CHAPTER 8
LIMITATIONS AND STANDARDS: DATA SELECTION AND CALCULATION

This section describes the data sources, data selection, data conventions, and statistical methodology used by EPA in calculating the long-term averages, variability factors, and proposed limitations. The proposed effluent limitations and standards[1] are based on long-term average effluent values and variability factors that account for variation in treatment performance within a particular treatment technology over time. EPA is proposing limitations for flow-through and recirculating system subcategories. EPA is not proposing limitations for net pen systems. In calculating the proposed limitations for total suspended solids (TSS), EPA used a combination of the data from sampling episodes and data from industry discharge monitoring reports (DMRs). For both subcategories, EPA considered, but did not propose, limitations for total phosphorus. For the recirculating subcategory, EPA also considered, but did not propose, limitations for 5-day biochemical oxygen demand (BOD_5). This section describes the data selection and calculations for limitations based on the TSS, total phosphorus, and BOD_5 data.

Section 8.1 gives a brief overview of data sources (a more detailed discussion is provided in Chapter 3) and describes EPA's evaluation and selection of episode data sets that are the basis of the proposed limitations. Section 8.2 provides a more detailed discussion of the selection of the episode data sets for the options. Section 8.3 describes excluded and substituted data and Section 8.4 presents the procedures for data aggregation. Section 8.5 provides an overview of the limitations. Section 8.6 describes the procedures for estimation of long-term averages, variability factors, and limitations.

8.1 OVERVIEW OF DATA SELECTION

To develop the long-term averages, variability factors, and limitations, EPA used concentration data from facilities with components of the model technology in the two subcategories. These data were collected from two sources, EPA's sampling episodes and DMR data collected from EPA regional offices and in EPA's Permit Compliance System (PCS) database. This section refers to the DMR data as the facility's "self-monitoring episode."

EPA used only data from facilities that had the model technologies described in Chapter 9. EPA qualitatively reviewed these data from the sampling episodes and self-monitoring episodes and then selected episodes to represent each technology based on a

[1] In the remainder of this chapter, references to 'limitations' includes 'standards.'

review of the production processes and treatment technologies in place at each facility. Appendix C lists the data for the pollutants of concern (see Chapter 6) and Appendix D provides summary statistics for those data. The proposal record also contains an electronic spreadsheet of the data (DCN 50013, Section 10.1).

EPA's sampling episodes typically provided data for a range of pollutants. (See Chapters 3 and 6 for more information on sampling episode data.) In contrast, the industry self-monitoring (DMR) data were for only a limited subset of pollutants because most facilities monitor for only the pollutants specified in their permits.

EPA assumed that the DMR data were generated by the production method and treatment technologies reported by the facility in the Aquatic Animal Production (AAP) screener survey (USEPA, 2001) in response to the open-ended question (question 10) "What pollutant control practices do you use before water leaves your property?" Because of time constraints, EPA was able to incorporate additional DMR data from only four Virginia flow-through concentrated aquatic animal production (CAAP) facilities taken over a period of several years. For the final rule, EPA intends to review the PCS database and other possible sources of data to determine whether additional DMR data should be included in developing the final limitations.

Because of time constraints, in calculating the proposed limitations, EPA has not included self-monitoring data for any facility selected for an EPA sampling episode. For the final rule, if EPA selects data from a sampling episode, it is likely to use any self-monitoring data that were submitted by that facility or are available from PCS. In calculating the final limitations, EPA would then be likely to statistically analyze the data from each episode separately. This is consistent with EPA's practice for other industrial categories. Data from different sources generally characterize different time periods and/or different chemical analytical methods.

For the episode data sets that were used to develop the proposed limitations, EPA performed a detailed review of the data and all supporting documentation accompanying the data. This was done to ensure that the selected data represent a facility's normal operating conditions and ensure that the data accurately reflect the performance expected by the production method and treatment systems. Thus, EPA evaluated whether the data were collected while a facility was experiencing exceptional incidents (upsets). EPA also evaluated whether the DMR data were in compliance with the facility's permit.

The next section describes the episode and sample point selection for each subcategory and option.

8.2 EPISODE SELECTION FOR EACH SUBCATEGORY AND OPTION

This section describes the episodes selected for each technology option for the two proposed subcategories (flow-through and recirculating systems). Table 8.2-1 summarizes the episode and sample point selections. Appendix C lists the data for the pollutants of concern (see Chapter 6) and Appendix D provides summary statistics of those data.

Table 8.2-1. Summary of Episode and Sample Point Selection

Subcat	*Option*	*Episode*	*Influent*[a]	*Effluent*[a]
Flow-through	N/A[b]	6297C[c]	SP-12	SP-13(dup SP-14)
		6297D[d]	SP-4	N/A
		6297F[e]	N/A	SP-2 (dup SP-3)
	Raceway	6297E	N/A	SP-5 (dup SP-6)
		6460B	N/A	SP-7
	OLSB	6297A	SP-7	SP-8 (dup SP-9)
		6297B	SP-10	SP-11
		6460C	SP-8	SP-9
	1	6297G	SP-7	SP-8 (dup SP-9) and SP-5 (dup SP-6)
		6297H	SP-10	SP-11 with SP-5 (dup SP-6)
		6297I	SP-12	SP-13 (dup SP-14) and SP-2 (dup SP-3)
		6460A	N/A	SP-7 and SP-9
		DMR1	N/A	SP-1
		DMR3	N/A	SP-1
		DMR4	N/A	SP-1
	3	6460D	SP-7, SP-8	SP-10 (dup SP-11)
		DMR2	N/A	SP-1
Recirculating	N/A[b]	6439C[f]	SP-2	N/A
	1	6439A	SP-3	SP-4
	3	6439B	SP-8	SP-9 (dup SP-11)

[a]When EPA collected duplicate samples, it assigned a different sample point designation than the sample point for the original sample. The parentheses identify the sample points for the duplicates.
[b]Although these sample points were not considered in developing the limitations and are labeled as "Not applicable" (N/A), EPA used these data to review the overall performance at the facility. EPA has included these data in its data listings and summary statistics.
[c]Influent and effluent corresponding to the Hatch House OLSB.
[d]Source water.
[e]Effluent from the Hatch House.
[f]Overflow from production tanks.
Note: N/A, data were not provided for that location.

If a facility had multiple production and treatment trains that EPA sampled separately, EPA has treated the data as if they were collected from different facilities because the trains are operated independently with different waste streams. In the documentation, the episode identifier is appended with a character, such as "A", to indicate that the data are from one of the multiple trains. In the following sections and in the public record, EPA has masked the identity of the facilities for which it used DMR data. These episodes are identified only as DMRx where "x" is a one-digit number assigned to each DMR episode. EPA has arbitrarily assigned the sample point designation SP-1 to all DMR episodes.

8.2.1 Flow-through Subcategory

For the flow-through subcategory, EPA proposed limitations for Options 1 and 3. EPA also considered separate limitations for raceway and offline settling basins (OLSBs), although it chose to propose limitations for only the combined discharges. This section describes the data used to develop the limitations for Option 1, Option 3, raceways, and OLSBs. For this subcategory, EPA proposed limitations for TSS and considered limitations on total phosphorus discharges.

8.2.1.1 Option 1

In developing the proposed limitations for Option 1, EPA used data from two of its sampling episodes, 6297 and 6460, and three DMR episodes, DMR1, DMR3, and DMR4. As explained below, EPA used the data from the three DMR episodes and mathematically aggregated the data from each of the two episodes to obtain a total of seven process/treatment streams that it considered as seven episodes in its calculations. This section describes the data from each episode.

Episode 6297 was conducted on December 11-16, 2000, in Buhl, Idaho, at the Box Canyon trout facility owned and operated by Clear Springs Foods, Inc. Box Canyon is the largest trout-producing raceway system in the United States and has an average annual production of some 8 million pounds. The facility includes a hatchery consisting of upwelling incubators; 20 raceways and four steel tanks for producing fry; 180 flow-through raceways for growout; and three OLSBs for solids collection. An overall schematic of the facility with the sampling point locations is presented as Figure 8.2-1. Surface water from Box Canyon Spring is piped under the Snake River to Box Canyon at a rate of approximately 300 cubic feet per second (cfs). The water is diverted under the river through three steel pipes and through three turbines for electrical energy production. After passing through the turbines, the flow is split among the Blueheart, Eastman, and hatchery sections of the facility. Both the Blueheart and Eastman sections of the facility contain 90 concrete raceways holding approximately 10,000 fish per raceway. Automatic fish feeders are located above each raceway in four different locations. Automated feeding systems are used to feed the fish in the 180 raceways used for growout. All feeding in the hatchery is done by hand. Wastewater treatment operations at Box Canyon include quiescent zones, offline settling basins, and regular vacuuming of raceways. The quiescent zone at the terminal end of each raceway allows fecal material to settle before the raceway water is reused or discharged to the Snake River. Solids are removed from the quiescent zone by vacuuming. The vacuumed solids then flow by gravity to the designated OLSB for each section of the facility. In evaluating Option 1, EPA considered three process/treatment streams at this facility by mathematically combining the data from:

1. The Eastman raceway and its OLSB. This was labeled as *episode 6297G*.

2. The Eastman raceway and the Blueheart OLSB. This was labeled as *episode 6297H*.
3. The hatch house and its OLSB. This was labeled as *episode 6297I*.

EPA also received self-monitoring data from the Box Canyon facility and has summarized that information in *Listings for Episode 6297: DMR Data, Summary Statistics, and Estimates* (SAIC, 2002a). Because of time constraints, EPA did not include these data in developing the proposed limitations, but is considering their use for the final rule. In the record, EPA used the reported weekly flows to mathematically combine the data from different sample points. For the few cases where weekly flows were not reported, EPA used the average flow for the month. If a monthly average flow was also missing, then EPA used the maximum flow value reported for the month.

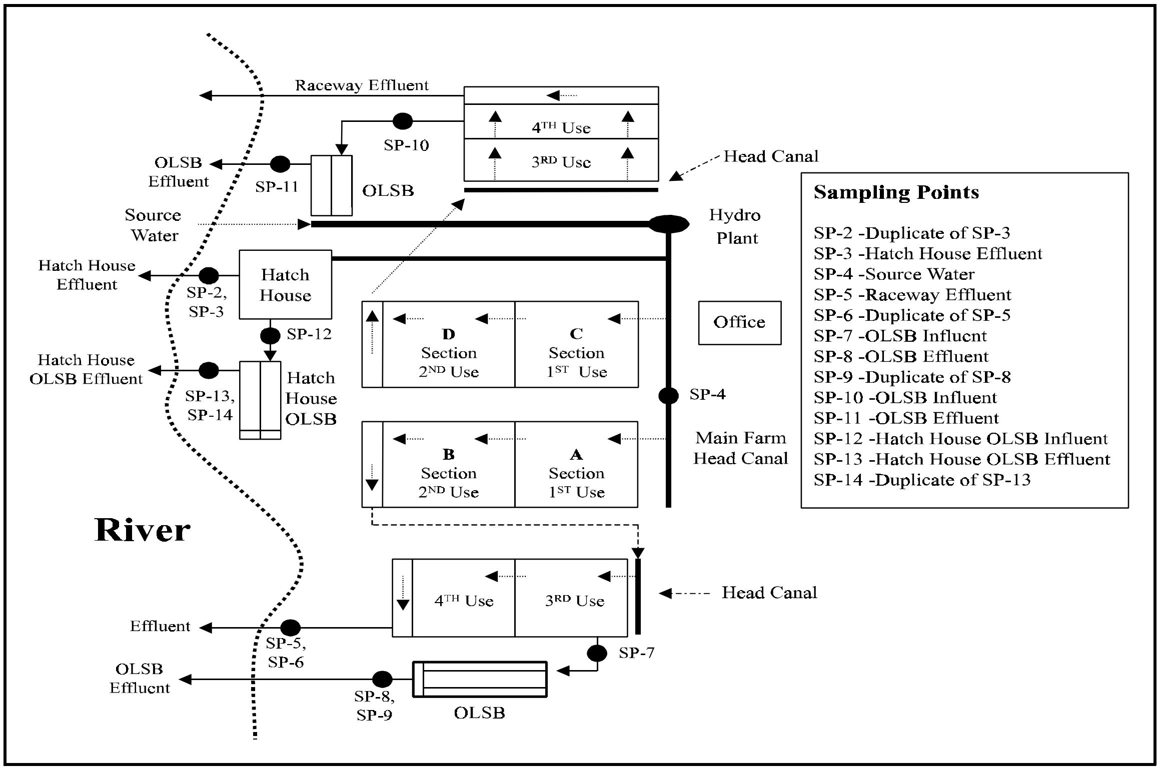

Figure 8.2-1. Schematic of Sampling Points and Facility for Episode 6297

Episode 6460 was conducted on August 24-29, 2001, in Harrietta, Michigan, at the Harrietta Hatchery trout facility. Harrietta Hatchery is a Michigan Department of Natural Resources hatchery whose mission is to produce rainbow and brown trout for stocking into Michigan waters. Harrietta produces about 1.2 million trout annually. The trout are harvested from Harrietta's raceways when they are about 5 to 8 in. in length or about eight to ten fish to the pound. Figure 8.2-2 shows the process diagram for the facility associated with this episode. Harrietta uses well water at a rate of up to 5.5 million gallons per day (mgd) from pumped and artesian wells that flow to the hatchery and 12 raceways. Wastewater treatment operations at the Harrietta Hatchery include the use of baffles, quiescent zones (sediment traps) in each raceway, a manure storage/settling pond, and a polishing pond. The outdoor growout system consists of 12 covered raceways grouped in three blocks of four. Water flows through each raceway in the block and is collected in a common trough, which is discharged either to an aeration shed or a polishing pond. At the downstream end of each raceway is a quiescent zone where solids settle and are easily vacuumed. The vacuumed solids are diverted into a manure collection/storage basin (or OLSB) adjacent to the polishing pond. A standpipe in each raceway can also be pulled to send water and solids to the OLSB. This OLSB has an intermittent discharge, typically weekly, and only occurred once during EPA's sampling episode (on 8/27/01). To accommodate EPA's schedule, the facility discharged from the OLSB two days earlier than originally scheduled. In evaluating Option 1, to obtain one value for the combined discharges for each day that EPA sampled, the Agency mathematically combined the data from the commingled raceway discharge and the OLSB discharge. Because the OLSB discharged on only 1 day, the daily values for the other 4 days are based on only the commingled raceway discharge. The daily data for this option were labeled as *episode 6460A*.

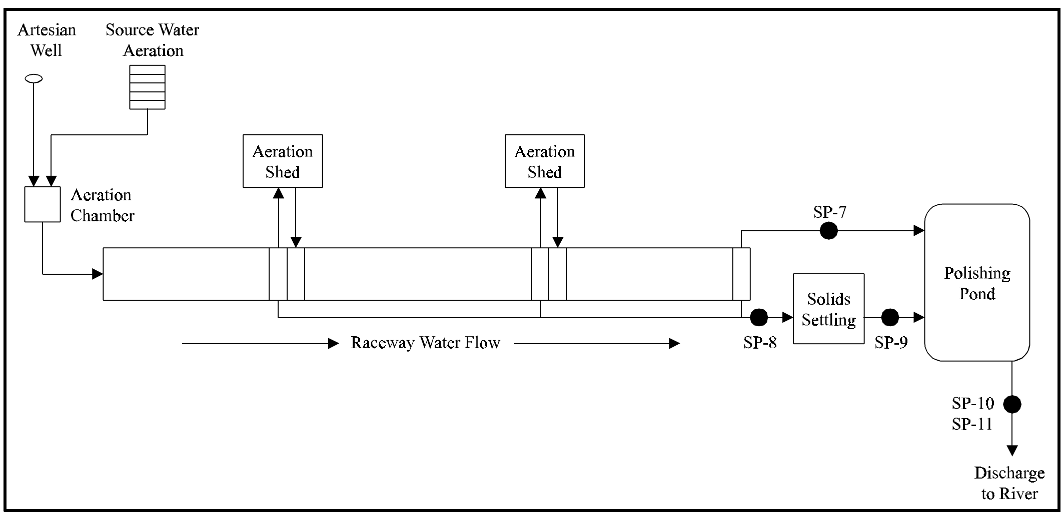

Figure 8.2-2. Schematic of Sampling Points and Facility for Episode 6460

For the three DMR episodes (DMR1, DMR3, and DMR4), EPA assumed that the discharges resulted from the combined flows from raceways and OLSBs based on examination of the facility NPDES permit and the responses to the open-ended question (question 10) in the AAP screener questionnaire, "What pollutant control practices do you use before water leaves your property?" The facility that provided the DMR1 data is Virginia Department of Game and Inland Fisheries, Coursey Springs Fish Culture Station, Millboro, Virginia, a state fish hatchery that produces brook, brown, and rainbow trout for stocking in public trout streams. The facility uses about 11.5 mgd of spring water and uses quiescent zones and full-flow settling for removing solids from the effluent stream. The DMR3 data are from Virginia Department of Game and Inland Fisheries, Marion Fish Culture Station, Marion, VA, another state facility that produces trout, muskellunge, pike, and walleye for stocking in public waters. This facility separately samples its effluents from quiescent zones and a full-flow settling basin below the trout raceways. The facility then mathematically combines the two effluent data values to obtain one daily value for the facility. The facility uses about 2.0 mgd for the trout production part of the operation. The DMR4 data are from Virginia Department of Game and Inland Fisheries, Buller Fish Culture Station, Marion, VA, a state-owned trout rearing station that produces trout for stocking in public waters. The facility samples its effluents from quiescent zones and a full-flow settling basin, separately, and then mathematically combines the results to obtain one daily value. The facility uses about 0.5 mgd for the trout production.

8.2.1.2 Option 3

For Option 3, EPA evaluated the data collected from the polishing pond at episode 6460 and the data from DMR2. Because the TSS data from DMR2 exceeded the monthly permit limit for 1 month, EPA excluded these data from further consideration in calculating the proposed TSS limitations. Thus, the proposed TSS limitations were based on the discharge from the polishing pond at episode 6460. The data were labeled as *episode 6460D*, and the facility is described under Option 1. The DMR2 data are from a state-owned trout production facility for stocking in public trout streams. The facility produces brook, brown, and rainbow trout in raceways. Effluents from the raceways flow into a two-stage settling pond for primary settling and secondary solids polishing. The system flow rate is about 2.8 mgd.

8.2.1.3 Raceways

To evaluate the performance of the raceways in Option 1, EPA calculated limitations using the data for the Eastman raceway from episode 6297 (labeled as *episode 6297E*) and the discharge (labeled as *episode 6460B*) from one of the blocks of raceways from episode 6460.

8.2.1.4 OLSBs

To evaluate the performance of the OLSBs in Option 1, EPA calculated limitations using the data for the Eastman and Blueheart OLSBs from episode 6297 (labeled as *episode 6297A* and *episode 6297B*, respectively) and the OLSB from episode 6460 (labeled as *episode 6460C*).

8.2.2 Recirculating Subcategory

For the recirculating subcategory, EPA proposed limitations for Option 3 based on the permit limits from the facility that EPA sampled during episode 6439, which was conducted at Fins Technology, LLC on April 23-28, 2001 in Turners Falls, Massachusetts. Fins Technology, started in 1990 as AquaFuture, Inc, produces about 1 million pounds of hybrid striped bass per year in a recirculating system. It sells live and iced whole fish throughout the U.S. east coast and New England. A unique feature of this facility is its ability to grow hybrid striped bass from egg to foodfish in recirculating systems, all of which are located on-site. Fins Technology uses recirculating system technology to maintain water quality in the growing tanks for the hybrid striped bass. The facility adds less than 10% of the total system volume each day to offset water losses because of filter backwashes and to account for some of the inefficiencies in the recirculating system. Wastewater is generated from solids filtration equipment that maintains process water quality in the recirculating system. Solids are generated when the solids filters are backwashed throughout the day. Additional system overflow water is added to the waste stream and comes directly from the process tanks. Because the facility has claimed its process diagram as CBI, EPA is providing only a brief summary of the process at that facility in Figure 8.2-3.

Rather than basing the proposed TSS limitations on the data it had collected, EPA used the permit limits for this facility because the facility had exceeded those limits during EPA's sampling episode. This facility is generally capable of complying with its permit limits, and therefore, EPA determined that the permit limits more accurately reflected normal operations of the model technology for this option. EPA also noted that the effluent from the polishing pond was more variable than EPA's experience with typical performance of polishing ponds. EPA is considering BOD and total phosphorus limitations for the recirculation subcategory in addition to TSS. The data and summary statistics for this episode are included in Appendices C and D. Table 8.6-2 in Section 8.6 provides the long-term average and variability factors for this episode.

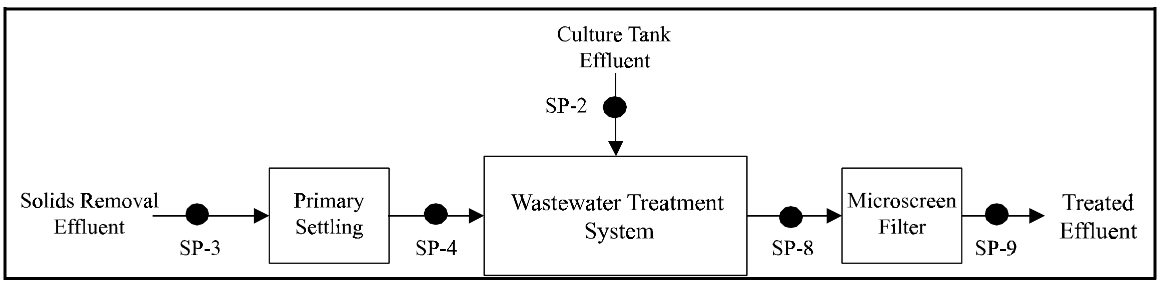

Figure 8.2-3. Schematic of Sampling Points and Facility for Episode 6439

8.3 DATA EXCLUSIONS AND SUBSTITUTIONS

In some cases, EPA did not use all of the data described in Section 8.2 in calculating the limitations. Other than the data exclusions and substitutions described in this section and those resulting from the data editing procedures, EPA has used the data from the episodes and sample points identified in Table 8.2-1.

EPA excluded the data for one sample (55949) of the influent during episode 6297 (sample point 12) because it was filtered before measuring the concentration levels. Instead, in its statistical analyses, EPA used the concentration data from another sample (55948) collected at approximately the same time at that sample point, but was not filtered prior to measuring the concentrations.

For the DMR data (episodes DMR1, DMR2, DMR3, and DMR4), EPA reviewed the NPDES permit information for each facility to determine the reporting requirements. For the parameters of interest to EPA (TSS, BOD, and settleable solids), the monitoring frequency was typically once per month or once per three months and the samples were typically 8-hour composite samples collected hourly or until 5 grab samples were collected. Other parameters sometimes required more frequent monitoring, which were reported over more than one 24-hour period. Since facilities report multiple parameters in a single report, multiple days are sometimes recorded as the monitoring period for all of the data. Based on the permit information, EPA assumed that each reported value (for the parameters of interest) was from a single 24-hour period. For purposes of the statistical analyses and data listings, EPA assumed that the sample date was the one associated with the "Monitoring from" date (starting date of the sampling) listed in the DMR.[2]

The DMR data did not indicate whether they were nondetected (ND) or noncensored (NC) values. Except for settleable solids, EPA assumed that all values were NC. For settleable solids, EPA assumed that all reported values of 0.1 mL/L were ND. For the two values reported at 0.01 mL/L, EPA assumed that they were ND and replaced the reported value with the detection limit of 0.1 mL/L. (One value is from DMR2 and the other from DMR4.) In the memorandum *Censoring Assumptions for DMR Data in the Aquatic Animals Proposal* (USEPA, 2002), EPA evaluates the effect of assuming that low values of TSS are ND rather than NC on the estimates.

In general, EPA used the reported measured value or sample-specific detection limit in its calculations. However, for hexane extractable material (HEM) and hexanoic acid, EPA compared each laboratory-reported sample result to the minimum level (ML) in the chemical analytical method. The ML is defined as the lowest level at which the entire analytical system must give a recognizable signal and an acceptable calibration point for the analyte. When an ML is published in a method, the Agency has demonstrated that at least one well-operated laboratory can achieve the ML, and when that laboratory or another laboratory uses that method, it is required to demonstrate, through calibration of the instrument or analytical system, that it can make measurements at the ML. HEM and hexanoic acid are the only two pollutants of concern measured using EPA Methods with the ML concept, so EPA determined that only their data needed to be compared in this manner. None of the measured values or sample-specific detection limits were reported with values below the ML. If EPA had found any such values (or if it finds such values for the final rule), EPA would have substituted the ML for these lower values. In its statistical models, EPA also would have assumed that these substitutions were ND concentrations.

8.4 DATA AGGREGATION

In some cases, EPA determined that two or more samples had to be mathematically aggregated to obtain a single value that could be used in other calculations. In some

[2] There was one exception for DMR4, which reported two settleable solids data with the same starting date of sampling and different ending dates. For the data point reported with a later ending date, EPA assumed that the data were taken the day after the reported starting date

cases, this meant that field duplicates and grab samples were aggregated for a single sample point. In addition, for one facility, data were aggregated to obtain a single daily value representing the facility's influent or effluent from multiple sample points. Appendix C lists the data after these aggregations were completed and a single daily value was obtained for each day for each pollutant. *Listing 5: Unaggregated Data for Pollutants of Concern* (SAIC, 2002b) provides the unaggregated data.

In all aggregation procedures, EPA considered the censoring type associated with the data, as well as the measured values to be detected. In statistical terms, the censoring type for such data was NC. Measurements reported as less than some sample-specific detection limit (e.g., <10 mg/L) were censored and were considered to be ND. In the tables and data listings in this document and the record for the rulemaking, EPA has used the abbreviations NC and ND to indicate the censoring types[3].

The distinction between the two censoring types is important because the procedure used to determine the variability factors considers censoring type explicitly. This estimation procedure modeled the facility data sets using the modified delta-lognormal distribution. In this distribution, data are modeled as a mixture of two distributions. Thus, EPA concluded that the distinctions between detected and nondetected measurements were important and should be an integral part of any data aggregation procedure. (See Appendix E for a detailed discussion of the modified delta-lognormal distribution.)

Because each aggregated data value was entered into the modified delta-lognormal model as a single value, the censoring type associated with that value was also important. In many cases, a single aggregated value was created from unaggregated data that were all either detected or nondetected. In the remaining cases with a mixture of detected and nondetected unaggregated values, EPA determined that the resulting aggregated value should be considered to be detected because the pollutant was measured at detectable levels.

This section describes each of the different aggregation procedures. They are presented in the order in which the aggregation was performed: filtrate samples, field duplicates, grab samples, and multiple sample points.

8.4.1 Aggregation of Filtrate Samples

For SP 12 at episode 6297, the laboratory filtered the samples and processed the aqueous filtrate and filtered solids separately. As a result, for the classical/conventional analytes and the metals pollutants, the laboratory reported two results for each sample. The aqueous filtrate results were reported in weight/volume units (e.g., mg/L), while the filtered solids were reported in weight/weight units (e.g., mg/kg). EPA aggregated the results as explained in the memorandum *Conversion of Aquaculture Data for Episode*

[3] Laboratories can also report numerical results for specific pollutants detected in the samples as "right-censored." Right-censored measurements are those that are reported as being greater than the highest calibration value of the analysis (e.g., >1000 µg/L). None of the data used to develop the proposed TSS limitations were right-censored.

6297 (DynCorp, 2002). *Listing of the Aquatic, Solid, and Combined Filtrate Data for Facility 6297*" (SAIC, 2002c) provides the reported (unaggregated) and aggregated values.

8.4.2 Aggregation of Field Duplicates

During the sampling episodes, EPA collected a small number, about 10%, of field duplicates. Field duplicates are two samples collected from the same sampling point at approximately the same time, assigned different sample numbers, and flagged as duplicates for a single sample point at a facility. *Listing 6: Individual Field Duplicate Sample Results for Pollutants of Concern* (SAIC, 2002d), provides the individual values for the field duplicates for the pollutants of concern for the sample points identified in Table 8.2-1.

Because the analytical data from each duplicate pair characterize the same conditions at the same time at a single sampling point, EPA aggregated the data to obtain one data value for those conditions by calculating the arithmetic average of the duplicate pair.

In most cases, both duplicates had the same censoring type. In these cases, the censoring type of the aggregate was the same as the duplicates. In the remaining cases, one duplicate was an NC value and the other duplicate was an ND value. In these cases, EPA determined that the appropriate censoring type of the aggregate was NC because the pollutant had been present in one sample. (Even if the other duplicate had a zero value,[4] the pollutant still would have been present if the samples had been physically combined.) Table 8.4-1 summarizes the procedure for aggregating the analytical results from the field duplicates. This aggregation step for the duplicate pairs was the first step in the aggregation procedures for both influent and effluent measurements.

Table 8.4-1. Aggregation of Field Duplicates

If the Field Duplicates Are:	*Censoring Type of Average is:*	*Value of Aggregate is:*	*Formulas for Aggregate Value of Duplicates:*
Both NC	NC	Arithmetic average of measured values	$(NC_1 + NC_2)/2$
Both ND	ND	Arithmetic average of sample-specific detection limits	$(DL_1 + DL_2)/2$
One NC and one ND	NC	Arithmetic average of measured value and sample-specific detection limit	(NC + DL)/2

NC - noncensored (or detected). ND - nondetected. DL - sample-specific detection limit.

[4] This is presented as a "worst-case" scenario. In practice, the laboratories cannot measure 'zero' values. Rather they report that the value is less than some level.

8.4.3 Aggregation of Grab Samples

During the sampling episodes, EPA collected mostly composite samples. However, the chemical analytical method specifies that grab samples must be used for two pollutants of concern: oil and grease (O&G) and settleable solids. For O&G, EPA collected multiple (usually three) grab samples during a sampling day at a sample point. For settleable solids, a single grab sample was collected each day at each sample point. To obtain one value characterizing the pollutant levels at the sample point on a single day, EPA mathematically aggregated the measurements from the grab samples. *Listing 7: Individual Grab Sample Results for Pollutants of Concern* (SAIC, 2002e), provides these values for the sample points identified in Table 8.2-1.

The procedure arithmetically averaged the measurements to obtain a single value for the day. When one or more measurements were NC, EPA determined that the appropriate censoring type of the aggregate was 'non-censored' because the pollutant was present. Table 8.4-2 summarizes this procedure.

8.4.4 Aggregation of Data Across Sample Points ("Flow-Weighting")

After field duplicates and grab samples were aggregated, the data from each sample point in facilities with multiple sample points were further aggregated to obtain a single daily value representing the episode's influent or effluent. *Listing 5: Unaggregated Data for Pollutants of Concern* (SAIC, 2002b) provides the unaggregated data for the pollutants of concern for the sample points identified in Table 8.2-1.

Table 8.4-2. Aggregation of Grab Samples

If the Grab or Multiple Samples are:	*Censoring Type of Daily Value is:*	*Daily Value is:*	*Formulas for Calculating Daily Value:*
All NC	NC	Arithmetic average of measured values	$\frac{\sum_{i=1}^{n} NC_i}{n}$
All ND	ND	Arithmetic average of sample-specific detection limits	$\frac{\sum_{i=1}^{n} DL_i}{n}$
Mixture of NC and ND values (total number of observations is n = k + m)	NC	Arithmetic average of measured values and sample-specific detection limits	$\frac{\sum_{i=1}^{k} NC_i + \sum_{i=1}^{m} DL_i}{n}$

NC - noncensored (or detected). ND - nondetected. DL - sample-specific detection limit.

In aggregating values across sample points, if one or more of the values were NC, the aggregated result was considered NC because the pollutant was present in at least one stream. When all of the values were ND, the aggregated result was considered to be ND. The procedure for aggregating data across streams is summarized in Table 8.4-3. The following example demonstrates the procedure for hypothetical pollutant X at an episode with discharges on Day 1 from an OLSB and raceway for Option 1 of the flow-through subcategory.

Example of calculating an aggregated flow-weighted value:

Day	Sample Point	Flow (cfs)	Concentration (mg/L)	Censoring
1	Raceway	1	50	NC
1	OLSB	100	10	ND

Calculation to obtain aggregated, flow-weighted value:

$$\frac{(100\ \text{cfs} \times 10\ \text{mg/L}) + (1\ \text{cfs} \times 50\ \text{mg/L})}{100\ \text{cfs} + 1\ \text{cfs}} = 10.4\ \text{mg/L}$$

Because one of the values was NC, the aggregated value of 10.4 mg/L is NC.

Table 8.4-3. Aggregation of Data Across Streams

If the n Observations are:	***Censoring Type is:***	***Formulas for Value of Aggregate***
All NC	NC	$\dfrac{\sum_{i=1}^{n} NC_i \times flow_i}{\sum_{i=1}^{n} flow_i}$
All ND	ND	$\dfrac{\sum_{i=1}^{n} DL_i \times flow_i}{\sum_{i=1}^{n} flow_i}$
Mixture of k NC and m ND (total number of observations is n=k+m)	NC	$\dfrac{\sum_{i=1}^{k} NC_i \times flow_i + \sum_{i=1}^{m} DL_i \times flow_i}{\sum_{i=1}^{n} flow_i}$

NC - noncensored (or detected). ND - nondetected. DL - sample-specific detection limit.

8.5 Overview of Limitations

The preceding sections discuss the data selected as the basis for the limitations along with the data aggregation procedures EPA used to obtain daily values in its calculations. This section provides a general overview of limitations before returning to the development of the proposed limitations for the CAAP industry.

For the CAAP industry, the limitations for pollutants for each option are provided as daily maximums and maximums for monthly averages. Definitions provided in 40 CFR 122.2 state that the daily maximum limitation is the "highest allowable 'daily discharge,'" and the maximum for monthly average limitation (also referred to as the "average monthly discharge limitation") is the "highest allowable average of 'daily discharges' over a calendar month, calculated as the sum of all 'daily discharges' measured during a calendar month divided by the number of 'daily discharges' measured during that month." Daily discharges are defined as the "'discharge of a pollutant' measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling."

This section describes EPA's objective for daily maximum and monthly average limitations, the selection of percentiles for those limitations, and compliance with final limitations. EPA has included this discussion in Chapter 8 because these fundamental concepts are often the subject of comments on EPA's effluent guidelines regulations and in EPA's contacts and correspondence with industry.

8.5.1 Objective

In establishing daily maximum limitations, EPA's objective is to restrict the discharges on a daily basis at a level that is achievable for a facility that targets its treatment at the long-term average. EPA acknowledges that variability around the long-term average results from normal operations. Occasionally, facilities discharge at a level that is greater than or considerably lower than the long-term average. To allow for these possibly higher daily discharges, EPA has established the daily maximum limitation. A facility that consistently discharges at a level near the daily maximum limitation is *not* targeting its treatment to achieve the long-term average, which is part of EPA's objective in establishing the daily maximum limitations. That is, targeting treatment to achieve the limitations might result in frequent values exceeding the limitations due to routine variability in treated effluent.

In establishing monthly average limitations, EPA's objective is to provide an additional restriction to help ensure that facilities target their average discharges to achieve the long-term average. The monthly average limitation requires continuous dischargers to provide on-going control, on a monthly basis, that complements controls imposed by the daily maximum limitation. In order to meet the monthly average limitation, a facility must counterbalance a value near the daily maximum limitation with one or more values well below the daily maximum limitation. To achieve compliance, these values must result in a monthly average value at or below the monthly average limitation.

8.5.2 Selection of Percentiles

EPA calculates limitations based on percentiles chosen with the intention to be high enough to accommodate reasonably anticipated variability within the control of the facility and to be low enough to reflect a level of performance consistent with the Clean Water Act requirement that these effluent limitations be based on the "best" technologies. The daily maximum limitation is an estimate of the 99th percentile of the distribution of the *daily* measurements. The monthly average limitation is an estimate of the 95th percentile of the distribution of the *monthly* averages of the daily measurements.

The 99th and 95th percentiles do not relate to, or specify, the percentage of time a discharger operating the "best available" or "best available demonstrated" level of technology will meet (or not meet) the limitations. Rather, the use of these percentiles relates to the development of limitations. (The percentiles used as a basis for the limitations are calculated using the products of the long-term averages and the variability factors as explained in the next section.) If a facility is designed and operated to achieve the long-term average on a consistent basis and maintains adequate control of its processes and treatment systems, the allowance for variability provided in the limitations is sufficient to meet the requirements of the rule. The use of 99 percent and 95 percent represents a need to draw a line at a definite point in the statistical distributions (100 percent is not feasible because it represents an infinitely large value) and a policy judgment about where to draw the line that would ensure that operators work hard to establish and maintain the appropriate level of control. In essence, in developing the limitations, EPA has taken into account the reasonable anticipated variability in discharges that might occur at a well-operated facility. By targeting its treatment at the long-term average, a well-operated facility should be able to comply with the limitations at all times because EPA has incorporated into limitations an appropriate allowance for variability.

In conjunction with the statistical methods, EPA performs an engineering review to verify that the limitations are reasonable based on the design and expected operation of the control technologies and the facility process conditions. As part of that review, EPA examines the range of performance by the facility data sets used to calculate the limitations. Some facility data sets demonstrate the best available technology, and others demonstrate the same technology but not the best demonstrated design and operating conditions for that technology. For the latter facilities, EPA evaluates how the facility can upgrade its design, operating, and maintenance conditions to meet the limitations. If such upgrades are not possible, the limitations are modified to reflect the lowest levels that the technologies can reasonably be expected to achieve.

8.5.3 Compliance with Limitations

EPA promulgates limitations that facilities are capable of complying with at all times by properly operating and maintaining their processes and treatment technologies. However, the issue of exceedances or excursions (values that exceed the limitations) is often raised. Comments often suggest that EPA include a provision that a facility is in compliance with permit limitations if its discharge does not exceed the specified limitations, with the exception that the discharge may exceed the monthly average limitations 1 month out of 20 and the daily average limitations 1 day out of 100. This issue was, in fact, raised in other rules, including EPA's final Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) rulemaking. EPA's general approach in that case for developing limitations based on percentiles was the same as this rule and was upheld in *Chemical Manufacturers Association* v. *U.S. Environmental Protection Agency*, 870 F.2d 177, 230 (5th Cir. 1989). The Court determined the following:

> EPA reasonably concluded that the data points exceeding the 99th and 95th percentiles represent either quality-control problems or upsets because there can be no other explanation for these isolated and extremely high discharges. If these data points result from quality-control problems, the exceedances they represent are within the control of the plant. If, however, the data points represent exceedances beyond the control of the industry, the upset defense is available.
>
> Id. at 230.

More recently, this issue was raised in EPA's Phase I rule for the pulp and paper industry. In that rulemaking, EPA used the same general approach for developing limitations based on percentiles that it had used for the OCPSF rulemaking and for the proposed CAAP rule. This approach for the monthly average limitation was upheld in *National Wildlife Federation et al.* v. *Environmental Protection Agency*, No. 99-1452, Slip Op. at Section III.D (D.C. Cir.) (April 19, 2002). The Court determined that

> EPA's approach to developing monthly limitations was reasonable. It established limitations based on percentiles achieved by facilities using well-operated and controlled processes and treatment systems. It is therefore reasonable for EPA to conclude that measurements above the limitations are due to either upset conditions or deficiencies in process and treatment system maintenance and operation. EPA has included an affirmative defense that is available to mills that exceed limitations due to an unforeseen event. EPA reasonably concluded that other exceedances would be the result of design or operational deficiencies. EPA rejected Industry Petitioners' claim that facilities are expected to operate processes and treatment systems so as to violate the limitations at some pre-set rate. EPA explained that the statistical methodology was used as a framework to establish the limitations based on percentiles. These limitations were never intended to have the rigid probabilistic interpretation that Industry Petitioners have adopted. Therefore, we reject Industry Petitioners' challenge to the effluent limitations.

As that Court recognized, EPA's allowance for reasonably anticipated variability in its effluent limitations, coupled with the availability of the upset defense, reasonably accommodates acceptable excursions. Any further excursion allowances would go beyond the reasonable accommodation of variability and would jeopardize the effective control of pollutant discharges on a consistent basis and/or bog down administrative and enforcement proceedings in detailed fact-finding exercises, contrary to Congressional intent. See, for example, Rep. No. 92-414, 92d Congress, 2d Sess. 64, reprinted in *A Legislative History of the Water Pollution Control Act Amendments of 1972* (at 1482); *Legislative History of the Clean Water Act of 1977* (at 464-65).

EPA expects that facilities will comply with promulgated limitations *at all times*. If the exceedance is caused by an upset condition, the facility would have an affirmative defense to an enforcement action if the requirements of 40 CFR 122.41(n) are met. If the exceedance is caused by a design or operational deficiency, EPA has determined that the facility's performance does not represent the appropriate level of control (best available technology for existing sources; best available demonstrated technology for new sources). For promulgated limitations and standards, EPA has determined that such exceedances can be controlled by diligent process and wastewater treatment system operational practices such as frequent inspection and repair of equipment, use of backup systems, and operator training and performance evaluations.

8.6 ESTIMATION OF THE PROPOSED LIMITATIONS

In estimating the proposed limitations, EPA determines an average performance level (the "option long-term average" discussed in the next section) that a facility with well-designed, well-operated model technologies (which reflect the appropriate level of control) is capable of achieving. This long-term average is calculated from data from the facilities using the model technologies for the option. EPA expects that all facilities subject to the final limitations will design and operate their treatment systems to achieve the long-term average performance level consistently because facilities with well-designed, well-operated model technologies have demonstrated that this can be done.

In the second step of developing a limitation, EPA determines an allowance for the variation in pollutant concentrations when processed through extensive and well-designed production and treatment systems. This allowance for variance incorporates all components of variability, including shipping, sampling, storage, and analytical variability, and is incorporated into the limitations by using variability factors calculated from the data from the facilities using the model technologies. If a facility operates its treatment system to meet the relevant long-term average, EPA expects the facility will be able to meet the limitations. Variability factors assure that normal fluctuations in a facility's treatment are accounted for in the limitations. By accounting for these reasonable excursions above the long-term average, EPA's use of variability factors results in limitations that are generally well above the actual long-term averages.

Facilities that are designed and operated to achieve long-term average effluent levels used in developing the limitation should be capable of compliance with the limitations, which incorporate variability, at all times.

The following sections describe the calculation of the option long-term averages and option variability factors.

8.6.1 Calculation of Option Long-Term Averages

This section discusses the calculation of long-term averages by episode (episode long-term average) and by option (option long-term average) for each pollutant. These averages were used to calculate the limitations and as the option long-term averages for the pollutants of concern.

First, EPA calculated the episode long-term average by using either the modified delta-lognormal distribution or the arithmetic average (see Table 8.6-1 for the episode long-term averages). For the final rule, EPA intends to evaluate the appropriateness of the modified delta-lognormal distribution for these data and possibly consider other distributions such as the censored lognormal distribution (see Appendix F). In Appendix D, EPA has listed the arithmetic average (column labeled "Obs Mean") and the estimated episode long-term average (column labeled "Est LTA"). If EPA used the arithmetic average as the episode long-term average, the two columns have the same value.

Table 8.6-1. Episode Long-Term Averages and Variability Factors

Sub-category	*Option or Technology*	*Pollutant*	*Episode*	*Number of Data Points*	*Episode Long-Term Average (mg/L)*	*Episode Variability Factors*	
						Daily	*Monthly*
Flow-Through	OLSB	TSS	6297A	5	58.1037	1.6295	1.1933
			6297B	5	69.7312	1.3358	1.1091
			6460C	1	38.0000	n/a	n/a
		Total Phosphorus	6297A	5	10.1657	1.1281	1.0437
			6297B	5	9.4936	1.3719	1.1199
			6460C	1	0.3600	n/a	n/a
	Raceway	TSS	6297E	5	4.0000	n/a	n/a
			6460B	5	4.0000	n/a	n/a
		Total Phosphorus	6297E	5	0.1721	1.9026	1.3831
			6460B	5	0.0445	2.1131	1.3186
	1	TSS	6297G	5	4.5330	1.0645	1.0224
			6297H	5	4.6477	n/a	n/a
			6297I	5	4.1696	n/a	n/a
			6460A	5	9.5361	n/a	n/a
			DMR1	19	1.7814	2.9449	1.5141
			DMR3	37	3.6962	2.0935	1.3138
			DMR4	34	2.6764	3.7816	1.6997
		Total Phosphorus	6297G	5	0.2746	2.1236	1.3212
			6297H	5	0.2641	1.7196	1.2800
			6297I	5	0.1323	2.9745	1.5454
			6460A	5	0.0978	5.7387	2.1297
			DMR1	12	0.0932	5.6559	2.1113
	3	TSS	6460D	5	4.0000	n/a	n/a
			DMR2[a]	16	3.1236	5.1171	1.9920
		Total Phosphorus	6460D	5	0.0462	1.5830	1.1804
			DMR2	9	0.2146	6.1765	2.2280
Recir-culating	3	TSS	6439B[a]	5	47.0929	1.8709	1.2574
		BOD	6439B[a]	5	45.8269	1.2004	1.0671
		Total Phosphorus	6439B[a]	5	10.9182	1.9564	1.2793

Note: n/a means that the data set did not meet the requirements specified in Appendix E.
[a] As explained in Section 8.2, EPA excluded these data from developing the limitations.

Second, EPA calculated the option long-term average for a pollutant as the *median* of the episode long-term averages for that pollutant from selected episodes with the technology basis for the option (see Sections 8.1 and 8.2). The median is the midpoint of the values ordered (ranked) from smallest to largest. If there is an odd number of values (with n = number of values), the value of the (n + 1)/2 ordered observation is the median. If there are an even number of values, the two values of the n/2 and [(n/2)+1] ordered observations are arithmetically averaged to obtain the median value.

For example, for subcategory Y option Z, if the four (n = 4) episode long-term averages for pollutant X are:

Facility	Episode-Specific Long-Term Average
A	20 mg/L
B	9 mg/L
C	16 mg/L
D	10 mg/L

the ordered values are:

Order	Facility	Episode-Specific Long-Term Average
1	A	9 mg/L
2	B	10 mg/L
3	C	16 mg/L
4	D	20 mg/L

and the pollutant-specific long-term average for option Z is the median of the ordered values (the average of the 2nd and 3rd ordered values): (10 + 16)/2 mg/L = 13 mg/L.

The option long-term averages were used in developing the limitations for each pollutant within each regulatory option.

8.6.2 Calculation of Option Variability Factors

In developing the option variability factors used in calculating the limitations, EPA first developed daily and monthly episode variability factors using the modified delta-lognormal distribution. Table 8.6-1 lists the episode variability factors.

Appendix E describes the estimation procedure for the episode variability factors using the modified delta-lognormal distribution. For the final rule, EPA intends to evaluate the appropriateness of the modified delta-lognormal distribution for the CAAP data and possibly consider other distributions such as the censored lognormal distribution (see Appendix F). In addition to evaluating the distributional assumptions, EPA intends to evaluate whether autocorrelation is likely to be present in weekly measurements of wastewater data from the CAAP industry. When data are said to be autocorrelated, it means that measurements taken at specific time intervals (such as 1 week or 2 weeks apart) are related. For example, positive autocorrelation would be present in the data if the final effluent concentration of TSS was relatively high one week and was likely to remain at similar high values the next and possibly succeeding weeks. In some industries, measurements in final effluent are likely to be similar from one day (or week) to the next because of the consistency from day to day in the production processes and in final effluent discharges due to the hydraulic retention time of wastewater in basins, holding tanks, and other components of wastewater treatment systems. To determine if autocorrelation exists in the data, a statistical evaluation is necessary and will be considered before the final rule. To estimate autocorrelation in the data, many measurements for each pollutant would be required with values for equally spaced intervals over an extended period of time. If such data are available for the final rule, EPA intends to perform a statistical evaluation of autocorrelation and, if necessary, provide any adjustments to the limitations. This adjustment would increase the values of the variance and monthly variability factor used in calculating the maximum monthly limitation. However, the estimate of the long-term average and the daily variability factor (and thus the maximum daily limitation) are generally only slightly affected by autocorrelation.

After calculating the episode variability factors, EPA calculated the option daily variability factor as the *mean* of the episode daily variability factors for that pollutant in the subcategory and option. Likewise, the option monthly variability factor was the mean of the episode monthly variability factors for that pollutant in the subcategory and option. Table 8.6-2 lists the option variability factors.

Table 8.6-2. Option Long-Term Averages, Variability Factors, and Limitations

Subcategory	*Option or Technology*	*Pollutant*	*Option Long-Term Average (mg/L)*	*Option Variability Factors*		*Limitations (mg/L)*	
				Daily	*Monthly*	*Daily Maximum*	*Monthly Average*
Flow-through	OLSB	TSS	58.1	1.48	1.15	87	67
		Total Phosphorus	9.49	1.25	1.08	11.9	10.3
	Raceway	TSS	4.00	2.47	1.39	9.88	5.56
		Total Phosphorus	0.108	2.01	1.35	0.217	0.146
	1	TSS	4.17	2.47	1.39	11	6
		Total Phosphorus	0.132	3.64	1.68	0.482	0.222
	3	TSS	4.00	2.47	1.39	10	6
		Total Phosphorus	0.130	3.88	1.70	0.506	0.222
Recirculating	3	TSS *	–	–	–	50	30
		BOD	45.8	1.20	1.07	55.0	48.9
		Total Phosphorus	10.9	1.96	1.28	21.4	14.0

* Section 8.2 explains the derivation of these limitations.

8.6.3 Transfers of Option Variability Factors

After estimating the option variability factors, EPA identified one option (Option 3) and one technology (raceways) in the flow-through subcategory, for which variability factors for TSS could not be calculated. (See Table 8.6-3.) This resulted when all episode data sets had too few detected measurements to calculate episode variability factors (see data requirements in Appendix E). For example, if TSS had all ND values for all of the episodes in an option, it was not possible to calculate the option variability factors. In both cases, EPA calculated the limitations using the Option 1 variability factors from the flow-through subcategory. EPA determined that these variability factor transfers were appropriate because EPA would expect the effluent from a raceway and from a polishing pond (Option 3) to be less variable than the combined discharges from an OLSB and a raceway (Option 1).

Table 8.6-3. Cases Where Option Variability Factors Could Not Be Calculated

Subcategory	***Option or Technology***	***Pollutant***	***Source of Variability Factors***
Flow-through	Raceway	TSS	Option 1
	3	TSS	Option 1

8.6.4 Summary of Steps Used to Derive the Proposed Limitations

This section summarizes the steps used to derive the proposed limitations for TSS. EPA used these same steps to calculate the limitations that it considered for total phosphorus and BOD. For each pollutant in an option (or technology such as OLSB) for a subcategory, EPA performed the following steps in calculating the limitations:

Step 1 EPA calculated the *episode long-term averages* and *daily and monthly variability factors* for all selected episodes with the model technology for the option in the subcategory. (See Section 8.2 for selection of episodes and Table 8.6-1 for episode long-term averages and variability factors.)

Step 2 EPA calculated the *option long-term average* as the median of the episode long-term averages. (See Table 8.6-2.)

Step 3 EPA calculated the *option variability factors* for each pollutants as the mean of the episode variability factors from the episodes with the model technology. (See Table 8.6-2.) The option daily variability factor is the mean of the episode daily variability factors. Similarly, the option monthly variability factor is the mean of the episode monthly variability factors.

Step 4 For the pollutants for which Steps 1 and 3 failed to provide option variability factors, EPA determined variability factors on a case-by-case basis. (See Table 8.6-3.)

Step 5 EPA calculated each *daily maximum limitation* for a pollutant using the product of the option long-term average and the option daily variability factor. (See Table 8.6-2.)

Step 6 EPA calculated each *monthly average limitation* for a pollutant using the product of the option long-term average and the option monthly variability factor. (See Table 8.6-2.)

Step 7 EPA *compared* the daily maximum limitations to the data used to develop the limitations. EPA usually performs this comparison to determine whether it used appropriate distributional assumptions for the data used to develop the limitations (i.e., whether the curves EPA used provide a reasonable "fit" to the actual effluent data[5] or if there was an engineering or process reason for an unusual discharge). Except for one case, all proposed daily maximum limitations had greater values than the data used to develop the limitations. The exception was the TSS proposed daily maximum limitation for Option 1 in the flow-through subcategory. The single value exceeding the limitation was from episode 6460A on the day when the facility discharged from the OLSB. As explained in Section 8.2, during EPA's visit, the facility discharged the OLSB at a shorter than usual retention time. EPA also notes that the facility's OLSB would be considered to be underdesigned if it were the final treatment step at the facility. However, the facility has a polishing pond, which was designed to operate as a part of the overall treatment train at the facility, and thus the OLSB can be operated at less than maximum treatment efficiency and the effluent from this OLSB receives additional treatment prior to discharge.

8.7 REFERENCES

DynCorp, 2002. Memorandum: Conversion of Aquaculture Data for Episode 6297, from H. McCarty to C. Simbanin, July 24, 2002.

SAIC. (Science Applications International Corporation, Inc.) 2002a. Listings for Episode 6297: DMR Data, Summary Statistics, and Estimates, Falls Church, VA.

SAIC. (Science Applications International Corporation, Inc.) 2002b. Listing 5: Unaggregated Data for Pollutants of Concern, Falls Church, VA.

SAIC. (Science Applications International Corporation, Inc.) 2002c. Listing of the Aquatic, Solid, and Combined Filtrate Data for Facility 6297, Falls Church, VA.

SAIC. (Science Applications International Corporation, Inc.) 2002d. Listing 6: Individual Field Duplicate Sample Results for Pollutants of Concern, Falls Church, VA.

[5] EPA believes that the fact that the Agency performs such an analysis before promulgating limitations might give the impression that EPA expects occasional exceedances of the limitations. This conclusion is *incorrect*. EPA promulgates limitations that facilities are capable of complying with at all times by properly operating and maintaining their treatment technologies.

SAIC. (Science Applications International Corporation, Inc.) 2002e. Listing 7: Individual Grab Sample Results for Pollutants of Concern, Falls Church, VA.

USEPA. (U.S. Environmental Protection Agency) 2001. *Screener Survey for the Aquatic Animal Production Industry.* OMB Control No. 2040-0237 U.S. Environmental Protection Agency, Washington, DC.

USEPA. (U.S. Environmental Protection Agency) 2002. Memorandum: Censoring Assumptions for DMR Data in the Aquatic Animals Proposal, from M. Smith to M. Jordan, August 14, 2002.