4	1000.0
RHODIUM	7440166	1000	25	3	732.1	1.0	1000.0
RUTHENIUM	7440188	1000	25	4	471.5	1.0	1000.0
SAMARIUM	7440199	500	25	4	369.3	0.5	500.0
SCANDIUM	7440202	100	25	4	72.3	0.1	100.0
SELENIUM	7782492	5	27	17	86.4	0.5	429.2

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LISTING OF CHWC ANALYTES WITH AT LEAST ONE DETECT

Analyte	CAS_NO	Min. Level	Number of Obs.	Number of Detects	Mean	Min.	Max.
SILICON	7440213	100	25	24	26447.4	28.2	340000.0
SILVER	7440224	10	27	13	72.3	1.0	390.8
SODIUM	7440235	5000	27	27	7414026.5	6400.0	62400000.0
STRONTIUM	7440246	100	25	19	650.9	32.7	4190.0
SULFUR	7704349	1000	20	20	11699602.3	2145.0	174000000.0
TANTALUM	7440257	500	25	1	364.4	0.5	500.0
TERBIUM	7440279	500	25	4	370.7	0.5	500.0
THALLIUM	7440280	10	27	5	8.3	1.2	20.2
THORIUM	7440291	1000	25	2	477.5	1.0	1000.0
THULIUM	7440304	500	25	3	362.2	0.5	500.0
TIN	7440315	30	27	15	451.3	14.5	6046.0
TITANIUM	7440326	5	27	21	638.2	2.2	4474.2
TOTAL CYANIDE	57125	20	17	5	202.3	10.0	3160.0
TOTAL DISSOLVED SOLIDS	C-010	10	27	27	23962622.2	89000.0	185000000.0
TOTAL ORGANIC CARBON (TOC)	C-012	1000	27	9	179621.5	1700.0	4540000.0
TOTAL PHENOLS	C-020	50	27	7	5525.7	6.0	146000.0
TOTAL PHOSPHORUS	14265442	10	27	24	1173.3	10.0	4520.0
TOTAL SULFIDE (IODOMETRIC)	18496258	1000	27	22	88296.7	10.0	1180000.0
TOTAL SUSPENDED SOLIDS	C-009	4000	27	19	112529.6	1000.0	522000.0
TRIBROMOMETHANE	75252	10	27	2	19.2	10.0	162.4
TRICHLOROFLUOROMETHANE	75694	10	27	1	11.1	10.0	39.6
TUNGSTEN	7440337	1000	25	5	559.6	93.2	1000.0

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LISTING OF CHWC ANALYTES WITH AT LEAST ONE DETECT

Analyte	CAS_NO	Min. Level	Number of Obs.	Number of Detects	Mean	Min.	Max.
URANIUM	7440611	1000	25	11	4697.9	10.1	67100.0
VANADIUM	7440622	50	27	16	70.7	1.7	488.2
YTTERBIUM	7440644	100	25	1	73.1	0.1	100.0
YTTRIUM	7440655	5	27	4	3.5	0.4	7.4
ZINC	7440666	20	27	27	4482.3	44.7	28569.0
ZIRCONIUM	7440677	100	25	5	152.0	0.1	1310.0
1234678-HPCDD	35822469	0	27	7	0.0	0.0	0.0
1234678-HPCDF	67562394	0	27	9	0.0	0.0	0.0
123478-HXCDD	39227286	0	27	1	0.0	0.0	0.0
123478-HXCDF	70648269	0	27	4	0.0	0.0	0.0
1234789-HPCDF	55673897	0	27	3	0.0	0.0	0.0
123678-HXCDD	57653857	0	27	1	0.0	0.0	0.0
123678-HXCDF	57117449	0	27	4	0.0	0.0	0.0
12378-PECDD	40321764	0	27	1	0.0	0.0	0.0
12378-PECDF	57117416	0	27	2	0.0	0.0	0.0
123789-HXCDD	19408743	0	27	2	0.0	0.0	0.0
123789-HXCDF	72918219	0	27	1	0.0	0.0	0.0
2-BUTANONE	78933	50	27	1	73.3	49.9	678.2
2-PROPANONE	67641	50	27	4	56.8	49.9	141.5
2-PROPEN-1-OL	107186	10	27	2	15.8	10.0	93.9
2,4-D	94757	1	11	2	2.5	1.0	8.9
2,4-DB	94826	2	11	1	4.6	2.0	17.9

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LISTING OF CHWC ANALYTES WITH AT LEAST ONE DETECT

Analyte	CAS_NO	Min. Level	Number of Obs.	Number of Detects	Mean	Min.	Max.
2,4,5-T	93765	0	11	1	0.5	0.2	1.8
2,4,5-TP	93721	0	11	2	0.5	0.2	1.8
234678-HXCDF	60851345	0	27	5	0.0	0.0	0.0
23478-PECDF	57117314	0	27	3	0.0	0.0	0.0
2378-TCDD	1746016	0	27	1	0.0	0.0	0.0
2378-TCDF	51207319	0	27	4	0.0	0.0	0.0

APPENDIX B

LISTING OF CHWC ANALYTES WITH NO DETECTS

Analyte	CAS_NO	Min. Level	Number of Obs.
ACENAPHTHENE	83329	10	27
ACENAPHTHYLENE	208968	10	27
ACEPHATE	30560191	20	14
ACIFLUORFEN	50594666	10	14
ACRYLONITRILE	107131	50	27
ALACHLOR	15972608	0	14
ALDRIN	309002	0	14
ALPHA-BHC	319846	0	14
ALPHA-CHLORDANE	5103719	0	14
ALPHA-TERPINEOL	98555	10	27
ANILINE	62533	10	27
ANILINE, 2,4,5-TRIMETHYL-	137177	20	27
ANTHRACENE	120127	10	27
ARAMITE	140578	50	27
AZINPHOS ETHYL	2642719	2	11
AZINPHOS METHYL	86500	1	11
BENFLURALIN	1861401	0	14
BENZANTHRONE	82053	50	27
BENZENE	71432	10	27
BENZENETHIOL	108985	10	27
BENZIDINE	92875	50	27
BENZO(A)ANTHRACENE	56553	10	27

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Analyte	CAS_NO	Min. Level	Number of Obs.
BENZO(A)PYRENE	50328	10	27
BENZO(B)FLUORANTHENE	205992	10	27
BENZO(GHI)PERYLENE	191242	20	27
BENZO(K)FLUORANTHENE	207089	10	27
BENZONITRILE, 3,5-DIBROMO-4-HYDROXY-	1689845	50	27
BENZYL ALCOHOL	100516	10	27
BETA-BHC	319857	0	14
BETA-NAPHTHYLAMINE	91598	50	27
BIPHENYL	92524	10	27
BIPHENYL, 4-NITRO	92933	10	27
BIS(2-CHLOROETHOXY)METHANE	111911	10	27
BIS(2-CHLOROETHYL) ETHER	111444	10	27
BIS(2-CHLOROISOPROPYL) ETHER	108601	10	27
BROMACIL	314409	1	14
BROMOMETHANE	74839	50	27
BROMOXYNIL OCTANOATE	1689992	1	14
BUTACHLOR	23184669	1	14
BUTYL BENZYL PHTHALATE	85687	10	27
CAPTAFOL	2425061	2	14
CAPTAN	133062	1	14
CARBAZOLE	86748	20	27
CARBOPHENOTHION	786196	1	14

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Analyte	CAS_NO	Min. Level	Number of Obs.
CHLORFENVINPHOS	470906	2	11
CHLOROACETONITRILE	107142	10	27
CHLOROBENZENE	108907	10	27
CHLOROBENZILATE	510156	1	14
CHLOROETHANE	75003	50	27
CHLOROMETHANE	74873	50	27
CHLORONEB	2675776	1	14
CHLOROPROPYLATE	5836102	10	14
CHLOROTHALONIL	1897456	0	14
CHLORPYRIFOS	2921882	2	11
CHRYSENE	218019	10	27
CIS-PERMETHRIN	61949766	2	14
CIS-1,3-DICHLOROPROPENE	10061015	10	27
COUMAPHOS	56724	5	11
CROTONALDEHYDE	4170303	50	27
CROTOXYPHOS	7700176	99	27
DACTHAL (DCPA)	1861321	0	14
DEF	78488	2	11
DELTA-BHC	319868	0	14
DEMETON A	8065483A	2	11
DEMETON B	8065483B	2	11
DI-N-BUTYL PHTHALATE	84742	10	27

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LISTING OF CHWC ANALYTES WITH NO DETECTS

Analyte	CAS_NO	Min. Level	Number of Obs.
DI-N-OCTYL PHTHALATE	117840	10	27
DI-N-PROPYLNITROSAMINE	621647	20	27
DIALLATE A	2303164A	2	14
DIALLATE B	2303164B	2	14
DIAZINON	333415	2	11
DIBENZO(A,H)ANTHRACENE	53703	20	27
DIBENZOFURAN	132649	10	27
DIBROMOMETHANE	74953	10	27
DICHLOFENTHION	97176	2	11
DICHLONE	117806	2	14
DICHLORVOS	62737	5	11
DICOFOL	115322	1	14
DICROTOPHOS	141662	5	3
DIELDRIN	60571	0	14
DIETHYL ETHER	60297	50	27
DIETHYL PHTHALATE	84662	10	27
DIMETHOATE	60515	1	11
DIMETHYL PHTHALATE	131113	10	27
DIMETHYL SULFONE	67710	10	27
DIOXATHION	78342	5	3
DIPHENYL ETHER	101848	10	27
DIPHENYLAMINE	122394	10	27

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Analyte	CAS_NO	Min. Level	Number of Obs.
DIPHENYLDISULFIDE	882337	20	27
DISULFOTON	298044	2	11
ENDOSULFAN I	959988	0	14
ENDOSULFAN II	33213659	1	14
ENDOSULFAN SULFATE	1031078	0	14
ENDRIN	72208	0	14
ENDRIN ALDEHYDE	7421934	0	14
ENDRIN KETONE	53494705	0	14
EPN	2104645	2	11
ETHALFLURALIN	55283686	0	14
ETHANE, PENTACHLORO-	76017	20	27
ETHION	563122	2	11
ETHOPROP	13194484	2	11
ETHYL CYANIDE	107120	10	27
ETHYL METHACRYLATE	97632	10	27
ETHYL METHANESULFONATE	62500	20	27
ETHYLBENZENE	100414	10	27
ETHYLENETHIOUREA	96457	20	27
ETRIDIAZOLE	2593159	0	6
FAMPHUR	52857	5	11
FENARIMOL	60168889	0	14
FENSULFOTHION	115902	5	11

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LISTING OF CHWC ANALYTES WITH NO DETECTS

Analyte	CAS_NO	Min. Level	Number of Obs.
FENTHION	55389	2	11
FLUORANTHENE	206440	10	27
FLUORENE	86737	10	27
GAMMA-BHC	58899	0	14
GAMMA-CHLORDANE	5103742	0	14
GOLD	7440575	1000	25
HEPTACHLOR	76448	0	14
HEPTACHLOR EPOXIDE	1024573	0	14
HEXACHLOROBENZENE	118741	10	27
HEXACHLOROBUTADIENE	87683	10	27
HEXACHLOROCYCLOPENTADIENE	77474	10	27
HEXACHLOROETHANE	67721	10	27
HEXACHLOROPROPENE	1888717	20	27
HEXAMETHYLPHOSPHORAMIDE	680319	2	3
INDENO(1,2,3-CD)PYRENE	193395	20	27
IODOMETHANE	74884	10	27
ISOBUTYL ALCOHOL	78831	10	27
ISODRIN	465736	0	14
ISOPROPALIN	33820530	0	14
ISOSAFROLE	120581	10	27
KEPONE	143500	1	14
LEPTOPHOS	21609905	2	11

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Analyte	CAS_NO	Min. Level	Number of Obs.
LONGIFOLENE	475207	50	27
M-XYLENE	108383	10	27
MALACHITE GREEN	569642	10	27
MALATHION	121755	2	11
MERPHOS	150505	2	8
MESTRANOL	72333	20	27
METHAPYRILENE	91805	10	27
METHOXYCHLOR	72435	0	14
METHYL CHLORPYRIFOS	5598130	2	11
METHYL METHACRYLATE	80626	10	27
METHYL METHANESULFONATE	66273	20	27
METHYL PARATHION	298000	2	11
METHYL TRITHION	953173	5	3
METRIBUZIN	21087649	0	14
MEVINPHOS	7786347	5	11
MIREX	2385855	0	14
N-HEXADECANE	544763	10	27
N-NITROSODI-N-BUTYLAMINE	924163	10	27
N-NITROSODIETHYLAMINE	55185	10	27
N-NITROSODIMETHYLAMINE	62759	50	27
N-NITROSODIPHENYLAMINE	86306	20	27
N-NITROSOMETHYLETHYLAMINE	10595956	10	27

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LISTING OF CHWC ANALYTES WITH NO DETECTS

Analyte	CAS_NO	Min. Level	Number of Obs.
N-NITROSOMETHYLPHENYLAMINE	614006	99	27
N-NITROSOMORPHOLINE	59892	10	27
N-NITROSOPIPERIDINE	100754	10	27
N-OCTADECANE	593453	10	27
N-TETRACOSANE	646311	10	27
N,N-DIMETHYLFORMAMIDE	68122	10	27
NALED	300765	8	11
NAPHTHALENE	91203	10	27
NITROBENZENE	98953	10	27
NITROFEN	1836755	0	14
O+P XYLENE	136777612	10	27
O-ANISIDINE	90040	10	27
O-CRESOL	95487	10	27
O-TOLUIDINE	95534	10	27
O-TOLUIDINE, 5-CHLORO-	95794	10	27
P-CHLOROANILINE	106478	10	27
P-CYMENE	99876	10	27
P-DIMETHYLAMINOAZOBENZENE	60117	20	27
P-NITROANILINE	100016	50	27
PALLADIUM	7440053	500	25
PARATHION (ETHYL)	56382	2	11
PCB 1016	12674112	1	14

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Analyte	CAS_NO	Min. Level	Number of Obs.
PCB 1221	11104282	1	14
PCB 1232	11141165	1	14
PCB 1242	53469219	1	14
PCB 1248	12672296	1	14
PCB 1254	11097691	1	14
PCB 1260	11096825	1	14
PENDAMETHALIN	40487421	1	14
PENTACHLOROBENZENE	608935	20	27
PENTACHLORONITROBENZENE (PCNB)	82688	0	14
PENTACHLOROPHENOL	87865	50	27
PENTAMETHYLBENZENE	700129	10	27
PERTHANE	72560	10	14
PERYLENE	198550	10	27
PHENACETIN	62442	10	27
PHENANTHRENE	85018	10	27
PHENOL, 2-METHYL-4,6-DINITRO-	534521	20	27
PHENOTHIAZINE	92842	50	27
PHORATE	298022	2	11
PHOSMET	732116	5	11
PHOSPHAMIDON E	297994	5	11
PHOSPHAMIDON Z	23783984	5	11
PICLORAM	1918021	1	11

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Analyte	CAS_NO	Min. Level	Number of Obs.
PRONAMIDE	23950585	10	27
PROPACHLOR	1918167	0	14
PROPANIL	709988	1	14
PROPAZINE	139402	1	14
PYRENE	129000	10	27
PYRIDINE	110861	10	27
RESORCINOL	108463	50	27
RONNEL	299843	2	11
SAFROLE	94597	10	27
SIMAZINE	122349	8	14
SQUALENE	7683649	99	27
STROBANE	8001501	5	14
STYRENE	100425	10	27
SULFOTEP	3689245	2	11
SULPROFOS	35400432	2	11
TELLURIUM	13494809	1000	25
TEPP	107493	5	3
TERBACIL	5902512	2	14
TERBUFOS	13071799	2	11
TERBUTHYLAZINE	5915413	5	14
TETRACHLOROETHENE	127184	10	27
TETRACHLOROMETHANE	56235	10	27

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Analyte	CAS_NO	Min. Level	Number of Obs.
TETRACHLORVINPHOS	22248799	2	11
THIANAPHTHENE	95158	10	27
THIOACETAMIDE	62555	20	27
THIOXANTHE-9-ONE	492228	20	27
TOKUTHION	34643464	4	3
TOLUENE	108883	10	27
TOLUENE, 2,4-DIAMINO-	95807	99	27
TOTAL RECOVERABLE OIL AND GREASE	C-007	5000	3
TOXAPHENE	8001352	5	14
TRANS-PERMETHRIN	61949777	2	14
TRANS-1,2-DICHLOROETHENE	156605	10	27
TRANS-1,3-DICHLOROPROPENE	10061026	10	27
TRANS-1,4-DICHLORO-2-BUTENE	110576	50	27
TRIADIMEFON	43121433	1	14
TRICHLORFON	52686	5	11
TRICHLOROETHENE	79016	10	27
TRICHLORONATE	327980	2	11
TRICRESYLPHOSPHATE	78308	10	11
TRIFLURALIN	1582098	0	14
TRIMETHYLPHOSPHATE	512561	2	3
TRIPHENYLENE	217594	10	27
TRIPROPYLENEGLYCOL METHYL ETHER	20324338	99	27

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LISTING OF CHWC ANALYTES WITH NO DETECTS

Analyte	CAS_NO	Min. Level	Number of Obs.
VINYL ACETATE	108054	50	27
VINYL CHLORIDE	75014	10	27
1-BROMO-2-CHLOROBENZENE	694804	10	27
1-BROMO-3-CHLOROBENZENE	108372	10	27
1-CHLORO-3-NITROBENZENE	121733	50	27
1-METHYLFLUORENE	1730376	10	27
1-METHYLPHENANTHRENE	832699	10	27
1-NAPHTHYLAMINE	134327	10	27
1-PHENYLNAPHTHALENE	605027	10	27
1,1-DICHLOROETHANE	75343	10	27
1,1-DICHLOROETHENE	75354	10	27
1,1,1-TRICHLOROETHANE	71556	10	27
1,1,1,2-TETRACHLOROETHANE	630206	10	27
1,1,2-TRICHLOROETHANE	79005	10	27
1,1,2,2-TETRACHLOROETHANE	79345	10	27
1,2-DIBROMO-3-CHLOROPROPANE	96128	20	27
1,2-DIBROMOETHANE	106934	10	27
1,2-DICHLOROBENZENE	95501	10	27
1,2-DICHLOROETHANE	107062	10	27
1,2-DICHLOROPROPANE	78875	10	27
1,2-DIPHENYLHYDRAZINE	122667	20	27
1,2,3-TRICHLOROBENZENE	87616	10	27

APPENDIX B

LISTING OF CHWC ANALYTES WITH NO DETECTS

Analyte	CAS_NO	Min. Level	Number of Obs.
1,2,3-TRICHLOROPROPANE	96184	10	27
1,2,3-TRIMETHOXYBENZENE	634366	10	27
1,2,4-TRICHLOROBENZENE	120821	10	27
1,2,4,5-TETRACHLOROBENZENE	95943	10	27
1,2:3,4-DIEPOXYBUTANE	1464535	20	27
1,3-BUTADIENE, 2-CHLORO	126998	10	27
1,3-DICHLORO-2-PROPANOL	96231	10	27
1,3-DICHLOROBENZENE	541731	10	27
1,3-DICHLOROPROPANE	142289	10	27
1,3,5-TRITHIANE	291214	50	27
1,4-DICHLOROBENZENE	106467	10	27
1,4-DINITROBENZENE	100254	20	27
1,4-DIOXANE	123911	10	27
1,4-NAPHTHOQUINONE	130154	99	27
1,5-NAPHTHALENEDIAMINE	2243621	99	27
2-(METHYLTHIO)BENZOTHIAZOLE	615225	10	27
2-CHLOROETHYLVINYL ETHER	110758	10	27
2-CHLORONAPHTHALENE	91587	10	27
2-CHLOROPHENOL	95578	10	27
2-HEXANONE	591786	50	27
2-ISOPROPYLNAPHTHALENE	2027170	10	27
2-METHYLBENZOTHIOAZOLE	120752	10	27

APPENDIX B

LISTING OF CHWC ANALYTES WITH NO DETECTS

Analyte	CAS_NO	Min. Level	Number of Obs.
2-METHYLNAPHTHALENE	91576	10	27
2-NITROANILINE	88744	10	27
2-NITROPHENOL	88755	20	27
2-PHENYLNAPHTHALENE	612942	10	27
2-PICOLINE	109068	50	27
2-PROPENAL	107028	50	27
2-PROPENENITRILE, 2-METHYL-	126987	10	27
2,3-BENZOFLUORENE	243174	10	27
2,3-DICHLOROANILINE	608275	10	27
2,3-DICHLORONITROBENZENE	3209221	50	27
2,3,4,6-TETRACHLOROPHENOL	58902	20	27
2,3,6-TRICHLOROPHENOL	933755	10	27
2,4-DICHLOROPHENOL	120832	10	27
2,4-DIMETHYLPHENOL	105679	10	27
2,4-DINITROPHENOL	51285	50	27
2,4-DINITROTOLUENE	121142	10	27
2,4,5-TRICHLOROPHENOL	95954	10	27
2,4,6-TRICHLOROPHENOL	88062	10	27
2,6-DI-TERT-BUTYL-P-BENZOQUINONE	719222	99	27
2,6-DICHLORO-4-NITROANILINE	99309	99	27
2,6-DICHLOROPHENOL	87650	10	27
2,6-DINITROTOLUENE	606202	10	27

APPENDIX B

LISTING OF CHWC ANALYTES WITH NO DETECTS

Analyte	CAS_NO	Min. Level	Number of Obs.
3-CHLOROPROPENE	107051	10	27
3-METHYLCHOLANTHRENE	56495	10	27
3-NITROANILINE	99092	20	27
3,3'-DICHLOROBENZIDINE	91941	50	27
3,3'-DIMETHOXYBENZIDINE	119904	50	27
3,6-DIMETHYLPHENANTHRENE	1576676	10	27
4-AMINOBIPHENYL	92671	10	27
4-BROMOPHENYL PHENYL ETHER	101553	10	27
4-CHLORO-2-NITROANILINE	89634	20	27
4-CHLORO-3-METHYLPHENOL	59507	10	27
4-CHLOROPHENYLPHENYL ETHER	7005723	10	27
4-METHYL-2-PENTANONE	108101	50	27
4-NITROPHENOL	100027	50	27
4,4'-DDD	72548	0	14
4,4'-DDE	72559	0	14
4,4'-DDT	50293	0	14
4,4'-METHYLENEBIS(2-CHLOROANILINE)	101144	20	27
4,5-METHYLENE PHENANTHRENE	203645	10	27
5-NITRO-O-TOLUIDINE	99558	10	27
7,12-DIMETHYLBENZ(A)ANTHRACENE	57976	10	27

APPENDIX C

Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type [1]	Mean	Min	Max	Unit
ACENAPHTHENE	83329	ND	14.83	10.00	35.56	UG/L
ACENAPHTHYLENE	208968	ND	14.83	10.00	35.56	UG/L
ACEPHATE	30560191	ND	30.53	20.00	71.00	UG/L
ACETOPHENONE	98862	NC	15.47	10.00	35.56	UG/L
ACIFLUORFEN	50594666	ND	15.27	10.00	35.56	UG/L
ACRYLONITRILE	107131	ND	50.00	49.94	50.00	UG/L
ALACHLOR	15972608	ND	0.31	0.20	0.71	UG/L
ALDRIN	309002	ND	0.31	0.20	0.71	UG/L
ALPHA-BHC	319846	ND	0.08	0.05	0.18	UG/L
ALPHA-CHLORDANE	5103719	ND	0.15	0.10	0.36	UG/L
ALPHA-TERPINEOL	98555	ND	14.83	10.00	35.56	UG/L
ALUMINUM	7429905	NC	897.59	13.60	2538.00	UG/L
AMENABLE CYANIDE	C-025	ND	10.00	10.00	10.00	UG/L
AMMONIA AS NITROGEN	7664417	NC	14312.40	100.00	75000.00	UG/L
ANILINE	62533	ND	14.83	10.00	35.56	UG/L
ANILINE,2,4,5-TRIMETHYL-	137177	ND	29.66	20.00	71.12	UG/L
ANTHRACENE	120127	ND	14.83	10.00	35.56	UG/L
ANTIMONY	7440360	NC	268.16	7.80	958.80	UG/L
ARAMITE	140578	ND	74.14	50.00	177.80	UG/L
ARSENIC	7440382	NC	166.41	4.60	827.20	UG/L
ATRAZINE	1912249	ND	15.27	10.00	35.56	UG/L
AZINPHOS ETHYL	2642719	ND	3.05	2.00	7.10	UG/L
AZINPHOS METHYL	86500	ND	3.19	1.00	5.00	UG/L

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[1] Measurement type ND means that the pollutant was not detected at any data point.
Measurement type NC means that the pollutant was detected for at least one data point.

APPENDIX C

Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
BARIUM	7440393	NC	237.70	43.10	613.00	UG/L
BENFLURALIN	1861401	ND	0.31	0.20	0.71	UG/L
BENZANTHRONE	82053	ND	74.14	50.00	177.80	UG/L
BENZENE	71432	ND	10.00	9.99	10.00	UG/L
BENZENETHIOL	108985	ND	14.83	10.00	35.56	UG/L
BENZIDINE	92875	ND	74.14	50.00	177.80	UG/L
BENZO(A)ANTHRACENE	56553	ND	14.83	10.00	35.56	UG/L
BENZO(A)PYRENE	50328	ND	14.83	10.00	35.56	UG/L
BENZO(B)FLUORANTHENE	205992	ND	14.83	10.00	35.56	UG/L
BENZO(GHI)PERYLENE	191242	ND	29.66	20.00	71.12	UG/L
BENZO(K)FLUORANTHENE	207089	ND	14.83	10.00	35.56	UG/L
BENZOIC ACID	65850	ND	74.14	50.00	177.80	UG/L
BENZONITRILE, 3,5-DIBROMO-4-HYDROXY-	1689845	ND	74.14	50.00	177.80	UG/L
BENZYL ALCOHOL	100516	ND	14.83	10.00	35.56	UG/L
BERYLLIUM	7440417	ND	0.93	0.30	1.50	UG/L
BETA-BHC	319857	ND	0.15	0.10	0.36	UG/L
BETA-NAPHTHYLAMINE	91598	ND	74.14	50.00	177.80	UG/L
BIPHENYL	92524	ND	14.83	10.00	35.56	UG/L
BIPHENYL, 4-NITRO	92933	ND	14.83	10.00	35.56	UG/L
BIS(2-CHLOROETHOXY) METHANE	111911	ND	14.83	10.00	35.56	UG/L
BIS(2-CHLOROETHYL) ETHER	111444	ND	14.83	10.00	35.56	UG/L
BIS(2-CHLOROISOPROPYL) ETHER	108601	ND	14.83	10.00	35.56	UG/L
BIS(2-ETHYLHEXYL) PHTHALATE	117817	NC	22.57	10.00	53.05	UG/L

APPENDIX C

Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
BISMUTH	7440699	NC	205.14	0.10	887.00	UG/L
BOD 5-DAY	C-002	NC	9960.00	1000.00	53000.00	UG/L
BORON	7440428	NC	1604.60	918.00	3760.00	UG/L
BROMACIL	314409	ND	1.53	1.00	3.56	UG/L
BROMODICHLOROMETHANE	75274	ND	10.00	9.99	10.00	UG/L
BROMOMETHANE	74839	ND	50.00	49.94	50.00	UG/L
BROMOXYNIL OCTANOATE	1689992	ND	0.76	0.50	1.78	UG/L
BUTACHLOR	23184669	ND	0.76	0.50	1.78	UG/L
BUTYL BENZYL PHTHALATE	85687	ND	14.83	10.00	35.56	UG/L
CADMIUM	7440439	NC	312.19	1.80	2616.00	UG/L
CALCIUM	7440702	NC	293146.00	8140.00	1270000.00	UG/L
CAPTAFOL	2425061	ND	3.05	2.00	7.10	UG/L
CAPTAN	133062	ND	1.53	1.00	3.56	UG/L
CARBAZOLE	86748	ND	29.66	20.00	71.12	UG/L
CARBON DISULFIDE	75150	ND	10.00	9.99	10.00	UG/L
CARBOPHENOTHION	786196	ND	1.53	1.00	3.56	UG/L
CERIUM	7440451	NC	507.47	1.00	1000.00	UG/L
CHEMICAL OXYGEN DEMAND (COD)	C-004	NC	343140.00	67000.00	1036000.00	UG/L
CHLORFENVINPHOS	470906	ND	3.05	2.00	7.10	UG/L
CHLORIDE	16887006	NC	6833746.67	1010000.00	17002400.00	UG/L
CHLOROACETONITRILE	107142	ND	10.00	9.99	10.00	UG/L
CHLOROBENZENE	108907	ND	10.00	9.99	10.00	UG/L
CHLOROBENZILATE	510156	ND	1.53	1.00	3.56	UG/L

APPENDIX C

Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
CHLOROETHANE	75003	ND	50.00	49.94	50.00	UG/L
CHLOROFORM	67663	ND	10.00	9.99	10.00	UG/L
CHLOROMETHANE	74873	ND	50.00	49.94	50.00	UG/L
CHLORONEB	2675776	ND	1.53	1.00	3.56	UG/L
CHLOROPROPYLATE	5836102	ND	15.27	10.00	35.56	UG/L
CHLOROTHALONIL	1897456	ND	0.31	0.20	0.71	UG/L
CHLORPYRIFOS	2921882	ND	3.05	2.00	7.10	UG/L
CHROMIUM	7440473	NC	127.17	5.80	529.20	UG/L
CHRYSENE	218019	ND	14.83	10.00	35.56	UG/L
CIS-PERMETHRIN	61949766	ND	3.05	2.00	7.10	UG/L
CIS-1,3-DICHLOROPROPENE	10061015	ND	10.00	9.99	10.00	UG/L
COBALT	7440484	NC	10.50	2.30	35.24	UG/L
COPPER	7440508	NC	1786.69	8.50	10554.00	UG/L
COUMAPHOS	56724	ND	7.64	5.00	17.78	UG/L
CROTONALDEHYDE	4170303	ND	50.00	49.94	50.00	UG/L
CROTOXYPHOS	7700176	ND	146.80	99.00	352.04	UG/L
DACTHAL (DCPA)	1861321	ND	0.08	0.05	0.18	UG/L
DALAPON	75990	NC	0.53	0.20	1.06	UG/L
DEF	78488	ND	3.05	2.00	7.10	UG/L
DELTA-BHC	319868	ND	0.08	0.05	0.18	UG/L
DEMETON A	8065483A	ND	3.05	2.00	7.10	UG/L
DEMETON B	8065483B	ND	3.05	2.00	7.10	UG/L
DI-N-BUTYL PHTHALATE	84742	ND	14.83	10.00	35.56	UG/L

APPENDIX C

Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
DI-N-OCTYL PHTHALATE	117840	ND	14.83	10.00	35.56	UG/L
DI-N-PROPYLNITROSAMINE	621647	ND	29.66	20.00	71.12	UG/L
DIALLATE A	2303164A	ND	3.05	2.00	7.10	UG/L
DIALLATE B	2303164B	ND	3.05	2.00	7.10	UG/L
DIAZINON	333415	ND	3.05	2.00	7.10	UG/L
DIBENZO(A,H)ANTHRACENE	53703	ND	29.66	20.00	71.12	UG/L
DIBENZOFURAN	132649	ND	14.83	10.00	35.56	UG/L
DIBENZOTHIOPHENE	132650	ND	14.83	10.00	35.56	UG/L
DIBROMOCHLOROMETHANE	124481	ND	10.00	9.99	10.00	UG/L
DIBROMOMETHANE	74953	ND	10.00	9.99	10.00	UG/L
DICAMBA	1918009	NC	0.32	0.20	0.71	UG/L
DICHLOFENTHION	97176	ND	3.05	2.00	7.10	UG/L
DICHLONE	117806	ND	3.05	2.00	7.10	UG/L
DICHLORPROP	120365	NC	7.66	1.00	47.00	UG/L
DICHLORVOS	62737	ND	7.64	5.00	17.78	UG/L
DICOFOL	115322	ND	1.53	1.00	3.56	UG/L
DICROTOPHOS	141662	ND	5.00	5.00	5.00	UG/L
DIELDRIN	60571	ND	0.06	0.04	0.14	UG/L
DIETHYL ETHER	60297	ND	50.00	49.94	50.00	UG/L
DIETHYL PHTHALATE	84662	ND	14.83	10.00	35.56	UG/L
DIMETHOATE	60515	ND	1.86	1.00	3.56	UG/L
DIMETHYL PHTHALATE	131113	ND	14.83	10.00	35.56	UG/L
DIMETHYL SULFONE	67710	ND	14.83	10.00	35.56	UG/L

APPENDIX C

Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
DINOSEB	88857	NC	0.87	0.50	2.63	UG/L
DIOXATHION	78342	ND	5.00	5.00	5.00	UG/L
DIPHENYL ETHER	101848	ND	14.83	10.00	35.56	UG/L
DIPHENYLAMINE	122394	ND	14.83	10.00	35.56	UG/L
DIPHENYLDISULFIDE	882337	ND	29.66	20.00	71.12	UG/L
DISULFOTON	298044	ND	3.05	2.00	7.10	UG/L
DYSPROSIUM	7429916	NC	67.17	0.10	100.00	UG/L
ENDOSULFAN I	959988	ND	0.15	0.10	0.36	UG/L
ENDOSULFAN II	33213659	ND	1.53	1.00	3.56	UG/L
ENDOSULFAN SULFATE	1031078	ND	0.15	0.10	0.36	UG/L
ENDRIN	72208	ND	0.31	0.20	0.71	UG/L
ENDRIN ALDEHYDE	7421934	ND	0.15	0.10	0.36	UG/L
ENDRIN KETONE	53494705	ND	0.15	0.10	0.36	UG/L
EPN	2104645	ND	3.05	2.00	7.10	UG/L
ERBIUM	7440520	ND	66.70	0.10	100.00	UG/L
ETHALFLURALIN	55283686	ND	0.15	0.10	0.36	UG/L
ETHANE, PENTACHLORO-	76017	ND	29.66	20.00	71.12	UG/L
ETHION	563122	ND	3.05	2.00	7.10	UG/L
ETHOPROP	13194484	ND	3.05	2.00	7.10	UG/L
ETHYL CYANIDE	107120	ND	10.00	9.99	10.00	UG/L
ETHYL METHACRYLATE	97632	ND	10.00	9.99	10.00	UG/L
ETHYL METHANESULFONATE	62500	ND	29.66	20.00	71.12	UG/L
ETHYLBENZENE	100414	ND	10.00	9.99	10.00	UG/L

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Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
ETHYLENETHIOUREA	96457	ND	29.66	20.00	71.12	UG/L
ETRIDIAZOLE	2593159	ND	0.10	0.10	0.10	UG/L
EUROPIUM	7440531	NC	68.07	0.10	100.00	UG/L
FAMPHUR	52857	ND	7.64	5.00	17.78	UG/L
FENARIMOL	60168889	ND	0.31	0.20	0.71	UG/L
FENSULFOTHION	115902	ND	7.64	5.00	17.78	UG/L
FENTHION	55389	ND	3.05	2.00	7.10	UG/L
FLUORANTHENE	206440	ND	14.83	10.00	35.56	UG/L
FLUORENE	86737	ND	14.83	10.00	35.56	UG/L
FLUORIDE	16984488	NC	82620.53	16500.00	360000.00	UG/L
GADOLINIUM	7440542	NC	236.22	0.50	500.00	UG/L
GALLIUM	7440553	NC	236.12	0.50	500.00	UG/L
GAMMA-BHC	58899	ND	0.08	0.05	0.18	UG/L
GAMMA-CHLORDANE	5103742	ND	0.08	0.05	0.18	UG/L
GERMANIUM	7440564	NC	335.79	0.50	500.00	UG/L
GOLD	7440575	ND	100.33	1.00	200.00	UG/L
HAFNIUM	7440586	NC	500.92	1.00	1000.00	UG/L
HEPTACHLOR	76448	ND	0.15	0.10	0.36	UG/L
HEPTACHLOR EPOXIDE	1024573	ND	0.08	0.05	0.18	UG/L
HEXACHLOROBENZENE	118741	ND	14.83	10.00	35.56	UG/L
HEXACHLOROBUTADIENE	87683	ND	14.83	10.00	35.56	UG/L
HEXACHLOROCYCLOPENTADIENE	77474	ND	14.83	10.00	35.56	UG/L
HEXACHLOROETHANE	67721	ND	14.83	10.00	35.56	UG/L

APPENDIX C

Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
HEXACHLOROPROPENE	1888717	ND	29.66	20.00	71.12	UG/L
HEXAMETHYLPHOSPHORAMIDE	680319	ND	2.00	2.00	2.00	UG/L
HEXANOIC ACID	142621	ND	14.83	10.00	35.56	UG/L
HEXAVALENT CHROMIUM	18540299	NC	18.67	10.00	76.00	UG/L
HOLMIUM	7440600	NC	336.78	0.50	500.00	UG/L
INDENO(1,2,3-CD)PYRENE	193395	ND	29.66	20.00	71.12	UG/L
INDIUM	7440746	NC	512.02	1.00	1000.00	UG/L
IODINE	7553562	NC	1943.00	500.00	3840.00	UG/L
IODOMETHANE	74884	ND	10.00	9.99	10.00	UG/L
IRIDIUM	7439885	NC	609.97	1.00	1708.00	UG/L
IRON	7439896	NC	2904.13	149.00	10838.00	UG/L
ISOBUTYL ALCOHOL	78831	ND	10.00	9.99	10.00	UG/L
ISODRIN	465736	ND	0.15	0.10	0.36	UG/L
ISOPHORONE	78591	ND	14.83	10.00	35.56	UG/L
ISOPROPALIN	33820530	ND	0.31	0.20	0.71	UG/L
ISOSAFROLE	120581	ND	14.83	10.00	35.56	UG/L
KEPONE	143500	ND	1.53	1.00	3.56	UG/L
LANTHANUM	7439910	NC	68.18	0.10	100.00	UG/L
LEAD	7439921	NC	1613.89	2.10	13248.00	UG/L
LEPTOPHOS	21609905	ND	3.05	2.00	7.10	UG/L
LITHIUM	7439932	NC	231.26	79.00	532.80	UG/L
LONGIFOLENE	475207	ND	74.14	50.00	177.80	UG/L
LUTETIUM	7439943	NC	66.78	0.10	100.00	UG/L

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Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
M-XYLENE	108383	ND	10.00	9.99	10.00	UG/L
MAGNESIUM	7439954	NC	7435.80	1140.00	20400.00	UG/L
MALACHITE GREEN	569642	ND	14.83	10.00	35.56	UG/L
MALATHION	121755	ND	3.05	2.00	7.10	UG/L
MANGANESE	7439965	NC	114.72	4.00	388.00	UG/L
MCPA	94746	NC	115.60	50.00	399.20	UG/L
MCPP	7085190	NC	375.68	50.00	2594.00	UG/L
MERCURY	7439976	NC	21.06	0.20	115.36	UG/L
MERPHOS	150505	ND	3.58	2.00	7.10	UG/L
MESTRANOL	72333	ND	29.66	20.00	71.12	UG/L
METHAPYRILENE	91805	ND	14.83	10.00	35.56	UG/L
METHOXYCHLOR	72435	ND	0.31	0.20	0.71	UG/L
METHYL CHLORPYRIFOS	5598130	ND	3.05	2.00	7.10	UG/L
METHYL METHACRYLATE	80626	ND	10.00	9.99	10.00	UG/L
METHYL METHANESULFONATE	66273	ND	29.66	20.00	71.12	UG/L
METHYL PARATHION	298000	ND	3.05	2.00	7.10	UG/L
METHYL TRITHION	953173	ND	5.00	5.00	5.00	UG/L
METHYLENE CHLORIDE	75092	ND	10.00	9.99	10.00	UG/L
METRIBUZIN	21087649	ND	0.15	0.10	0.36	UG/L
MEVINPHOS	7786347	ND	7.64	5.00	17.78	UG/L
MIREX	2385855	ND	0.31	0.20	0.71	UG/L
MOLYBDENUM	7439987	NC	336.68	4.60	1024.40	UG/L
MONOCROTOPHOS	6923224	NC	2.00	2.00	2.00	UG/L

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Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
N-DECANE	124185	ND	14.83	10.00	35.56	UG/L
N-DOCOSANE	629970	ND	14.83	10.00	35.56	UG/L
N-DODECANE	112403	ND	14.83	10.00	35.56	UG/L
N-EICOSANE	112958	ND	14.83	10.00	35.56	UG/L
N-HEXACOSANE	630013	NC	20.41	10.00	92.91	UG/L
N-HEXADECANE	544763	ND	14.83	10.00	35.56	UG/L
N-NITROSODI-N-BUTYLAMINE	924163	ND	14.83	10.00	35.56	UG/L
N-NITROSODIETHYLAMINE	55185	ND	14.83	10.00	35.56	UG/L
N-NITROSODIMETHYLAMINE	62759	ND	74.14	50.00	177.80	UG/L
N-NITROSODIPHENYLAMINE	86306	ND	29.66	20.00	71.12	UG/L
N-NITROSOMETHYLETHYLAMINE	10595956	ND	14.83	10.00	35.56	UG/L
N-NITROSOMETHYLPHENYLAMINE	614006	ND	146.80	99.00	352.04	UG/L
N-NITROSOMORPHOLINE	59892	ND	14.83	10.00	35.56	UG/L
N-NITROSOPIPERIDINE	100754	ND	14.83	10.00	35.56	UG/L
N-OCTACOSANE	630024	NC	21.81	10.00	95.71	UG/L
N-OCTADECANE	593453	ND	14.83	10.00	35.56	UG/L
N-TETRACOSANE	646311	ND	14.83	10.00	35.56	UG/L
N-TETRADECANE	629594	ND	14.83	10.00	35.56	UG/L
N-TRIACONTANE	638686	NC	16.53	10.00	46.21	UG/L
N,N-DIMETHYLFORMAMIDE	68122	ND	14.83	10.00	35.56	UG/L
NALED	300765	ND	8.64	5.00	17.78	UG/L
NAPHTHALENE	91203	ND	14.83	10.00	35.56	UG/L
NEODYMIUM	7440008	NC	246.75	0.50	500.00	UG/L

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Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
NICKEL	7440020	NC	134.26	4.50	327.00	UG/L
NIOBIUM	7440031	NC	525.87	29.25	1000.00	UG/L
NITRATE/NITRITE	C-005	NC	2650.93	360.00	4560.00	UG/L
NITROBENZENE	98953	ND	14.83	10.00	35.56	UG/L
NITROFEN	1836755	ND	0.31	0.20	0.71	UG/L
NORFLURAZON	27314132	NC	1.59	1.00	4.08	UG/L
O+P XYLENE	136777612	ND	10.00	9.99	10.00	UG/L
O-ANISIDINE	90040	ND	14.83	10.00	35.56	UG/L
O-CRESOL	95487	ND	14.83	10.00	35.56	UG/L
O-TOLUIDINE	95534	ND	14.83	10.00	35.56	UG/L
O-TOLUIDINE, 5-CHLORO-	95794	ND	14.83	10.00	35.56	UG/L
OCDD	3268879	NC	0.00	0.00	0.00	UG/L
OCDF	39001020	NC	0.00	0.00	0.00	UG/L
OIL AND GREASE	C-036	NC	5066.67	5000.00	6000.00	UG/L
OSMIUM	7440042	NC	67.19	0.10	100.00	UG/L
P-CHLOROANILINE	106478	ND	14.83	10.00	35.56	UG/L
P-CRESOL	106445	ND	14.83	10.00	35.56	UG/L
P-CYMENE	99876	ND	14.83	10.00	35.56	UG/L
P-DIMETHYLAMINOAZOBENZENE	60117	ND	29.66	20.00	71.12	UG/L
P-NITROANILINE	100016	ND	74.14	50.00	177.80	UG/L
PALLADIUM	7440053	ND	333.50	0.50	500.00	UG/L
PARATHION (ETHYL)	56382	ND	3.05	2.00	7.10	UG/L
PCB 1016	12674112	ND	1.53	1.00	3.56	UG/L

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Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
PCB 1221	11104282	ND	1.53	1.00	3.56	UG/L
PCB 1232	1141165	ND	1.53	1.00	3.56	UG/L
PCB 1242	53469219	ND	1.53	1.00	3.56	UG/L
PCB 1248	12672296	ND	1.53	1.00	3.56	UG/L
PCB 1254	11097691	ND	1.53	1.00	3.56	UG/L
PCB 1260	11096825	ND	1.53	1.00	3.56	UG/L
PENDAMETHALIN	40487421	ND	0.76	0.50	1.78	UG/L
PENTACHLOROBENZENE	608935	ND	29.66	20.00	71.12	UG/L
PENTACHLORONITROBENZENE (PCNB)	82688	ND	0.08	0.05	0.18	UG/L
PENTACHLOROPHENOL	87865	ND	74.14	50.00	177.80	UG/L
PENTAMETHYLBENZENE	700129	ND	14.83	10.00	35.56	UG/L
PERTHANE	72560	ND	15.27	10.00	35.56	UG/L
PERYLENE	198550	ND	14.83	10.00	35.56	UG/L
PHENACETIN	62442	ND	14.83	10.00	35.56	UG/L
PHENANTHRENE	85018	ND	14.83	10.00	35.56	UG/L
PHENOL	108952	NC	17.11	10.00	44.16	UG/L
PHENOL, 2-METHYL-4,6-DINITRO-	534521	ND	29.66	20.00	71.12	UG/L
PHENOTHIAZINE	92842	ND	74.14	50.00	177.80	UG/L
PHORATE	298022	ND	3.05	2.00	7.10	UG/L
PHOSMET	732116	ND	7.64	5.00	17.78	UG/L
PHOSPHAMIDON E	297994	ND	7.64	5.00	17.78	UG/L
PHOSPHAMIDON Z	23783984	ND	7.64	5.00	17.78	UG/L
PHOSPHORUS	7723140	NC	32480.80	3210.00	225800.00	UG/L

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Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
PICLORAM	1918021	ND	0.76	0.50	1.78	UG/L
PLATINUM	7440064	NC	528.11	1.00	1000.00	UG/L
POTASSIUM	7440097	NC	77743.00	1310.00	195400.00	UG/L
PRASEODYMIUM	7440100	NC	927.87	1.00	3910.00	UG/L
PRONAMIDE	23950585	ND	14.83	10.00	35.56	UG/L
PROPACHLOR	1918167	ND	0.15	0.10	0.36	UG/L
PROPANIL	709988	ND	1.53	1.00	3.56	UG/L
PROPAZINE	139402	ND	1.53	1.00	3.56	UG/L
PYRENE	129000	ND	14.83	10.00	35.56	UG/L
PYRIDINE	110861	ND	14.83	10.00	35.56	UG/L
RESORCINOL	108463	ND	74.14	50.00	177.80	UG/L
RHENIUM	7440155	NC	615.13	205.00	1000.00	UG/L
RHODIUM	7440166	NC	670.22	1.00	1000.00	UG/L
RONNEL	299843	ND	3.05	2.00	7.10	UG/L
RUTHENIUM	7440188	NC	504.65	1.00	1000.00	UG/L
SAFROLE	94597	ND	14.83	10.00	35.56	UG/L
SAMARIUM	7440199	NC	336.92	0.50	500.00	UG/L
SCANDIUM	7440202	NC	66.75	0.10	100.00	UG/L
SELENIUM	7782492	NC	102.82	2.30	429.20	UG/L
SILICON	7440213	NC	15414.00	5380.00	28100.00	UG/L
SILVER	7440224	NC	98.92	1.00	390.80	UG/L
SIMAZINE	122349	ND	12.22	8.00	28.46	UG/L
SODIUM	7440235	NC	3443333.33	6400.00	11250600.00	UG/L

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Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
SQUALENE	7683649	ND	146.80	99.00	352.04	UG/L
STROBANE	8001501	ND	7.64	5.00	17.78	UG/L
STRONTIUM	7440246	NC	630.23	100.00	2280.00	UG/L
STYRENE	100425	ND	14.83	10.00	35.56	UG/L
SULFOTEP	3689245	ND	4.05	2.00	7.10	UG/L
SULFUR	7704349	NC	400788.06	2145.00	1078240.00	UG/L
SULPROFOS	35400432	ND	3.05	2.00	7.10	UG/L
TANTALUM	7440257	NC	333.89	0.50	500.00	UG/L
TELLURIUM	13494809	ND	667.00	1.00	1000.00	UG/L
TEPP	107493	ND	5.00	5.00	5.00	UG/L
TERBACIL	5902512	ND	3.05	2.00	7.10	UG/L
TERBIUM	7440279	NC	342.22	0.50	500.00	UG/L
TERBUFOS	13071799	ND	3.05	2.00	7.10	UG/L
TERBUTHYLAZINE	5915413	ND	7.64	5.00	17.78	UG/L
TETRACHLOROETHENE	127184	ND	10.00	9.99	10.00	UG/L
TETRACHLOROMETHANE	56235	ND	10.00	9.99	10.00	UG/L
TETRACHLORVINPHOS	22248799	ND	3.05	2.00	7.10	UG/L
THALLIUM	7440280	NC	9.19	1.20	20.00	UG/L
THIANAPHTHENE	95158	ND	14.83	10.00	35.56	UG/L
THIOACETAMIDE	62555	ND	29.66	20.00	71.12	UG/L
THIOXANTHE-9-ONE	492228	ND	29.66	20.00	71.12	UG/L
THORIUM	7440291	NC	512.90	1.00	1000.00	UG/L
THULIUM	7440304	NC	333.98	0.50	500.00	UG/L

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Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
TIN	7440315	NC	665.88	14.50	6046.00	UG/L
TITANIUM	7440326	NC	777.71	5.00	4474.20	UG/L
TOKUTHION	34643464	ND	2.00	2.00	2.00	UG/L
TOLUENE	108883	ND	10.00	9.99	10.00	UG/L
TOLUENE, 2,4-DIAMINO-	95807	ND	146.80	99.00	352.04	UG/L
TOTAL CYANIDE	57125	NC	17.93	10.00	105.00	UG/L
TOTAL DISSOLVED SOLIDS	C-010	NC	12815853.33	158000.00	32641200.00	UG/L
TOTAL ORGANIC CARBON (TOC)	C-012	NC	10485.33	10000.00	16000.00	UG/L
TOTAL PHENOLS	C-020	NC	93.20	50.00	681.00	UG/L
TOTAL PHOSPHORUS	14265442	NC	1088.60	10.00	4460.00	UG/L
TOTAL SULFIDE(IODOMETRIC)	18496258	NC	28261.33	1000.00	103200.00	UG/L
TOTAL SUSPENDED SOLIDS	C-009	NC	122553.33	4000.00	522000.00	UG/L
TOXAPHENE	8001352	ND	7.64	5.00	17.78	UG/L
TRANS-PERMETHRIN	61949777	ND	3.05	2.00	7.10	UG/L
TRANS-1,2-DICHLOROETHENE	156605	ND	10.00	9.99	10.00	UG/L
TRANS-1,3-DICHLOROPROPENE	10061026	ND	10.00	9.99	10.00	UG/L
TRANS-1,4-DICHLORO-2-BUTENE	110576	ND	50.00	49.94	50.00	UG/L
TRIADIMEFON	43121433	ND	1.53	1.00	3.56	UG/L
TRIBROMOMETHANE	75252	ND	10.00	9.99	10.00	UG/L
TRICHLORFON	52686	ND	7.64	5.00	17.78	UG/L
TRICHLOROETHENE	79016	ND	10.00	9.99	10.00	UG/L
TRICHLOROFLUOROMETHANE	75694	ND	10.00	10.00	10.00	UG/L
TRICHLORONATE	327980	ND	3.05	2.00	7.10	UG/L

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Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
TRICRESYLPHOSPHATE	78308	ND	15.27	10.00	35.56	UG/L
TRIFLURALIN	1582098	ND	0.15	0.10	0.36	UG/L
TRIMETHYLPHOSPHATE	512561	ND	2.00	2.00	2.00	UG/L
TRIPHENYLENE	217594	ND	14.83	10.00	35.56	UG/L
TRIPROPYLENEGLYCOL METHYL ETHER	20324338	ND	146.80	99.00	352.04	UG/L
TUNGSTEN	7440337	NC	649.28	93.20	1000.00	UG/L
URANIUM	7440611	NC	1096.71	10.10	2670.00	UG/L
VANADIUM	7440622	NC	107.67	2.60	488.20	UG/L
VINYL ACETATE	108054	ND	50.00	49.94	50.00	UG/L
VINYL CHLORIDE	75014	ND	10.00	9.99	10.00	UG/L
YTTERBIUM	7440644	NC	68.46	0.10	100.00	UG/L
YTTRIUM	7440655	ND	4.33	3.00	5.00	UG/L
ZINC	7440666	NC	3718.81	89.75	12310.00	UG/L
ZIRCONIUM	7440677	NC	67.89	0.10	100.00	UG/L
1-BROMO-2-CHLOROBENZENE	694804	ND	14.83	10.00	35.56	UG/L
1-BROMO-3-CHLOROBENZENE	108372	ND	14.83	10.00	35.56	UG/L
1-CHLORO-3-NITROBENZENE	121733	ND	74.14	50.00	177.80	UG/L
1-METHYLFLUORENE	1730376	ND	14.83	10.00	35.56	UG/L
1-METHYLPHENANTHRENE	832699	ND	14.83	10.00	35.56	UG/L
1-NAPHTHYLAMINE	134327	ND	14.83	10.00	35.56	UG/L
1-PHENYLNAPHTHALENE	605027	ND	14.83	10.00	35.56	UG/L
1,1-DICHLOROETHANE	75343	ND	10.00	9.99	10.00	UG/L
1,1-DICHLOROETHENE	75354	ND	10.00	9.99	10.00	UG/L

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Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
1,1,1-TRICHLOROETHANE	71556	ND	10.00	9.99	10.00	UG/L
1,1,1,2-TETRACHLOROETHANE	630206	ND	10.00	9.99	10.00	UG/L
1,1,2-TRICHLOROETHANE	79005	ND	10.00	9.99	10.00	UG/L
1,1,2,2-TETRACHLOROETHANE	79345	ND	10.00	9.99	10.00	UG/L
1,2-DIBROMO-3-CHLOROPROPANE	96128	ND	29.66	20.00	71.12	UG/L
1,2-DIBROMOETHANE	106934	ND	10.00	9.99	10.00	UG/L
1,2-DICHLOROBENZENE	95501	ND	14.83	10.00	35.56	UG/L
1,2-DICHLOROETHANE	107062	ND	10.00	9.99	10.00	UG/L
1,2-DICHLOROPROPANE	78875	ND	10.00	9.99	10.00	UG/L
1,2-DIPHENYLHYDRAZINE	122667	ND	29.66	20.00	71.12	UG/L
1,2,3-TRICHLOROBENZENE	87616	ND	14.83	10.00	35.56	UG/L
1,2,3-TRICHLOROPROPANE	96184	ND	10.00	9.99	10.00	UG/L
1,2,3-TRIMETHOXYBENZENE	634366	ND	14.83	10.00	35.56	UG/L
1,2,4-TRICHLOROBENZENE	120821	ND	14.83	10.00	35.56	UG/L
1,2,4,5-TETRACHLOROBENZENE	95943	ND	14.83	10.00	35.56	UG/L
1,2:3,4-DIEPOXYBUTANE	1464535	ND	29.66	20.00	71.12	UG/L
1,3-BUTADIENE, 2-CHLORO	126998	ND	10.00	9.99	10.00	UG/L
1,3-DICHLORO-2-PROPANOL	96231	ND	14.83	10.00	35.56	UG/L
1,3-DICHLOROBENZENE	541731	ND	14.83	10.00	35.56	UG/L
1,3-DICHLOROPROPANE	142289	ND	10.00	9.99	10.00	UG/L
1,3,5-TRITHIANE	291214	ND	74.14	50.00	177.80	UG/L
1,4-DICHLOROBENZENE	106467	ND	14.83	10.00	35.56	UG/L
1,4-DINITROBENZENE	100254	ND	29.66	20.00	71.12	UG/L

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Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
1,4-DIOXANE	123911	ND	10.00	9.99	10.00	UG/L
1,4-NAPHTHOQUINONE	130154	ND	146.80	99.00	352.04	UG/L
1,5-NAPHTHALENEDIAMINE	2243621	ND	146.80	99.00	352.04	UG/L
1234678-HPCDD	35822469	NC	0.00	0.00	0.00	UG/L
1234678-HPCDF	67562394	NC	0.00	0.00	0.00	UG/L
123478-HXCDD	39227286	ND	0.00	0.00	0.00	UG/L
123478-HXCDF	70648269	ND	0.00	0.00	0.00	UG/L
1234789-HPCDF	55673897	ND	0.00	0.00	0.00	UG/L
123678-HXCDD	57653857	ND	0.00	0.00	0.00	UG/L
123678-HXCDF	57117449	ND	0.00	0.00	0.00	UG/L
12378-PECDD	40321764	ND	0.00	0.00	0.00	UG/L
12378-PECDF	57117416	ND	0.00	0.00	0.00	UG/L
123789-HXCDD	19408743	ND	0.00	0.00	0.00	UG/L
123789-HXCDF	72918219	ND	0.00	0.00	0.00	UG/L
2-(METHYLTHIO)BENZOTHIAZOLE	615225	ND	14.83	10.00	35.56	UG/L
2-BUTANONE	78933	ND	50.00	49.94	50.00	UG/L
2-CHLOROETHYLVINYL ETHER	110758	ND	10.00	9.99	10.00	UG/L
2-CHLORONAPHTHALENE	91587	ND	14.83	10.00	35.56	UG/L
2-CHLOROPHENOL	95578	ND	14.83	10.00	35.56	UG/L
2-HEXANONE	591786	ND	50.00	49.94	50.00	UG/L
2-ISOPROPYLNAPHTHALENE	2027170	ND	14.83	10.00	35.56	UG/L
2-METHYLBENZOTHIOAZOLE	120752	ND	14.83	10.00	35.56	UG/L
2-METHYLNAPHTHALENE	91576	ND	14.83	10.00	35.56	UG/L

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Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
2-NITROANILINE	88744	ND	14.83	10.00	35.56	UG/L
2-NITROPHENOL	88755	ND	29.66	20.00	71.12	UG/L
2-PHENYLNAPHTHALENE	612942	ND	14.83	10.00	35.56	UG/L
2-PICOLINE	109068	ND	74.14	50.00	177.80	UG/L
2-PROPANONE	67641	ND	50.00	49.94	50.00	UG/L
2-PROPEN-1-OL	107186	ND	10.00	9.99	10.00	UG/L
2-PROPENAL	107028	ND	50.00	49.94	50.00	UG/L
2-PROPENENITRILE, 2-METHYL-	126987	ND	10.00	9.99	10.00	UG/L
2,3-BENZOFLUORENE	243174	ND	14.83	10.00	35.56	UG/L
2,3-DICHLOROANILINE	608275	ND	14.83	10.00	35.56	UG/L
2,3-DICHLORONITROBENZENE	3209221	ND	74.14	50.00	177.80	UG/L
2,3,4,6-TETRACHLOROPHENOL	58902	ND	29.66	20.00	71.12	UG/L
2,3,6-TRICHLOROPHENOL	933755	ND	14.83	10.00	35.56	UG/L
2,4-D	94757	NC	1.80	1.00	3.56	UG/L
2,4-DB	94826	NC	3.43	2.00	10.46	UG/L
2,4-DICHLOROPHENOL	120832	ND	14.83	10.00	35.56	UG/L
2,4-DIMETHYLPHENOL	105679	ND	14.83	10.00	35.56	UG/L
2,4-DINITROPHENOL	51285	ND	74.14	50.00	177.80	UG/L
2,4-DINITROTOLUENE	121142	ND	14.83	10.00	35.56	UG/L
2,4,5-T	93765	NC	0.35	0.20	0.71	UG/L
2,4,5-TP	93721	NC	0.42	0.20	1.25	UG/L
2,4,5-TRICHLOROPHENOL	95954	ND	14.83	10.00	35.56	UG/L
2,4,6-TRICHLOROPHENOL	88062	ND	14.83	10.00	35.56	UG/L

APPENDIX C

Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
2,6-DI-TERT-BUTYL-P-BENZOQUINONE	719222	ND	146.80	99.00	352.04	UG/L
2,6-DICHLORO-4-NITROANILINE	99309	ND	146.80	99.00	352.04	UG/L
2,6-DICHLOROPHENOL	87650	ND	14.83	10.00	35.56	UG/L
2,6-DINITROTOLUENE	606202	ND	14.83	10.00	35.56	UG/L
234678-HXCDF	60851345	ND	0.00	0.00	0.00	UG/L
23478-PECDF	57117314	ND	0.00	0.00	0.00	UG/L
2378-TCDD	1746016	ND	0.00	0.00	0.00	UG/L
2378-TCDF	51207319	ND	0.00	0.00	0.00	UG/L
3-CHLOROPROPENE	107051	ND	10.00	9.99	10.00	UG/L
3-METHYLCHOLANTHRENE	56495	ND	14.83	10.00	35.56	UG/L
3-NITROANILINE	99092	ND	29.66	20.00	71.12	UG/L
3,3'-DICHLOROBENZIDINE	91941	ND	74.14	50.00	177.80	UG/L
3,3'-DIMETHOXYBENZIDINE	119904	ND	74.14	50.00	177.80	UG/L
3,6-DIMETHYLPHENANTHRENE	1576676	ND	14.83	10.00	35.56	UG/L
4-AMINOBIPHENYL	92671	ND	14.83	10.00	35.56	UG/L
4-BROMOPHENYL PHENYL ETHER	101553	ND	14.83	10.00	35.56	UG/L
4-CHLORO-2-NITROANILINE	89634	ND	29.66	20.00	71.12	UG/L
4-CHLORO-3-METHYLPHENOL	59507	ND	14.83	10.00	35.56	UG/L
4-CHLOROPHENYLPHENYL ETHER	7005723	ND	14.83	10.00	35.56	UG/L
4-METHYL-2-PENTANONE	108101	ND	50.00	49.94	50.00	UG/L
4-NITROPHENOL	100027	ND	74.14	50.00	177.80	UG/L

APPENDIX C

Range of Pollutant Influent Concentrations of the Pooled Daily Data from the Three 5-Day EPA Sampling Episodes for all Analytes

Analyte	CAS_NO	Meas. Type	Mean	Min	Max	Unit
4,4'-DDD	72548	ND	0.31	0.20	0.71	UG/L
4,4'-DDE	72559	ND	0.15	0.10	0.36	UG/L
4,4'-DDT	50293	ND	0.15	0.10	0.36	UG/L
4,4'-METHYLENEBIS(2-CHLOROANILINE)	101144	ND	29.66	20.00	71.12	UG/L
4,5-METHYLENE PHENANTHRENE	203645	ND	14.83	10.00	35.56	UG/L
5-NITRO-O-TOLUIDINE	99558	ND	14.83	10.00	35.56	UG/L
7,12-DIMETHYLBENZ(A) ANTHRACENE	57976	ND	14.83	10.00	35.56	UG/L

APPENDIX D

ACRONYMS AND DEFINITIONS

Administrator -- The Administrator of the U.S. Environmental Protection Agency

Agency -- The U.S. Environmental Protection Agency

BAT -- The best available technology economically achievable, as described in Sec. 304(b)(2) of the CWA.

BCT -- The best conventional pollutant control technology, as described in Sec. 304(b)(4) of the CWA.

BOD$_5$ -- Biochemical oxygen demand - Five Day. A measure of biochemical decomposition of organic matter in a water sample. It is determined by measuring the dissolved oxygen consumed by microorganisms to oxidize the organic contaminants in a water sample under standard laboratory conditions of five days and 70EC. BOD$_5$ is not related to the oxygen requirements in chemical combustion.

Boiler -- means an enclosed device using controlled flame combustion and having the following characteristics:

(1) (i) The unit must have physical provisions for recovering and exporting thermal energy in the form of steam, heated fluids, or heated gases; and

(ii) The unit's combustion chamber and primary energy recovery section(s) must be of integral design. To be of integral design, the combustion chamber and the primary energy recovery section(s) (such as waterwalls and superheaters) must be physically formed into one manufactured or assembled unit. A unit in which the combustion chamber and the primary energy recovery section(s) are joined only by ducts or connections carrying flue gas is not integrally designed; however, secondary energy recovery equipment (such as economizers or air preheaters) need not be physically formed into the same unit as the combustion chamber and the primary energy recovery section. The following units are not precluded from being boilers solely because they are not of integral design: process heaters (units that transfer energy directly to a process stream), and fluidized bed combustion units; and

(iii) While in operation, the unit must maintain a thermal energy recovery efficiency of at least 60 percent, calculated in terms of the recovered energy compared with the thermal value of the fuel; and

(iv) The unit must export and utilize at least 75 percent of the recovered energy, calculated on an annual basis. In this calculation, no credit shall be given for recovered heat used internally in the same unit. (Examples of internal use are the preheating of fuel or combustion air, and the driving of induced or forced draft fans or feedwater pumps); or

(2) The unit is one which the Regional Administrator has determined, on a case-by-case basis, to be a boiler, after considering the standards in Section 260.32.

BPT -- The best practicable control technology currently available, as described in Sec. 304(b)(1) of the CWA.

Captive -- Used to describe a facility that only accepts waste generated on site and/or by the owner operator at the facility.

Clarification -- A treatment designed to remove suspended materials from wastewater--typically by sedimentation.

Clean Water Act (CWA) -- The Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1251 et seq.), as amended, *inter alia*, by the Clean Water Act of 1977 (Public Law 95-217) and the Water Quality Act of 1987 (Public Law 100-4).

Closed -- A facility or portion thereof that is currently not receiving or accepting wastes and has undergone final closure.

Combustion Unit -- A device for waste treatment which uses elevated temperatures as the primary means to change the chemical, physical, biological character or composition of the waste. Examples of combustion units are incinerators, fuel processors, boilers, industrial furnaces, and kilns.

Commercial Hazardous Waste Combustor -- Any thermal unit, except a cement kiln, that is subject to either to 40 CFR Part 264, Subpart O; Part 265, Subpart O; or Part 266, Subpart H if the thermal unit burns RCRA hazardous wastes received from off-site for a fee or other remuneration in the following circumstances. The thermal unit is a commercial hazardous waste combustor if the off-site wastes are generated at a facility not under the same corporate structure or subject to the same ownership as the thermal unit and

(1) The thermal unit is burning wastes that are not of a similar nature to wastes being burned from industrial processes on site or

(2) There are no wastes being burned from industrial processes on site.

Examples of wastes of a “similar nature” may include the following: wastes generated in industrial operations whose wastewaters are subject to the same provisions in 40 CFR Subchapter N or wastes burned as part of a product stewardship activity. The term commercial hazardous waste combustor includes the following facilities: a facility that burns exclusively waste received from off-site; and, a facility that burns both wastes generated on-site and wastes received from off-site. Facilities that may be commercial hazardous waste combustors include hazardous waste incinerators, rotary kiln incinerators, lime kilns, lightweight aggregate kilns, and boilers. A facility not otherwise a commercial hazardous waste combustor is not a commercial hazardous waste combustor if it burns RCRA hazardous waste for charitable organizations, as a community service or as an accommodation to local, state or government agencies so long as the waste is burned for no fee or other remuneration.

Commercial hazardous waste combustor wastewater -- Wastewater attributable to commercial hazardous waste combustion operations, but includes only wastewater from air pollution control systems and water used to quench flue gas or slag generated as a result of commercial hazardous waste combustor operations.

Conventional pollutants -- The pollutants identified in Sec. 304(a)(4) of the CWA and the regulations thereunder (biochemical oxygen demand (BOD_5), total suspended solids (TSS), oil and grease, fecal coliform, and pH).

Direct discharger -- A facility that discharges or may discharge treated or untreated pollutants into waters of the United States.

Disposal -- Intentional placement of waste or waste treatment residual into or on any land where the material will remain after closure. Waste or residual placed into any water is not defined as disposal, but as discharge.

Effluent -- Wastewater discharges.

Effluent limitation -- Any restriction, including schedules of compliance, established by a State or the Administrator on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters, the waters of the contiguous zone, or the ocean. (CWA Sections 301(b) and 304(b).)

EA -- Economic Analysis

EPA -- The U.S. Environmental Protection Agency.

Facility -- A facility is all contiguous property owned, operated, leased or under the control of the same person. The contiguous property may be divided by public or private right-of-way.

Hazardous Waste -- Any waste, including wastewaters defined as hazardous under RCRA, Toxic Substances Control Act (TSCA), or any state law.

Incinerator -- means any enclosed device that:

(1) Uses controlled flame combustion and neither meets the criteria for classification as a boiler, sludge dryer, or carbon regeneration unit, nor is listed as an industrial furnace; or
(2) Meets the definition of infrared incinerator or plasma arc incinerator.

Indirect discharger -- A facility that discharges or may discharge pollutants into a publicly-owned treatment works.

Industrial Furnace -- means any of the following enclosed devices that are integral components of manufacturing processes and that use thermal treatment to accomplish recovery of materials or energy:

(1) Cement kilns
(2) Lime kilns
(3) Aggregate kilns
(4) Phosphate kilns
(5) Coke ovens
(6) Blast furnaces
(7) Smelting, melting and refining furnaces (including pyrometallurgical devices such as cupolas, reverberator furnaces, sintering machine, roasters, and foundry furnaces)
(8) Titanium dioxide chloride process oxidation reactors
(9) Methane reforming furnaces
(10) Pulping liquor recovery furnaces
(11) Combustion devices used in the recovery of sulfur values from spent sulfuric acid
(12) Halogen acid furnaces (HAFs) for the production of acid from halogenated hazardous waste generated by chemical production facilities where the furnace is located on the site of a chemical production facility, the acid product has a halogen acid content of at least 3 percent, the acid product is used in a manufacturing process, and except for hazardous waste burned as fuel, hazardous waste fed to the furnace has a minimum halogen content of 20 percent as generated.
(13) Such other devices as the Administrator may, after notice and comment, add to this list on the basis of one or more of the following factors:
    (i) The design and use of the device primarily to accomplish recovery of material products;
    (ii) The use of the device to burn or reduce raw materials to make a material product;
    (iii) The use of the device to burn or reduce secondary materials as effective substitutes for raw

materials, in processes using raw materials as principal feedstocks;

(iv) The use of the device to burn or reduce secondary materials as ingredients in an industrial process to make a material product;

(v) The use of the device in common industrial practice to produce a material product; and,

(vi) Other factors, as appropriate.

Intracompany -- A facility that treats, disposes, or recycles/recovers wastes generated by off-site facilities under the same corporate ownership. The facility may also treat on-site generated wastes. If any waste from other facilities not under the same corporate ownership is accepted for a fee or other remunerations, the facility is considered commercial.

LTA -- Long-term Average. For purposes of the effluent guidelines, LTAs are defined as average pollutant levels achieved over a period of time by a technology option. LTAs were used in developing the limitations and standards in today's proposed regulation.

Minimum level -- The level at which an analytical system gives recognizable signals and an acceptable calibration point.

Municipal Facility -- A facility which is owned or operated by a municipal, county, or regional government.

New Source -- "New source" is defined at 40 CFR 122.2 and 122.29.

Non-conventional pollutants -- Pollutants that are neither conventional pollutants nor priority pollutants listed at 40 CFR Section 401.

Non-detect value -- A concentration-based measurement reported below the sample specific detection limit that can reliably be measured by the analytical method for the pollutant.

Non-hazardous waste -- All waste not defined as hazardous under RCRA regulations.

Non-water quality environmental impact -- An environmental impact of a control or treatment technology, other than to surface waters.

NPDES -- The National Pollutant Discharge Elimination System authorized under Sec. 402 of the CWA. NPDES requires permits for discharge of pollutants from any point source into waters of the United States.

NSPS -- New Source Performance Standards

OCPSF -- Organic Chemicals, Plastics, and Synthetic Fibers Manufacturing Effluent Guideline (40 CFR Part 414).

Off-site -- "Off-site" means outside the boundaries of a facility.

On-site -- "On-site" means within the boundaries of a facility.

Outfall -- The mouth of conduit drains and other conduits from which a facility effluent discharges into receiving waters or POTWs.

Point Source Category -- A category of sources of water pollutants.

POTW or POTWs -- Publicly-owned treatment works, as defined at 40 CFR 403.3(o).

Pretreatment Standard -- a regulation that establishes industrial wastewater effluent quality as required for discharge to a POTW. (CWA Section 307(b).)

Priority Pollutants -- The pollutants designated by EPA as priority in 40 CFR Part 423 Appendix A.

Process wastewater -- "Process Wastewater" is defined at 40 CFR 122.2.

PSES -- Pretreatment standards for existing sources of indirect discharges, under Sec. 307(b) of the CWA.

PSNS -- Pretreatment standards for new sources of indirect discharges, under Sec. 307(b) and (c) of the CWA.

RCRA -- Resource Conservation and Recovery Act (PL 94-580) of 1976, as amended.

Residuals -- The material remaining after a natural or technological process has taken place, e.g., the sludge remaining after initial wastewater treatment.

Sewage Sludge -- Sludge generated by a sewage treatment plant or POTW.

Sludge -- The accumulated solids separated from liquids during processing.

Small business -- Businesses with annual sales revenues less than $6 million. This is the Small Business Administration definition of small business for SIC code 4953, Refuse Systems (13 CFR Ch.1, § 121.601)

Solids -- For the purpose of this notice, a waste that has a very low moisture content, is not free-flowing, and does not release free liquids. This definition deals with the physical state of the waste, not the RCRA definition.

Treatment -- Any activity designed to change the character or composition of any waste so as to prepare it for transportation, storage, or disposal; render it amenable for recycling or recovery; or reduce it in volume.

TSS -- Total Suspended Solids. A measure of the amount of particulate matter that is suspended in a water sample. The measure is obtained by filtering a water sample of known volume. The particulate material retained on the filter is then dried and weighed.

Waste Receipt -- Wastes received for combustion.

Wastewater treatment system -- A facility, including contiguous land and structures, used to receive and treat wastewater. The discharge of a pollutant from such a facility is subject to regulation under the Clean Water Act.

Waters of the United States -- The same meaning set forth in 40 CFR 122.2

Zero discharge -- No discharge of pollutants to waters of the United States or to a POTW. Also included in this definition are discharge of pollutants by way of evaporation, deep-well injection, off-site transfer and land application.