WASTEWATER MASTER PLAN
TECHNICAL MEMORANDUM

TO:	Mike Kuenzi – Water Environment Services	**DATE:**	March 26, 2013
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SUBJECT:	Technical Memorandum No. 3 Tri-City WPCP Wastewater Characteristics		

1 MASTER PLAN

The recent completion of the Intertie II pump station provides the capability to transfer flows between the service areas of the Kellogg Creek and the Tri-City Water Pollution Control Plants (WPCP). Changes in service area characteristics over the past 5-years presented a need to reevaluate and update the basic criteria used in the original planning of the Capacity Management Program. This memorandum documents a detailed evaluation of the wastewater characteristics based on the Kellogg Creek influent wastewater. This information will be incorporated into a growth model (TM – 1 – WES Treatment Requirements) to determine the future system limitations that will need to be addressed.

2 BACKGROUND

The function and capacity of the Kellogg Creek WPCP treatment plant is directly dependent on the character of the influent waste stream. The wastewater characteristics for plant flow, BOD_5, and TSS for the 13-year study period between 2000 and 2012 were evaluated. Each of the parameters was characterized for the complete study period and for each year of the study period.

The plant influent flows and loads were evaluated using the samples taken at the influent of the treatment plant. An analysis of the daily rainfall data monitored at the treatment plant was also evaluated. This was done to develop the correlation between rainfall and plant flow.

3 SEASONAL INFLUENCE ON FLOWS AND LOADS

The plant influent flows and loads were characterized as the waste stream entering the treatment plant for each of the permitted seasons and on an annual basis. The time periods that were used were defined as the following: average annual, dry

weather, summer season, and winter season. The summer and winter seasons were developed based on the periods defined by the Oregon Administrative Rules (OAR) and specified in the plant's National Pollution Discharge Elimination System (NPDES) discharge permit. The actual date range for these periods is defined as:

- Average Annual – The calendar year average load condition. The maximum month will represent the maximum 30-day average flow and load that would be experienced at the plant during the year.

- Dry Weather – The period when the influent wastewater characteristics are not influenced by rainfall. This dry weather period used in this evaluation is the period between July 1 and September 30 each year. This period is the base flow and is directly related to the flows generated by the service area population.

- Summer Season – The summer season used in this evaluation is the period of time between May 1 and October 31 each year. This was the summer season in the previous permit. This period represents lower flows and a higher concentration of BOD_5 and TSS.

- Winter Season – The winter season used in this evaluation, as defined in the previous permit, was the period of time between November 1 and April 30 each year. This period represents higher flows due to infiltration and possible inflow (I/I) in the collection system.

There is a direct relationship between the plant flow and the seasonal rainfall that is experienced in the area. In a typical Pacific Northwest community, plant flows will increase following periods of steady rainfall. This is caused when the soils become saturated and the water table level rises to where it is above the inverts of the sewers. Groundwater then leaks into cracks or poor joints in the sewer resulting in increased plant flows. This can be observed at the plant by an increase in the baseline flow rate and a corresponding decrease in the concentration of BOD_5 and TSS. This is shown by the change in influent TSS concentration in ***Figure 1***.

4 WASTEWATER CHARACTERIZATION

The influent wastewater was characterized for flow, BOD_5, and TSS. The results of the analysis for each of these parameters will be the basis for determining the system capacity. A detailed analysis of each parameter is provided in separate attachments. A summary of the results of each evaluation is provided in the following sections.

4.1 INFLUENT FLOW

The influent flow was evaluated under a number of scenarios to determine the characteristics to be used to project future flows and loads. The analysis of influent flow is provided in ***Attachments B – F***. A summary of each analysis is provided in the

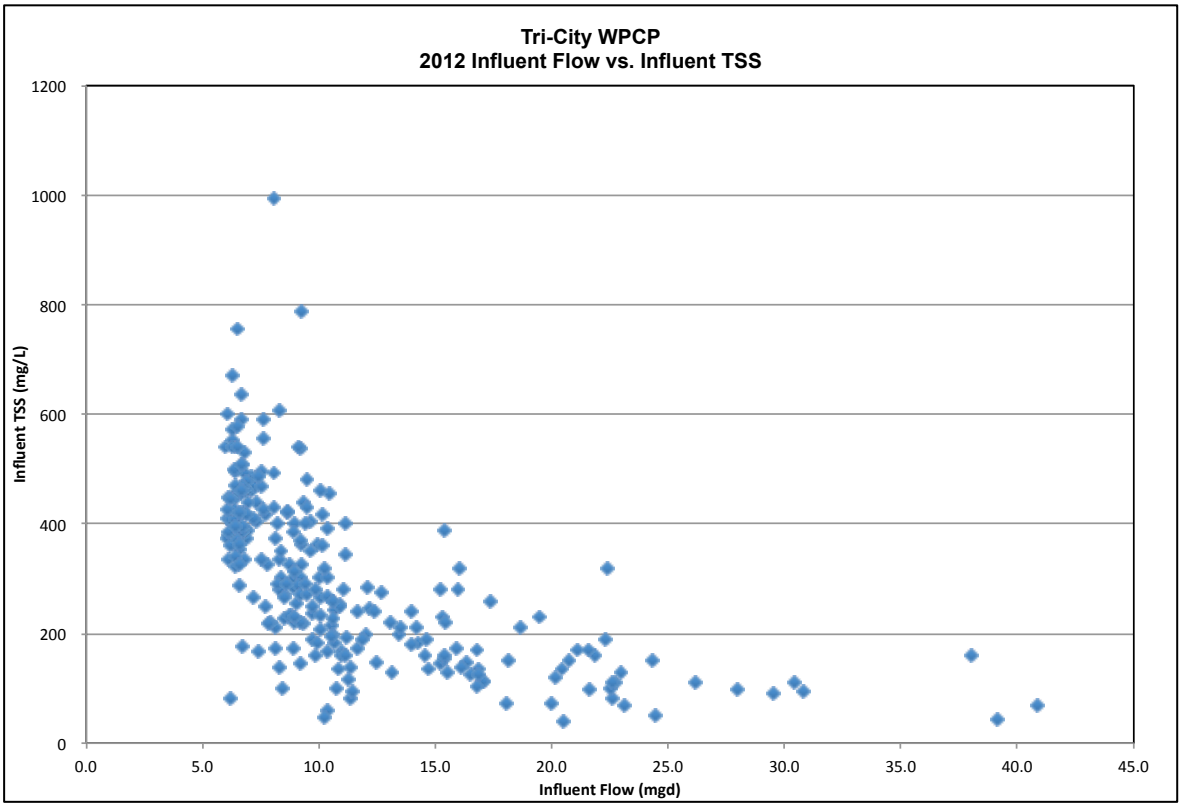


Figure 1: 2008 Influent TSS Concentration vs. Plant Flow

following sections. The average monthly influent flow for the period from 2000 to 2012 is shown in ***Figure 2***.

4.1.1 Flow per EDU

An EDU is an Equivalent Dwelling Unit. For this analysis, an EDU was based on an equivalent population of 2.5 capita per EDU. EDU based flows are determined by dividing the average flow by the EDUs. With the Rainfall Induced Infiltration and Inflow (RDII) contributing flows to the system, a Dry Weather analysis was also completed to determine actual EDU based flows. Populations used in this analysis are those provided by the Population Research Center of Portland State University in their 2011 study of the service areas.

An evaluation was performed for both the periods 2000 - 2012 (13-yr) and 2008 - 2012 (5-yr). To mitigate the high flows influenced by RDII, an analysis was done using the median in addition to the average to provide results that are not skewed by periodic high flows. The per EDU flows are shown in ***Table 1*** for the two study periods.

Table 1
Per EDU Flows

Period	2000 - 2012		2000 - 2012	
	Average	Median	Average	Median
Annual Average	273	234	260	222
Summer Season	218	207	202	183
Winter Season	335	292	319	275

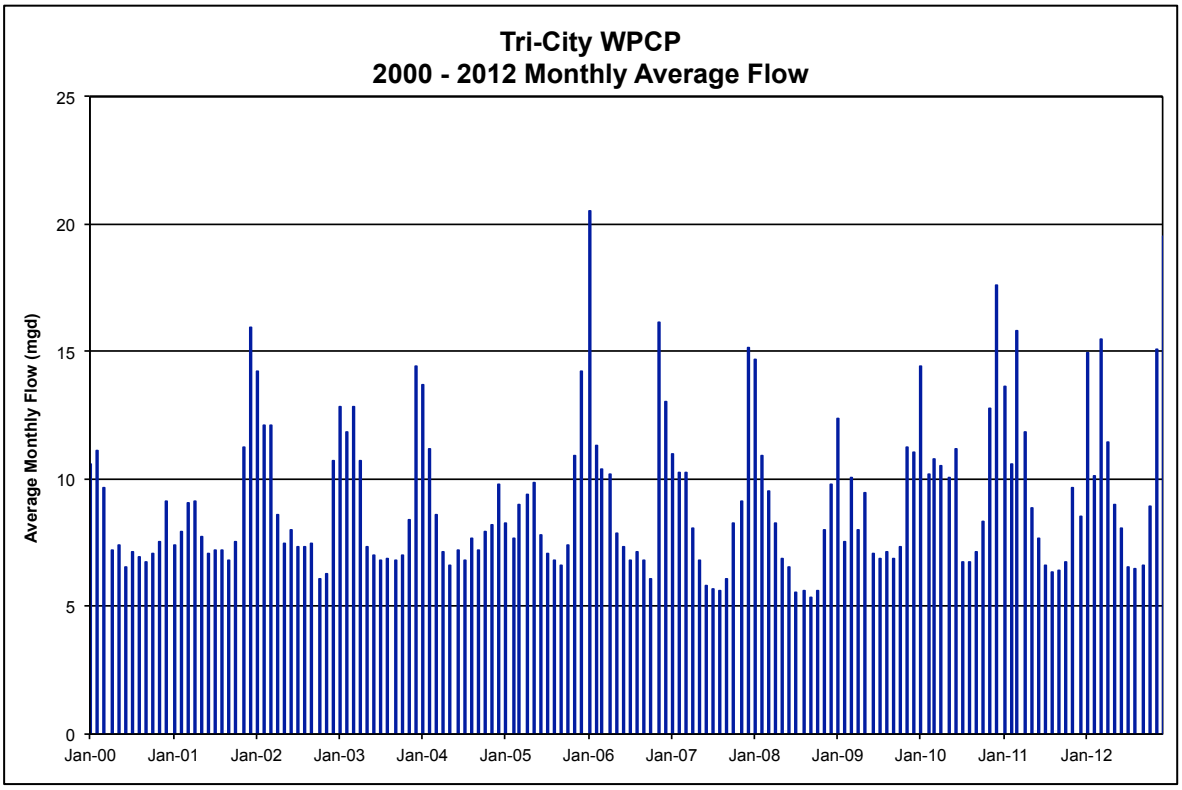


Figure 2: 2000 – 2012 Average Monthly Flow

As shown in the ***Table 1*** results, there is still an influence of RDII on the flows. To remove this influence, the analysis was done using flow data for the months of July, August and September only. The results of this analysis are shown in ***Table 2***.

Table 2
Per EDU Flows (Dry Weather Months)

Period	2000 - 2012		2008 - 2012	
	Average Month	Minimum Month	Average Month	Minimum Month
Monthly Average	205	201	179	176
Monthly Median	204	199	178	175
Monthly Minimum	187	182	164	158

This analysis provides three different results depending on how the analysis is done. The most recent 5-year period was used in the analysis because it showed lower values and was affected by the recent increase in diversions to the Tri-City WPCP. These results are as follows:

- Summer Season Flow - When using the summer season flow for the period between May 1 and October 30, the gpd/capita is 202 gpd/EDU. This is the method typically used for determining this value. In the situation for the Tri-

City WPCP the flows in this period are influenced greatly by rainfall. Therefore, the median flow for this period was determined with the result being 183 gpd/EDU.

- Dry Weather Months (July - September) - The analysis was done taking the rainfall influenced flows for the months of May, June and October out of the data set. In this analysis, the flow per capita was 179 gpd/EDU for the monthly average flows, 178 gpd/capita for the median flows, and 158 gpd/EDU for the monthly minimum flows.

The analysis of dry weather flows show that there are still periods of rainfall influenced flows that occur during the months of July, August, and September. The value for the average and median is the same for this period of time showing that the affects of RDII have been eliminated. The dry weather per EDU flows for the existing flows will be 178 gpd/EDU. The results of this evaluation are summarized in ***Table 3***. A conservative value of 200 gpd/EDU will be used for future growth planning. This analysis is provided in ***Attachment B – Develop Per EDU Flows***.

Table 3
Kellogg Creek WPCP Unit Flows fro Planning

Variable	Ave Annual	Dry Weather	Dry Season	Wet Season	Units
Flow	250	178	202	319	gal/EDU/day

4.1.2 Flow Peaking

The wastewater flows exhibit variation throughout the year due to the RDII in the collection system. An extensive evaluation of flow peaking was performed to characterize the wastewater flows.

4.1.2.1 *10-year Summer and 5-year Winter Rainfall*

The ODEQ criteria for determining the Maximum Month Wet Weather and Maximum Month Dry Weather rainfalls states that the Climatography No. 20 for the local weather station should be used. The closest weather station to Tri-City WPCP service area that is in the document is the Oregon City weather station. The Tri-City WPCP has a weather station with a precipitation record for the period of study between 2000 and 2012. Rainfall data for the Aurora airport was also evaluated, but the rainfall intensity was much less south of the service area. This evaluation of weather stations was done to obtain the most representative rainfall data for the service area and treatment plant.

In this evaluation, the rainfall for the treatment plant for the period 2000 - 2012 was evaluated against the Oregon City weather station and the Climatograpy No. 20 statistics for the Oregon City weather station. These statistics were evaluated to determine the 10-year summer and 5-year winter storms for the Tri-City WPCP service area, as specified in the DEQ Guidelines. The results of this analysis were:

- Summer Season - In 12 of the 13 years of study, the May plant flows were higher than the October Flows. The average 5-year summer rainfalls were greater for October. It appears that the higher flows are experienced following the wet season. Therefore, May should be used as the MMDWF month even though the rainfall is higher in October.

- Winter Season - In 7 of the 13 years of study, the January flows were higher than the November and December rainfall. The January rainfall is statistically higher than the December rainfall. Therefore, January will be used for the MMWWF month.

The results of this analysis for each of the four weather stations evaluated are shown in ***Table 4***.

Table 4
Weather Station Statistical Rainfalls

Station	Historical	
	5-Yr Winter	10-Yr Summer
Tri-City WPCP	3.97	8.31
Oregon City Station	4.41	10.28
Climatography No. 20	4.42	11.56

In this analysis, it appears that the Tri-City WPCP weather station receives less rainfall than the Oregon City station. The Oregon City station is most likely more representative of the service area. The statistics for this station are more up-to-date than the Climatography No. 20. Therefore, the probability of monthly rainfall occurrence for the Oregon City, OR weather station that was developed from the historical data will be used for this analysis.

An analysis of rainfall shows that the October is the highest summer rainfall month. Flows at the treatment plant showed the May flows as the highest month flows over the past thirteen years (2000 - 2012). The highest monthly dry season flow recorded in the 13-year period was in May. Therefore, the lower statistical May monthly rainfall will be used. The May 10-year probable rainfall of 4.41-in for the Oregon City weather station rain gage will be used to determine the MMDWF.

An analysis of plant flows shows that January had the highest monthly flow for 7 of the 13 years (2000 - 2012) evaluated. The statistical rainfall for the Oregon City weather station rain gage shows that January is the highest rainfall month for the service area. The January 5-year probable rainfall of 10.28-in for the Oregon City weather station rain gage will be used to determine the MMWWF.

4.1.3 Flow Peaking Factors

Peaking factors to establish current flows need to be determined for the Master Plan. Two methods were used to determine factors. These were the ODEQ Guidance and Historical Peaking Factors. This analysis was performed to determine the values to be used based on the results of the two analyses.

4.1.3.1.1 Historical Peaking Factors

Peaking factors can be developed from an evaluation of historical flows. In the historical flow method, peaking factors are determined for each variable as follows:

- Maximum Month Flow (MMF) -- Max. 30-day Average flow / Average Day flow
- Maximum Week Flow (MWF) -- Max. 7-day Average Flow / Average Day Flow
- Maximum Day Flow (MDF) -- Max. day flow / Average Day Flow

An analysis of plant flows for the period of time from January 2000 thorough December 2012 was performed to determine the historical peaking factors. Data was analyzed for the annual, winter season and summer season conditions.

The dry season flows that were used to determine the peaking factor is the average flow for the period May 1 - Oct 30 as stated in the NPDES Permit. These flows are affected by rainfall, especially in the months of May, June, and October. To mitigate the affects of RDII affected flows, the analysis was also done using the median of the plant influent flows for this period and an analysis was done for the months of July, August and September, only. The peaking factors were calculated for both the 13-year period and 5-year period to determine if there were changes in recent years with the increased diversions.

The average peaking factor and the maximum peaking factor were determined for each period. Typically, the maximum peaking factor for a period is used as that demonstrates the worst-case flow. In the 5-year and 13-year data sets, the maximum month flows were based on a 5-year and 13-year event for winter and summer, respectively. In this case, the average of the peaking factors for each study period were used. The results are summarized in ***Table 5***.

Table 5
Flow Peaking Factors

Method	Average DWF			Median DWF		
	MMDWF	MMWWF	Max Day	MMDWF	MMWWF	Max Day
Historical						
Average						
2000 - 2012	1.36	2.19	4.54	1.44	2.32	4.80
2008 - 2012	1.49	2.25	5.05	1.64	2.47	5.53
Median						
2000 - 2012	1.33	2.11	4.86	1.43	2.47	5.37
90 percentile						
2000 - 2012	1.59	2.61	5.62	1.76	2.85	5.87
Maximum						
2000 - 2012	1.65	2.98	5.78	1.92	3.00	6.12
DEQ						
2000 - 2012	-	-	-	1.70	2.55	5.87

4.1.3.1.2 DEQ Methodology Peaking Factors

DEQ has established guidelines for determining the statistical Maximum Month Dry Weather Flow (MMDWF) and Maximum Month Wet Weather Flow (MMWWF) for a treatment plant. These guidelines outline a procedure where historical flows and rainfall are used to develop a relationship that is used to determine plant flows based on rainfall.

Creating a scatter plot of the total monthly rainfall against the average monthly flow develops flows. A linear regression is performed on this data to develop an equation that represents the system. This regression formula is then used to determine the MMWWF and MMDWF using a probable rainfall. The probable rainfall for the MMDWF is the historical 10-year May monthly rainfall and for the MMWWF it is the 5-year November rainfall (See ***Attachment E***).

An analysis to develop the 5-year rainfall and the 10-year rainfall was performed. The results from this evaluation (***Attachment B***) were a 10-yr May rainfall of 4.41-inches and a 5-yr January rainfall of 10.28-inches at the Oregon City weather station. In this analysis, flow and rainfall data for the period form 2000 - 2012 was used.

In this analysis, plots for each of the study years (Jan - May and Nov - Dec data), for the period 2000 - 2012 and for the period 2008 - 2012 were developed. A regression was developed for each year and the MMWWF and MMDWF were calculated. A peaking factor, for each the MMDWF and MMWWF, was calculated using the average dry weather flow (ADWF) for the period of study of 6.64-mgd. The plot for the periods 2000 – 2012 is shown in ***Figure 3***.

The peaking factors for the 5-year winter (MMWWF) and the 10-year summer (MMDWF) flows were developed using the DEQ methodology for the two periods from 2000 - 2012 and 2008 - 2012. These values were compared with the historical values for each of the years from 2000 - 2012. It was determined that the values using the DEQ methodology on the data from 2008 - 2012 were the most representative data set when compared to the median dry season flow. These results are summarized in ***Table 6***.

Table 6
Peaking Factor Summary

Peaking Factor	DEQ Methodology	Historical
MMDWF Peaking	1.70	1.70
MMWWF Peaking	2.55	2.55

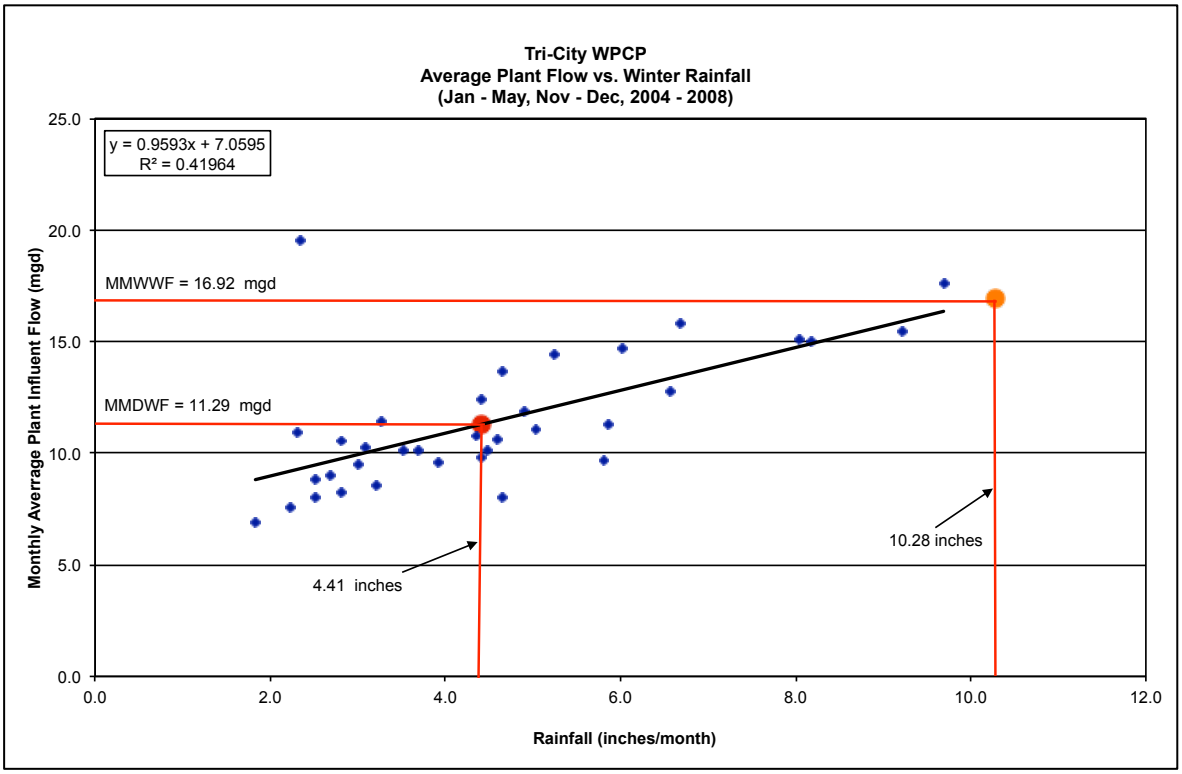


Figure 3: MMDWF and MMWWF Using DEQ Methodology

4.1.3.1.3 Max Day Flow

ODEQ has established a procedure for determining the probable maximum day flow for a wastewater treatment plant. This is done by using the statistical 5-year, 24-hour storm. The storm is used to calculate a flow using a regression from a scatter plot of the existing peak daily flows and rainfalls that occurred during saturated ground conditions.

In this analysis, a scatter plot of the daily rainfall vs. daily flow was developed for the period 2000 through 2012 and again for the period 2008 through 2012. A scatter plot was developed for each case when the rainfall was greater than 0.5-in, 1-in, 1.5-in and 2.0-inches. A linear regression was calculated on each plot and a formula was determined. This formula was used to determine the peak daily flow for the 5-year, 24-hour storm in each case. This plot is shown in ***Figure 4***.

The 5-year, 24-hour duration storm (winter and annual storm) can be obtained from NOAA in Atlas 2, Volume X for this region. As shown on the map, the 5-yr, 24-hr storm is estimated to be 3.0 inches for this area. The historical rainfall data shows that the rainfall at the Tri-City WPCP is less than the Kellogg Creek WPCP. A review of the historical data at the Oregon City shows that a 5-year, 24-hour storm of 2.5-inches better represents the flows in the service area. This evaluation is provided in ***Attachment F***.

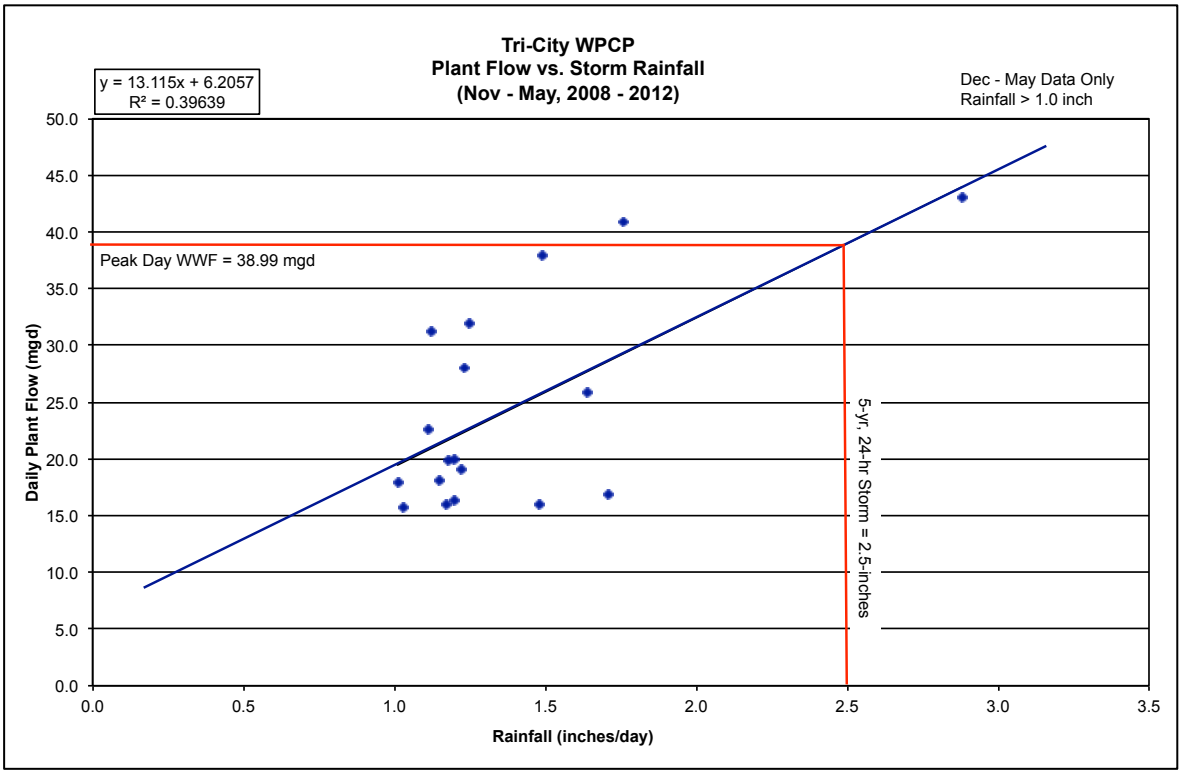


Figure 4: PDF Using DEQ Methodology

A statistical storm for the Tri-City service area of 2.5-inches was used based on the review of the historical daily rainfall for the Tri-City WPCP and the Oregon City weather station.

The DEQ Methodology suggests using the daily flow data for the months of January through May. In this analysis, the flow data for the period of December through May was used because it is more representative of the Tri-City WPCP system with high rainfalls and plant flows in December.

An evaluation of the data and daily peaking factors was performed for each year between 2000 and 2012. The peak daily flow observed over the 13-year evaluation period was 43.14-mgd on January 1, 2009 at a rainfall of 2.88-inches at the Tri-City WPCP City weather station. This high flow event is shown in ***Figure 5***. The base flow was already high following multiple days of rain around 0.5-inches and the high rainfall of 2.88-inches resulted in the high daily flow.

The calculated PDF using the DEQ statistically derived method is 39.0-mgd. The peak flow experienced at the treatment plant over the 13-year period was 43.14-mgd at a rainfall of 2.88-inches. Based on this analysis, a peak day flow value of 39.0-mgd will be used based on the DEQ methodology. The average dry weather flow for the 13-year period is 6.64-mgd. The daily peaking factor using the peak day flow of 39.0-

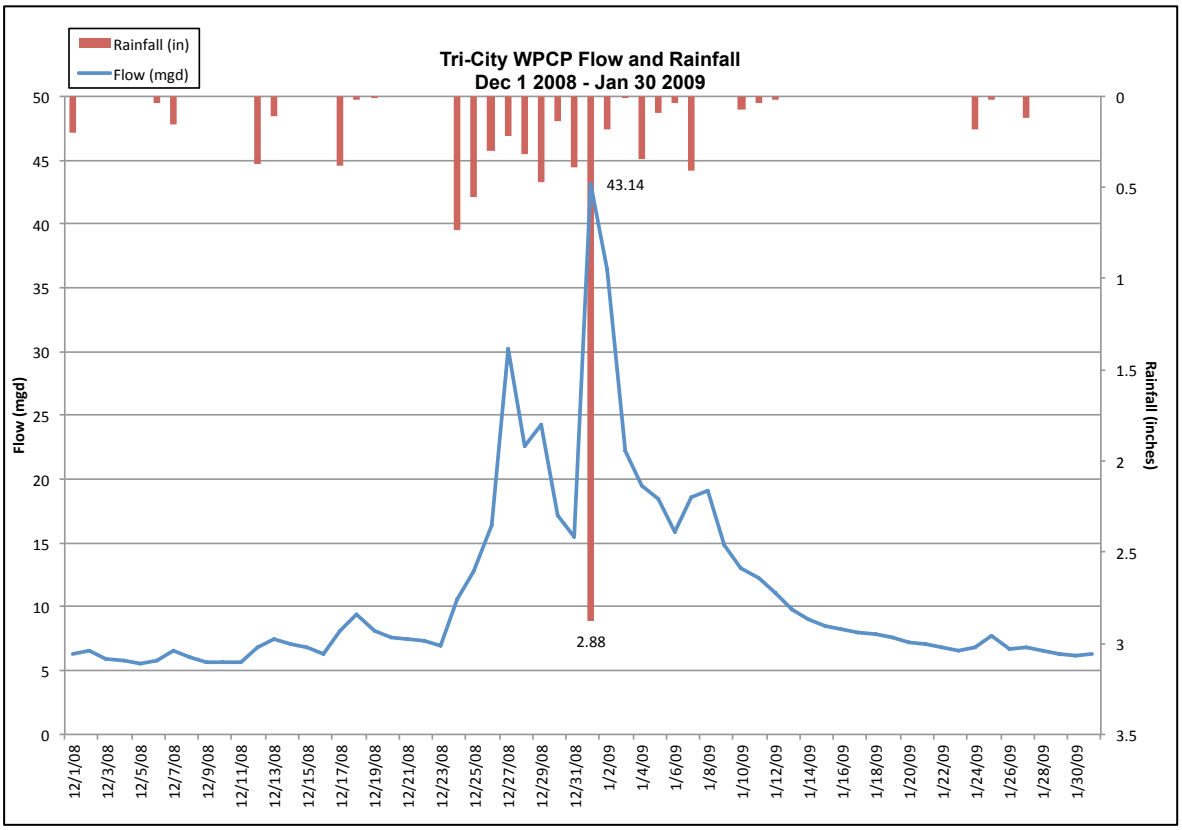


Figure 5: January 1, 2009 High Flow Event

mgd is 5.87. This peaking factor is consistent with the historical average peak day factor for the 5-year period from 2008-2012 of 5.53.

4.1.3.2 *Peak Hour Flow Determination*

A peak hour flow of 55.8-mgd was experienced on November 19, 2012. During this rainfall event, the plant measured rainfall of 1.99-inches and had a daily flow of 38.03-mgd followed by a second daily flow of 39.15-mgd. During this time, the Intertie II pump station was diverting 8.0-mgd to the Tri-City WPCP. The Diversion was measured at the Tri-City WPCP at 10.4-mgd, which included 2.4-mgd from the Clackamas Pump Station. It has been determined from the above information that the Peak Hour Flow during this event was 47.8-mgd from the Tri-City WPCP service area. The Peak Hour Peaking Factor was determined by dividing the peak hour flow of 47.8-mgd by the average dry weather flow of 6.64-mgd resulting in a peaking factor of 7.2 The high flow event for November 19, 2012 is shown in ***Figure 6***. The analysis for determining the peak hour peaking factor is provided in **Attachment G**.

4.1.3.3 *Peaking Factors for Planning*

The peaking factors calculated from the historical data were compared with the peaking factors developed using the DEQ Methodology. The DEQ methodology produced peaking factors that were substantiated by the values calculated from the historical flows. The flow peaking factors to be used for planning will be:

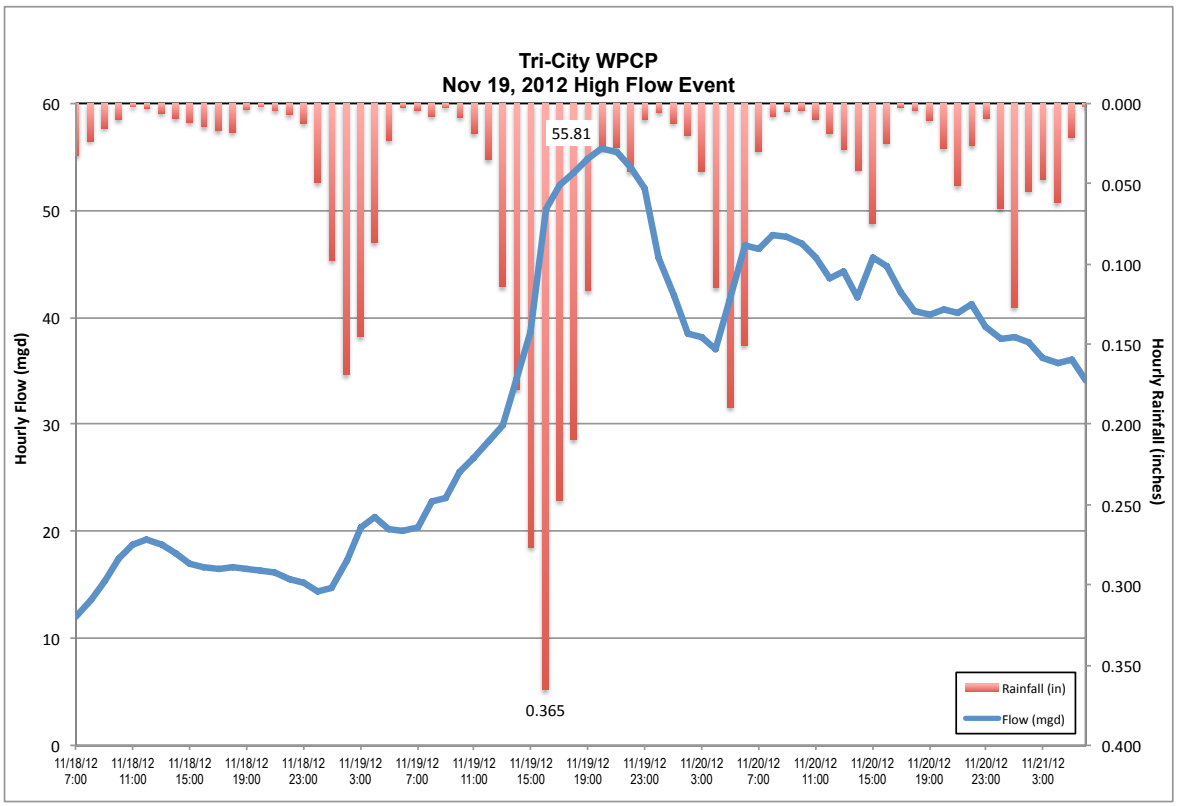


Figure 6: November 19, 2012 High Flow Event

- MMDWF = 1.70: Follows DEQ criteria for the data set from 2008 - 2012, but using the median dry season flow instead of the average dry season flow. This value is higher than the average of the MMDWF peaking factor based on average DWF for the period 2000 - 2012 of 1.55. The value for the most recent 5-year period was used as it included additional flows from the diversion and the median was used as it better represents the true dry weather flow as determined in ***Attachment B***.

- MMWWF = 2.55: Follows DEQ criteria for the data set from 2008 - 2012. This was lower than the 90% value from 2006 that was skewed by an abnormal flow event. This value also is slightly higher than the historical average peaking factor of 2.32.

- PDF or Max. Day Q = 5.87: Fits DEQ methodology and is fairly consistent with the historical data for the study period.

- PHF = 8.4 -- The Peak Hour Peaking Factor is determined by dividing the peak hour flow of 56.1-mgd by the average dry weather flow of 6.64-mgd resulting in a peaking factor of 8.4.

The other flow peaking factors that will be used will be based on the historical data. All of the flow peaking factors are summarized in ***Table 7***.

Table 7
Tri-City WPCP
Flow Peaking Factors for Master Planning

Process Condition	Influent Flow			
	Max. Month	Max. Week	Max. Day	Peak Hour
Average Annual	2.47	3.60	5.53	
Summer Season	1.70	1.83	2.23	
Winter Season	2.55	3.60	5.87	7.2

4.2 BIOCHEMICAL OXYGEN DEMAND (BOD_5)

The BOD_5 was evaluated to determine the characteristics used to project future loads. A summary of the analysis is provided in the following sections. The BOD_5 monthly average BOD_5 concentration and load for the period from 2000 to 2012 are shown in ***Figures 6*** and ***7***, respectively.

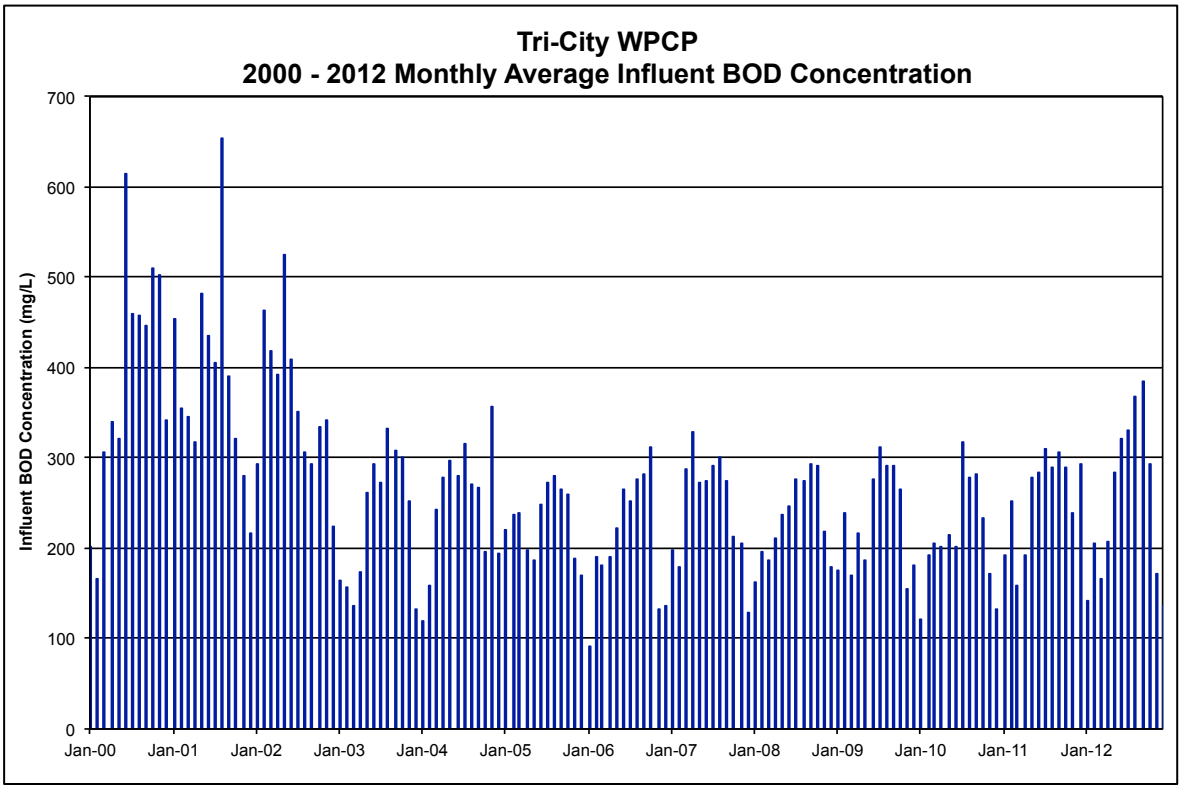


Figure 6: 2000 – 2012 Monthly Average Influent BOD_5 Concentration

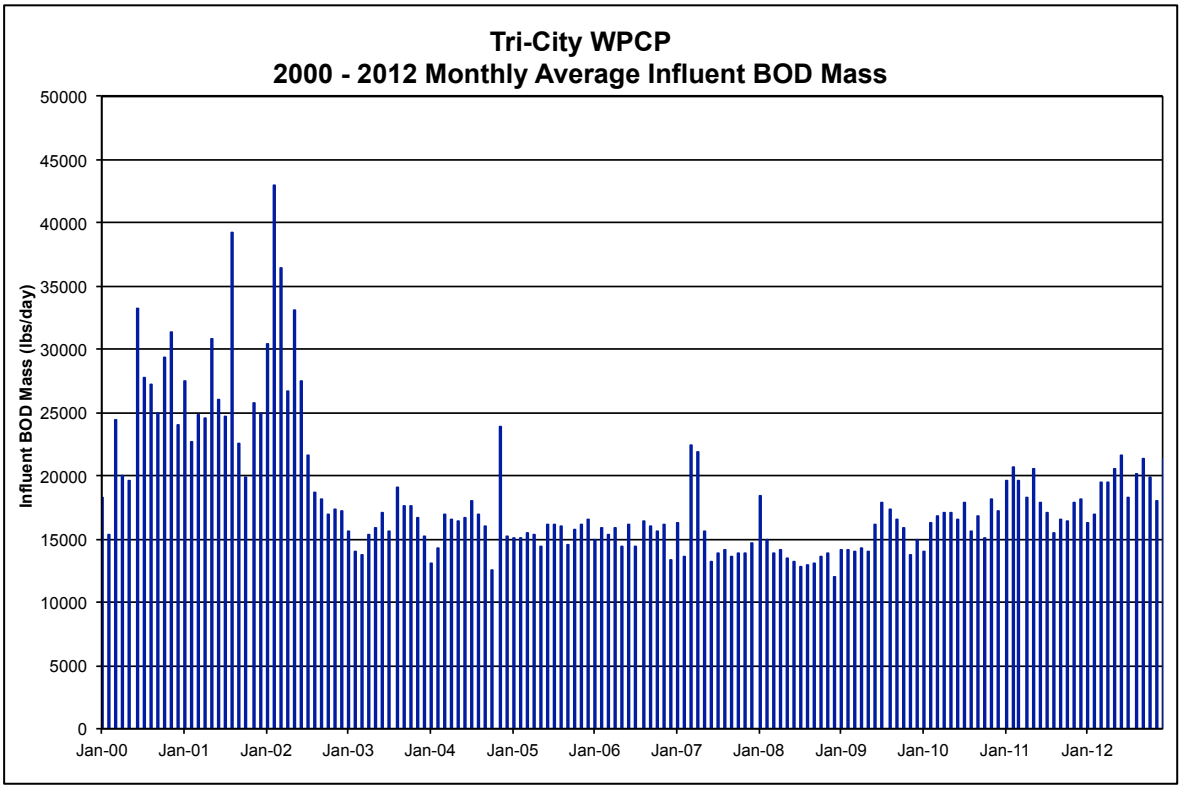


Figure 7: 2000 – 2012 Monthly Average Influent BOD_5 Load

4.2.1 BOD_5 Per Capita Load

Per capita loads are calculated by taking the average day load and dividing it by the EDUs for the Tri-City WPCP for the respective year. The average of the values calculated for each of the years was used as the per EDU load. The analysis of influent BOD_5 is provided in ***Attachment H***. The per capita loads developed from the sampling are shown in ***Table 8***.

Table 8
Tri-City WPCP
Influent BOD_5 Characteristics

Period	Per Capita BOD_5 Load (lbs/capita/day)	Peaking Factors		
		Max Month	Max Week	Max Day
Average Annual	0.46	1.21	1.43	2.77
Summer Season	0.46	1.14	1.30	2.15
Winter Season	0.46	1.16	1.37	2.43

4.2.2 BOD_5 Peaking Factors

Peaking factors and per EDU loads are necessary to characterize the influent wastewater and project loads into the future. Projections are made assuming that these characteristics remain the same. Peaking factors are determined as follows:

- Max Month -- Maximum 30 day average / Average Day
- Max Week -- Maximum 7-day average / Average Day
- Max Day -- Maximum day / Average Day

In this analysis, the loads for the period between January 2000 and December 2012 were evaluated. The maximum month, maximum week and max day values were developed for each of the seasonal conditions. The peaking factor for each year was calculated and an average of the peaking factors was determined. The average for the 13-year period as well as the previous 5-year period were used to determine the BOD_5 peaking factors to be used in the study. The BOD_5 peaking factors are shown in ***Table 8***.

4.3 TOTAL SUSPENDED SOLIDS (TSS)

The TSS was evaluated to determine the characteristics used to project future loads. A summary of the analysis is provided in the following sections. The TSS monthly average concentration and load for the period from 2000 to 2012 are shown in ***Figures 8*** and ***9***, respectively.

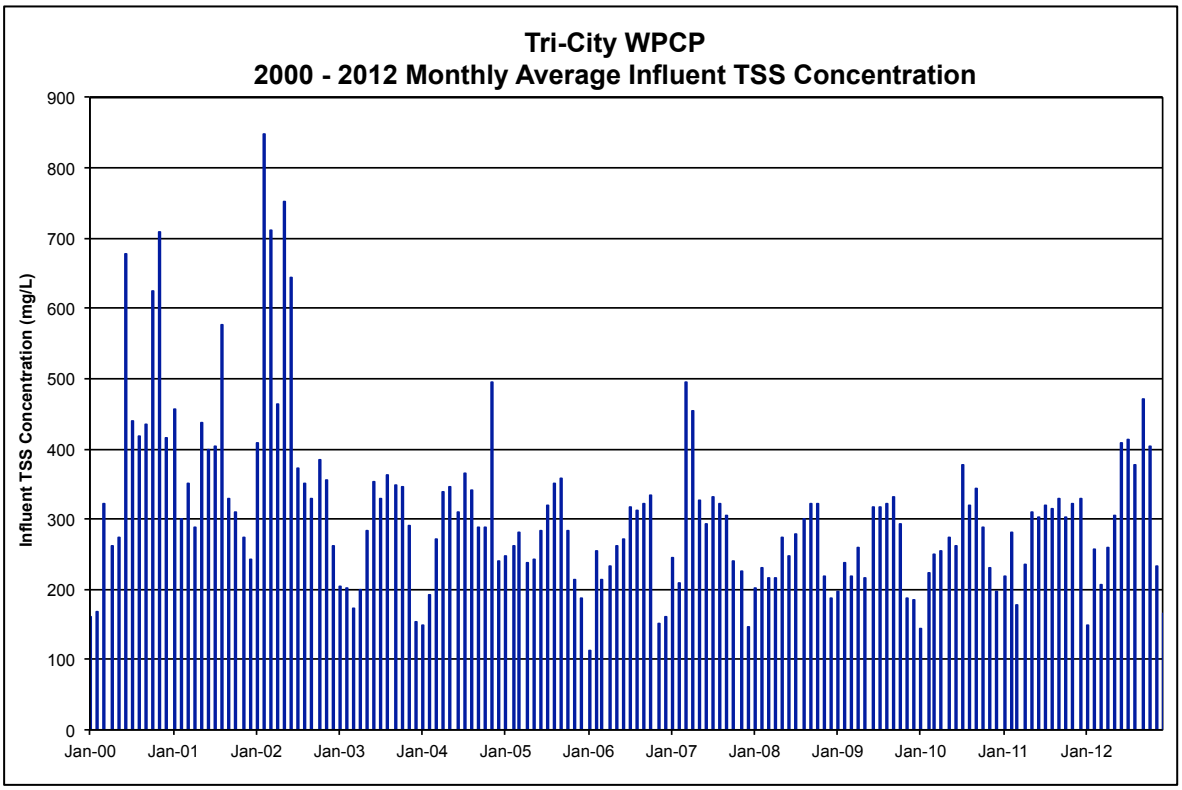


Figure 8: 2000 – 2012 Monthly Average Influent TSS Concentration

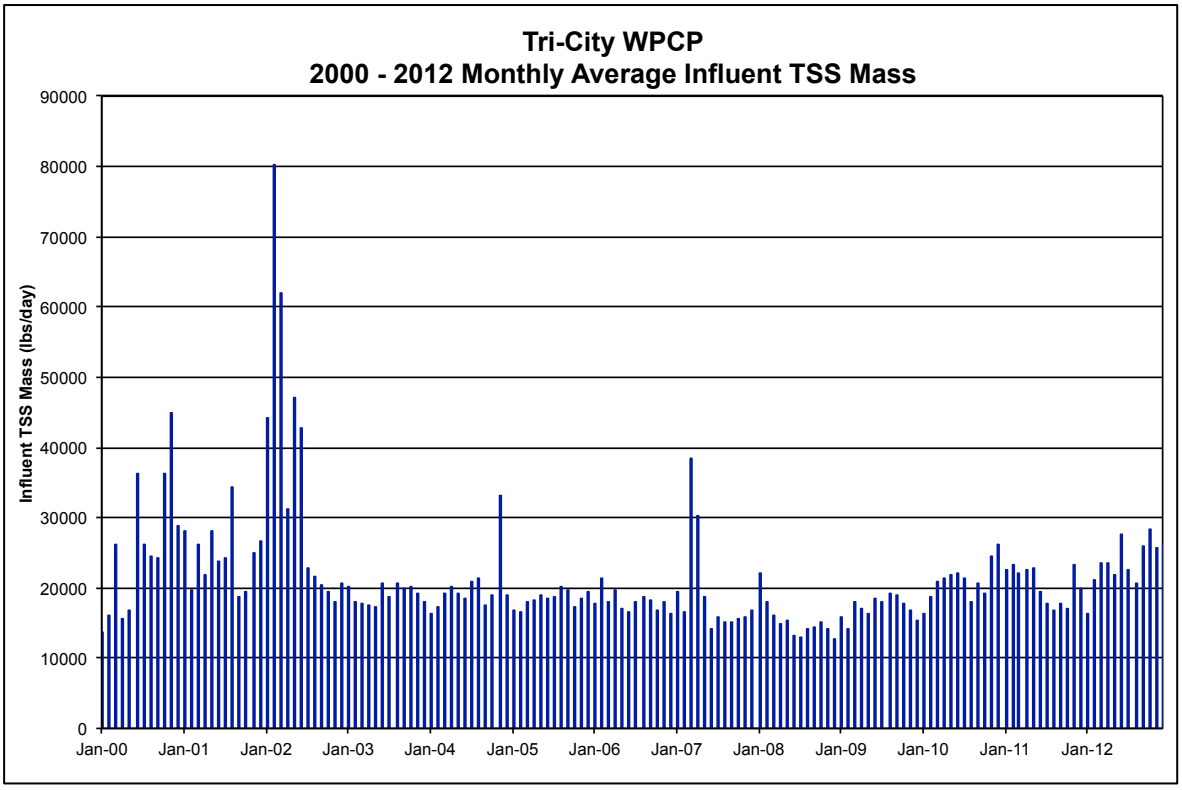


Figure 9: 2000 – 2012 Monthly Average Influent TSS Load

4.3.1 TSS Per Capita Load

Per EDU loads are calculated by taking the average day load and dividing it by the EDUs for the Tri-City WPCP for the respective year. The average of the values calculated for each of the years is used as the per EDU load. The analysis of influent TSS is provided in ***Attachment I***. The per capita loads developed from the sampling are shown in ***Table 9***. This analysis provides a per EDU load for TSS of 0.54 lbs/EDU per day. This is a standard value for municipal wastewater. This is the value that will be used to forecast the TSS load to the treatment plant.

4.3.2 TSS Peaking Factors

Peaking factors and per capita loads are necessary to characterize the influent wastewater and project loads into the future. Projections are made assuming that these characteristics remain the same. Peaking factors are determined as follows:

- Max Month -- Maximum 30 day average / Average Day
- Max Week -- Maximum 7-day average / Average Day
- Max Day -- Maximum day / Average Day

In this analysis, the loads for the period between January 2000 and December 2012 were evaluated. The maximum month, maximum week, and max day values were developed for each of the seasonal conditions. The peaking factor for each year was

calculated and an average of the peaking factors was determined. The average for the 13-year period, as well as the previous 5-year period, was used to determine the TSS peaking factors to be used in the study. The TSS peaking factors are shown in ***Table 9***.

Table 9
Tri-City WPCP
Influent TSS Characteristics

Period	Per Capita TSS Load (lbs/capita/day)	Peaking Factors		
		Max Month	Max Week	Max Day
Average Annual	0.54	1.29	1.56	2.84
Summer Season	0.53	1.13	1.36	2.41
Winter Season	0.54	1.25	1.49	2.73

5 STATISTICAL 2012 WASTEWATER CHARACTERISTICS

The statistical 2012 influent wastewater characteristics were developed using an EDU value of 38,197. The average day influent flow and load characteristics were determined by taking the EDUs for each of the conditions and multiplying it by the per EDU flow or load that was calculated for that condition. The maximum month, maximum week and maximum day flows and loads were then obtained by multiplying the average day value by the appropriate peaking factor. The results of these calculations are shown in ***Table 10***.

6 DIVERSION WASTEWATER CHARACTERISTICS

The flows and loads for the Clackamas Pump Station diversion was evaluated for the period January 2000 through December 2012. This includes the additional flows from the Intertie I project starting in 2009.

6.1 DIVERSION FLOWS

The diversion flow was evaluated under a number of scenarios to determine the characteristics to be used to project future flows and loads. The analysis of diversion flow is provided in ***Attachment A***. The average monthly diversion flow for the period from 2000 to 2012 is shown in ***Figure 11***. A statistical analysis of the diversion flows is summarized in ***Table 11***.

This analysis shows that the diversion flows averaged between 0.55 and 0.65-mgd from 2000 through 2008. In 2009, the Intertie I project was completed and the average flow increased to between 1.28-mgd and 1.33-mgd through 2012. The peak flow in 2012 was from the November 19, 2012 high flow event.

Table 10
Tri-City WPCP
Influent Wastewater Flows and Loads

Flow (mgd)						
Process Parameter	Ave Day	Max. Month	Max. Week	Max Day	Peak Hour	
Average Annual	9.93	16.81	24.50	37.60		
Dry Weather	6.80					
Dry Season	7.72	11.56	12.47	15.19		
Wet Season	12.18	17.34	24.50	39.91	49.0	
Biochemical Oxygen Demand						
Process Parameter	Average		Max. Month		Max. Week	
Average Annual	17,571	212	21,246	257	25,204	304
Dry Weather	17,571	310	21,246	375	25,204	444
Dry Season	17,571	273	21,246	330	25,204	392
Wet Season	17,571	173	21,246	209	25,204	248
Total Suspended Solids						
Process Parameter	Average		Max. Month		Max. Week	
Average Annual	20,626	249	26,581	321	32,123	388
Dry Weather	20,626	364	26,581	469	32,123	567
Dry Season	20,626	321	26,581	413	32,123	499
Wet Season	20,626	203	26,581	262	32,123	316

An analysis of diversion flows for the period of time from January 2000 thorough December 2012 was performed to determine the historical peaking factors. Data was analyzed for the annual, winter season and summer season conditions. The average peaking factor and the maximum peaking factor were determined for each period. Typically, the maximum peaking factor for a period is used as that demonstrates the worst-case flow. In this case, the average of the peaking factors for each study period were used. The results are summarized in ***Table 12***. The flow peaking factors that will be used to characterize the existing flows are summarized in ***Table 13***.

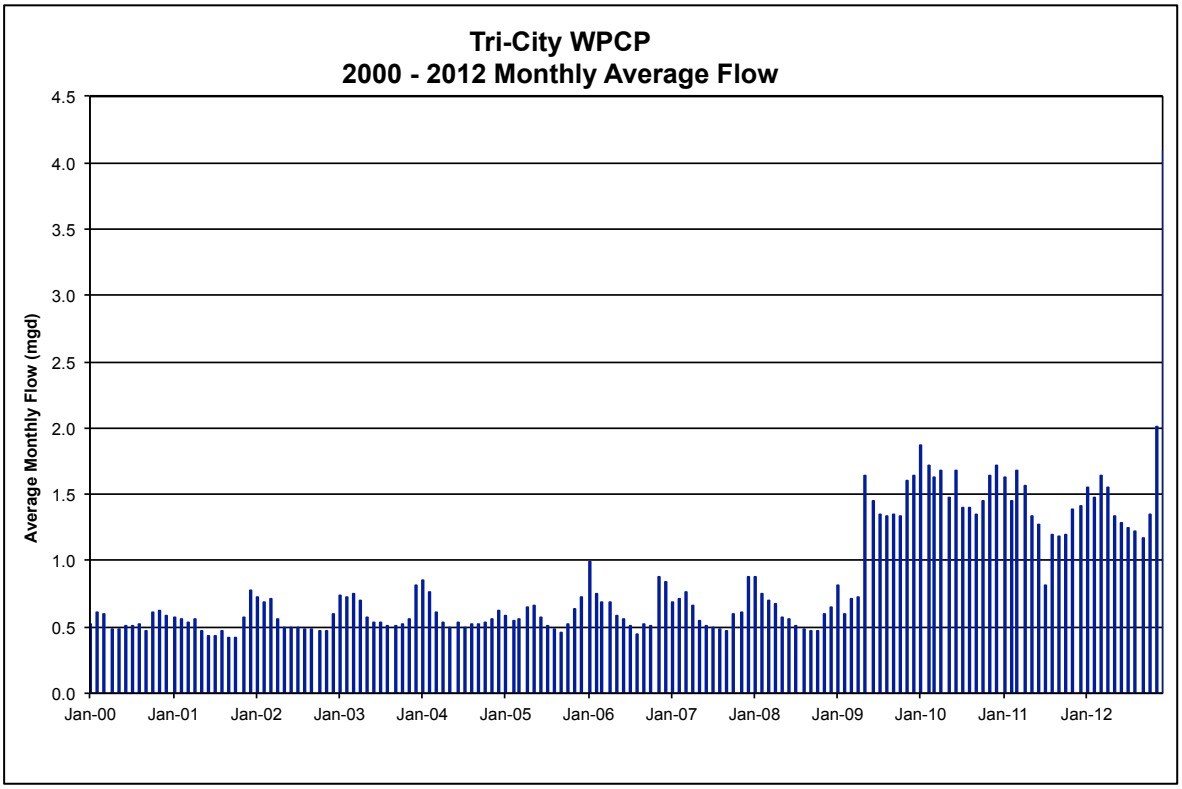


Figure 11: 2000 – 2012 Monthly Average Diversion Flow

Table 11
2000 – 2012 Diversion Flow Statistics

Statistic	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total	199.69	191.93	202.67	230.28	210.31	220.02	235.53	230.25	221.66	465.60	469.17	486.90	605.00
Max	0.88	0.94	0.97	1.37	1.00	1.40	1.21	1.42	1.59	2.05	2.18	1.97	9.40
Min	0.30	0.29	0.35	0.40	0.39	0.33	0.00	0.31	0.33	0.45	0.69	0.00	0.03
Average	0.55	0.53	0.56	0.63	0.57	0.60	0.65	0.63	0.61	1.28	1.61	1.33	1.65
Median	0.52	0.49	0.53	0.59	0.56	0.56	0.61	0.58	0.57	1.38	1.61	1.33	1.37
Count	366	365	364	365	366	365	365	365	364	365	292	365	366

6.2 DIVERSION BOD_5

The diversion BOD_5 was evaluated to determine the characteristics used to characterize the existing loads. The diversion monthly average BOD_5 concentration and load for the period from 2000 to 2012 are shown in ***Figures 12*** and ***13***, respectively. A statistical analysis of the diversion BOD_5 is summarized in ***Tables 14 and 15***.

Table 12
Diversion Flow Peaking Factors

Method	Average DWF			Median DWF		
	MMDWF	MMWWF	Max Day	MMDWF	MMWWF	Max Day
Historical						
Average						
2000 - 2012	1.21	1.51	2.17	1.19	1.49	2.09
2008 - 2012	1.25	1.34	1.88	1.23	1.33	1.72
Median						
2000 - 2012	1.22	1.49	2.26	1.22	1.49	2.09
90 percentile						
2000 - 2012	1.32	1.80	2.63	1.29	1.76	2.67
Maximum						
2000 - 2012	1.33	1.92	2.73	1.31	1.82	2.73

Table 13
Diversion
Flow Peaking Factors for Master Planning

Process Condition	Influent Flow			
	Max. Month	Max. Week	Max. Day	Peak Hour
Average Annual	1.54	1.75	2.17	
Summer Season	1.21	1.30	1.52	
Winter Season	1.51	1.74	2.11	3.30

Table 14
2000 – 2012 Diversion BOD Concentration Statistics

Statistic	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Max	2157	2109	1632	1698	2275	1473	2245	1857	2106	2112	1491	981	1098
Min	168	225	200	127	174	200	118	87	120	88	75	101	60
Average	666	773	652	509	518	533	514	567	630	354	300	444	411
Median	649	715	640	483	510	529	482	540	612	330	267	440	392

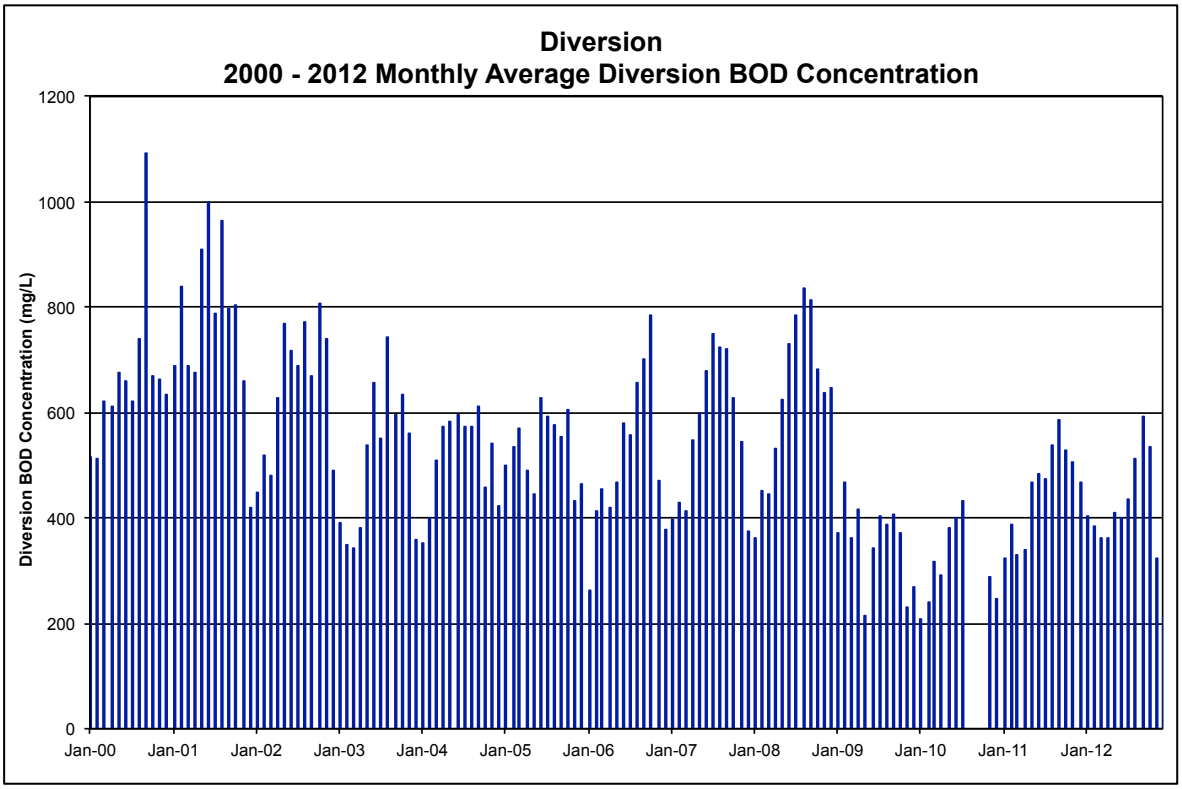


Figure 12: 2000 – 2012 Monthly Average Diversion BOD_5 Concentration

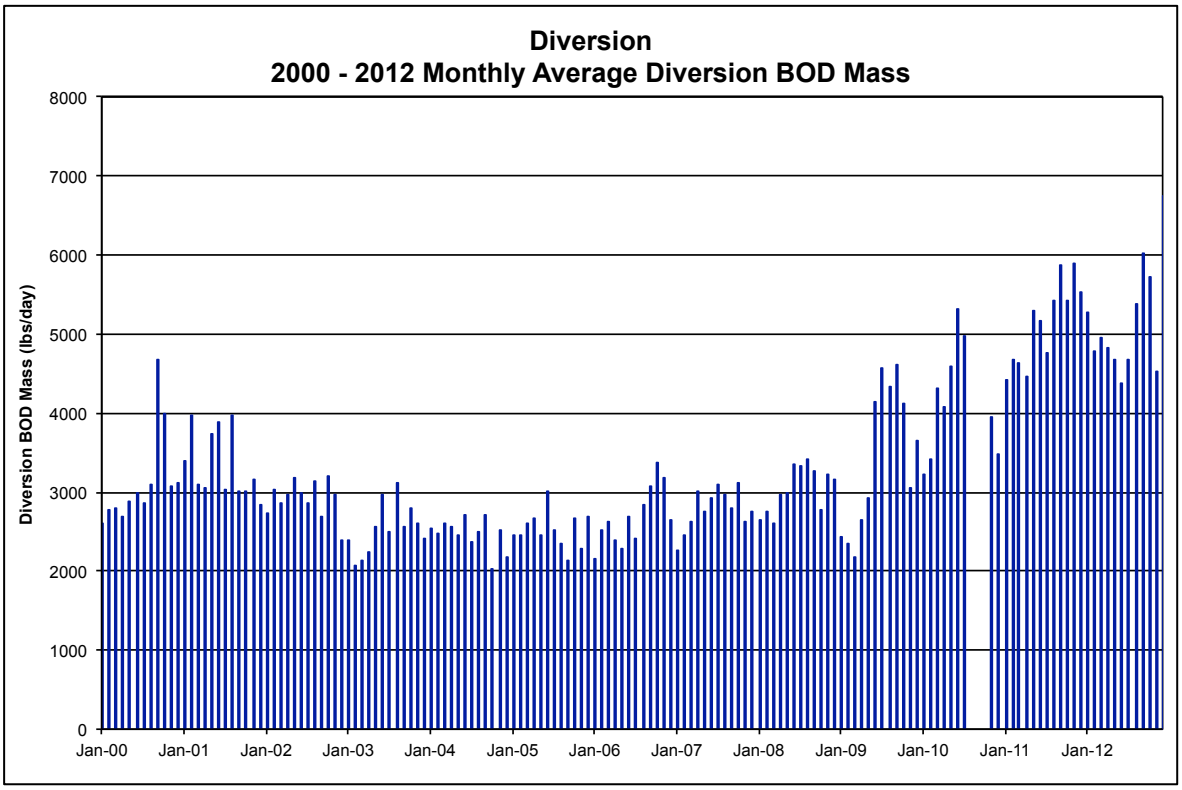


Figure 13: 2000 – 2012 Monthly Average Diversion BOD_5 Mass

Table 15
2000 – 2012 Diversion BOD Mass Statistics

Statistic	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total	613205	678149	977955	893922	884756	914459	926349	990042	1096908	1219991	955068	1528432	1069176
Max	9892	8619	7078	7505	10815	7617	8503	10067	9639	17262	18404	13824	14454
Min	995	995	1084	769	684	1040	731	617	716	534	1251	1322	1626
Average	3113	3357	2919	2532	2471	2526	2693	2789	3039	3417	4064	5078	5165
Median	3002	3156	2827	2505	2474	2493	2619	2732	2944	3167	3697	5115	4891

This analysis shows that the diversion BOD_5 ranges between 2500 and 3100 lbs/day between 2000 and 2008. With the completion of the Intertie I project in 2009, the load from the diversion increased each year up to 5165 lbs/day in 2012. Each year there was a high loads pumped through the diversion that amounted to up to 50% of the load at the Tri-City WPCP.

6.3 DIVERSION TSS

The diversion TSS was evaluated to determine the characteristics used to characterize the existing loads. The diversion monthly average TSS concentration and load for the period from 2000 to 2012 are shown in ***Figures 14*** and ***15***, respectively. A statistical analysis of the diversion TSS is summarized in ***Tables 16 and 17***.

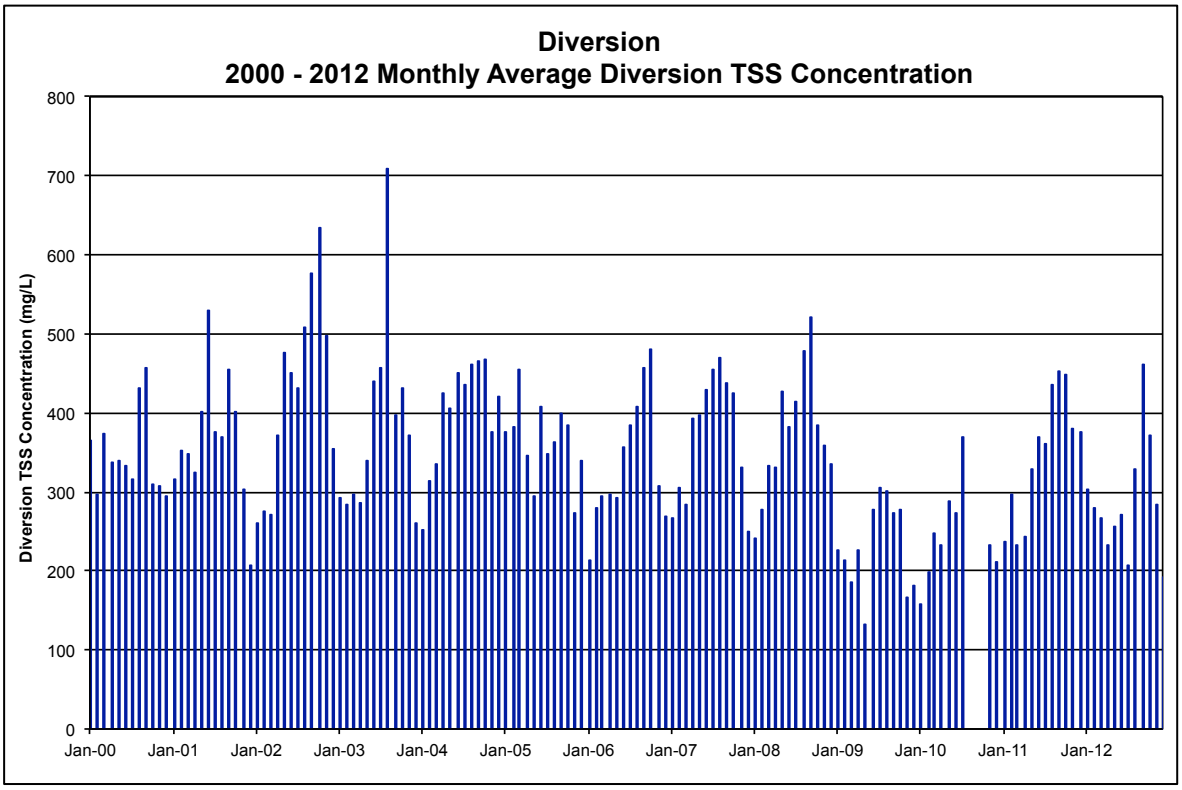


Figure 14: 2000 – 2012 Monthly Average Diversion TSS Concentration

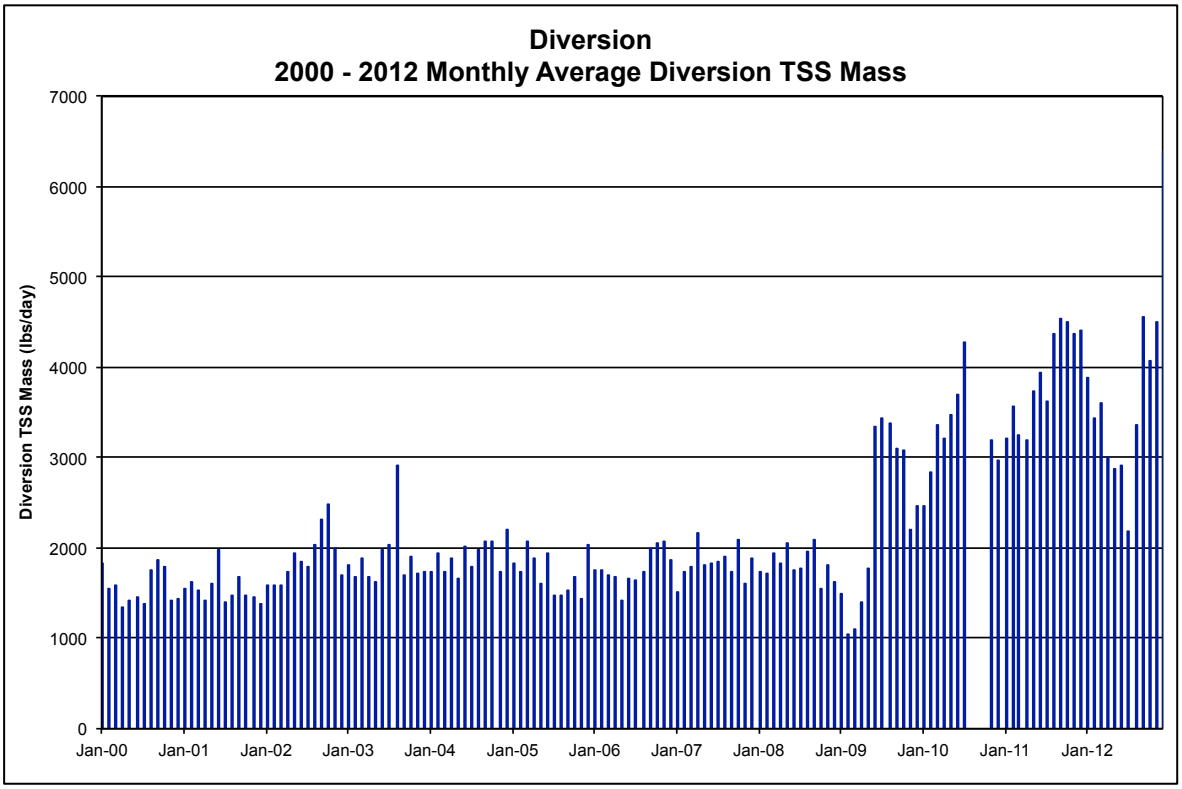


Figure 15: 2000 – 2012 Monthly Average Diversion TSS Mass

Table 16
2000 – 2012 Diversion TSS Concentration Statistics

Statistic	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Max	900	939	1196	2540	2630	1720	1430	1670	860	1552	1058	972	900
Min	94	129	135	91	120	67	110	68	83	34	57	102	46
Average	348	366	434	382	401	364	338	370	374	231	235	342	288
Median	334	352	410	349	356	339	314	356	362	212	218	339	270

Table 17
2000 – 2012 Diversion TSS Mass Statistics

Statistic	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total	389927	385275	647133	673431	692047	625055	616105	656871	657075	838486	748721	1211840	973960
Max	3828	3645	4987	9321	12502	8894	6437	9053	4627	12296	14383	8836	25464
Min	439	473	738	468	460	374	539	482	406	187	761	1387	483
Average	1572	1547	1903	1897	1906	1727	1786	1830	1820	2329	3186	3859	3732
Median	1521	1497	1773	1784	1711	1597	1690	1744	1827	2131	3021	3875	3391

This analysis shows that the diversion TSS ranges between 1500 and 1800 lbs/day between 2000 and 2008. With the completion of the Intertie I project in 2009, the TSS load from the diversion increased each year up to 3800 lbs/day in 2012. Each

year there was a high loads pumped through the diversion that amounted to up to 50% of the load at the Tri-City WPCP.

6.4 DIVERSION EDU EQUIVALENCE

The diversion flows have a high industrial component so they cannot be equated to a population. An analysis was done to determine the equivalent EDUs that the diversion flows and loads contribute to the Tri-City WPCP. This was done using the following factors for EDU equivalence:

- Flow EDU Equivalence based on 250 gallons per capita per day
- BOD_5 EDU Equivalence based on 0.50 lbs per capita per day
- TSS EDU Equivalence based on 0.50 lbs per capita

The analysis clearly showed that the BOD_5 has a high contribution of load to the treatment plant when compared to flow and TSS. Therefore, the diversion EDU equivalent will be based on a BOD_5 EDU Equivalence. This analysis is summarized in ***Table 18***. The results of this analysis show an EDU load equivalence for the diversion in 2012 of 10,330 EDUs. This is the value that will be used for the existing diversion.

Table 18
CCSD#1 Diversion Flows and Loads
Equivalent EDU Determination

Year	Average Flow (mgd)	Average BOD (lbs/day)	Average TSS (lbs/day)	Flow EDU Equivalence	BOD EDU Equivalence	TSS EDU Equivalence	Diversion EDU Equivalence
2000	0.55	3113	1572	2182	6225	3145	6225
2001	0.53	3357	1547	2103	6714	3095	6714
2002	0.56	2919	1903	2227	5839	3807	5839
2003	0.63	2532	1897	2524	5065	3794	5065
2004	0.57	2471	1906	2298	4943	3813	4943
2005	0.60	2526	1727	2411	5052	3453	5052
2006	0.65	2693	1786	2581	5386	3572	5386
2007	0.63	2789	1830	2523	5578	3659	5578
2008	0.61	3039	1820	2436	6077	3640	6077
2009	1.28	3417	2329	5102	6835	4658	6835
2010	1.61	4064	3186	6427	8128	6372	8128
2011	1.33	5078	3859	5336	10156	7719	10156
2012	1.65	5165	3732	6612	10330	7463	10330

7 ATTACHMENTS

Attachment A – Determine Diversion Flow Peaking Factors
Attachment B – Develop Per EDU Flows
Attachment C – Determine 10-yr Summer & 5-yr Winter Rainfall
Attachment D – Determine Flow Peaking Factors
Attachment E – Determine 5-yr Winter & 10-yr Summer Flows – DEQ Methodology
Attachment F – Determine Max Day Flow ($PDAF_5$)
Attachment G – Determine Peak Hour Flow (PHF)
Attachment H – Determine Peaking Factors and Per Capita Loads for BOD_5
Attachment I – Determine Peaking Factors and Per Capita Loads for TSS

ATTACHMENT A
Determine Diversion Flow Peaking Factors

ATTACHMENT B
Develop Per Capita Flows

Attachment B
Tri-City WPCP
Develop Per EDU Flows

Background

Per EDU flows are developed by dividing the average flow by the population. With the high wet weather flows that are experienced, a Dry Weather analysis will also be completed to determine actual population based flows.

Populations used in this analysis are those provided by the Population Research Center of Portland State University. The populations were converted to EDUs based on a 2.5 people per EDU factor.

Evaluation

An evaluation was performed for both the periods 2000 - 2012 (13-yr) and 2008 - 2012 (5-yr). Due to the high flows that can be influenced by RDII, an analysis was also done using the median instead of the average to provide results that are not skewed by periodic high flows.

Per EDU Flows (gpd/EDU)

Dry Season Months (May - October)

Period	10-year		5-year	
	Average	Median	Average	Median
Annual Average	273	234	260	222
Summer Season	218	207	202	183
Winter Season	335	292	319	275

Dry Weather Months (June - October)

Statistics	*10-year* gpd/EDU		*5-year* gpd/EDU	
	Ave Month	Min. Month	Ave Month	Min. Month
Monthly Average	213	195	193	176
Monthly Median	208	193	187	175
Monthly Minimum	188	173	167	158

Dry Weather Months (July - September)

Statistics	*10-year* gpd/EDU		*5-year* gpd/EDU	
	Ave Month	Min. Month	Ave Month	Min. Month
Monthly Average	205	201	179	176
Monthly Median	204	199	178	175
Monthly Minimum	187	182	164	158

This analysis provides three different results depending on how the analysis is done. These results are as follows:

Summer Season Flow:
When using the summer season flow which is the permitted period between May 1 and October 30, the gpd/EDU is 218 gpd/EDU. The data set for the past 5-year period was also evaluated with the result being 202 gpd/EDU. The value for the dry season used for the study will be 202 gpd/EDU.

Dry Weather Month (June - October):
The analysis was done taking the rainfall influenced flows for the month of May out of the data set. In this analysis, the flow per EDU was 213 gpd/EDU based on average flow and 208 gpd/EDU based on the monthly median. When using the minimum month flow for this period, the flow per EDU was 188 gpd/EDU. This shows that there was still influence from rainfall induced flows.

Dry Weather Months (July - September):
The analysis was done taking the rainfall influenced flows for the months of May, June and October out of the data set. In this analysis, the flow per EDU was 205 gpd/EDU for the monthly average flows, 204 gpd/EDU for the median flows and 187 gpd/EDU for the monthly minimum flows. For the past 5-year period, the values were 179 for the average, 178 for the median and a minimum of 164 gpd/EDU.

Discussion

The analysis of dry weather flows in Attachment C show that there are still periods of rainfall influenced flows that occur during the months of July, August and September. The occurrence is less during this period of time. It is therefore, logical to used the median value for the per EDU flows for the period July - September for the most recent 5-year period for the existing dry weather flows. Therefore, the Dry Weather Flow per EDU flows for this study will be 178 gpd/EDU.

Even with the lower flows in recent years, 200 gpd/EDU will be used for future growth.

Conclusion

This analysis determined a per EDU flow using the median flow for the dry weather period between July 1 and September 30 of 178 gpd/EDU. This value will be used for the existing population base. A value of 200 gpd/EDU will also be used for all future growth.

This value is lower than the value used in previous planning efforts of 250 gpd/EDU.

The wastewater unit flows to be used for planning are summarized below.

Variable	Ave Annual	Dry Weather	Dry Season	Wet Season	Units
Flow	260	178	202	319	gal/EDU/day

Table B-1
Tri-City WPCP
Influent Flow Characterization

Average Annual

Year	Service Area EDUs	Historical Average Annual Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Annual Flow per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	8.09	11.38	15.55	19.52	1.63	2.22	2.79	268
2001	31031	8.71	17.50	22.99	26.06	2.40	3.16	3.58	281
2002	30471	8.99	14.60	18.94	27.89	2.00	2.59	3.82	295
2003	30494	9.43	14.58	21.61	39.61	2.09	3.10	5.67	309
2004	30830	8.51	13.68	15.97	19.37	1.89	2.21	2.68	276
2005	30987	7.63	14.31	23.87	40.49	1.88	3.14	5.32	246
2006	31931	10.03	20.89	26.26	34.14	2.98	3.74	4.86	314
2007	33097	8.51	15.27	19.77	32.04	2.39	3.09	5.01	257
2008	34835	8.07	15.12	19.83	30.21	2.54	3.33	5.08	232
2009	34552	8.78	12.61	24.88	43.14	1.69	3.33	5.78	254
2010	35808	10.55	17.65	25.65	37.90	2.11	3.06	4.53	295
2011	37802	9.40	16.35	22.29	32.00	2.30	3.13	4.49	249
2012	38197	10.29	20.01	27.14	40.87	2.63	3.57	5.38	269
Average	**33097**	**9.00**	**15.69**	**21.90**	**32.56**	**2.19**	**3.05**	**4.54**	**273**

Summer Season

Year	Resident Service Area EDU	Historical Summer Season Flows (mgd)				Historical Peaking Factors From Average			Flow per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	6.99	7.77	9.17	10.94	1.11	1.31	1.57	231
2001	31031	7.28	9.10	9.31	12.70	1.25	1.28	1.74	235
2002	30471	7.30	8.65	9.00	10.97	1.18	1.23	1.50	240
2003	30494	6.98	10.69	9.88	9.17	1.53	1.42	1.31	229
2004	30830	7.24	7.90	9.26	10.73	1.09	1.28	1.48	235
2005	30987	7.61	10.13	12.40	14.65	1.33	1.63	1.93	246
2006	31931	7.02	10.09	9.21	9.60	1.44	1.31	1.37	220
2007	33097	6.39	8.43	11.63	16.95	1.32	1.82	2.65	193
2008	34835	5.95	8.27	8.47	9.67	1.39	1.42	1.63	171
2009	34552	7.47	9.65	13.13	16.21	1.29	1.76	2.17	216
2010	35808	8.37	13.43	17.27	20.76	1.60	2.06	2.48	234
2011	37802	7.12	11.76	10.22	11.05	1.65	1.44	1.55	188
2012	38197	7.60	11.47	12.39	17.38	1.51	1.63	2.29	199
Average	**33097**	**7.18**	**9.80**	**10.87**	**13.14**	**1.36**	**1.51**	**1.82**	**218**

Winter Season

Year	Resident Service Area EDU	Historical Winter Season Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Flow per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	9.20	11.38	15.55	19.52	1.63	2.22	2.79	304
2001	31031	10.16	17.50	22.99	26.06	2.40	3.16	3.58	327
2002	30471	10.71	14.60	18.94	27.89	2.00	2.59	3.82	351
2003	30494	11.93	14.58	21.61	39.61	2.09	3.10	5.67	391
2004	30830	9.79	13.68	15.97	19.37	1.89	2.21	2.68	318
2005	30987	9.95	14.31	23.87	40.49	1.88	3.14	5.32	321
2006	31931	13.64	20.89	26.26	34.14	2.98	3.74	4.86	427
2007	33097	10.67	15.27	19.77	32.04	2.39	3.09	5.01	322
2008	34835	10.22	15.12	19.83	30.21	2.54	3.33	5.08	293
2009	34552	10.11	12.61	24.88	43.14	1.69	3.33	5.78	293
2010	35808	12.78	17.65	25.65	37.90	2.11	3.06	4.53	357
2011	37802	11.72	16.35	22.29	32.00	2.30	3.13	4.49	310
2012	38197	13.00	20.01	27.14	40.87	2.63	3.57	5.38	340
Average	**33097**	**11.07**	**15.69**	**21.90**	**32.56**	**2.19**	**3.05**	**4.54**	**335**

Table B-2
Tri-City WPCP
Influent Flow Characterization

Average Annual

Year	Resident Service Area EDUs	Historical Average Annual Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Annual Flow per EDU
		Median	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	7.25	11.38	15.55	19.52	1.67	2.28	2.86	240
2001	31031	7.46	17.50	22.99	26.06	2.47	3.25	3.68	240
2002	30471	7.68	14.60	18.94	27.89	1.98	2.57	3.78	252
2003	30494	7.45	14.58	21.61	39.61	2.10	3.12	5.72	244
2004	30830	7.53	13.68	15.97	19.37	1.95	2.28	2.77	244
2005	30987	7.63	14.31	23.87	40.49	2.02	3.36	5.70	246
2006	31931	8.05	20.89	26.26	34.14	3.00	3.77	4.90	252
2007	33097	7.02	15.27	19.77	32.04	2.58	3.33	5.40	212
2008	34835	6.56	15.12	19.83	30.21	2.69	3.52	5.37	188
2009	34552	7.45	12.61	24.88	43.14	1.79	3.53	6.12	216
2010	35808	9.36	17.65	25.65	37.90	2.52	3.66	5.41	261
2011	37802	8.05	16.35	22.29	32.00	2.48	3.38	4.85	213
2012	38197	8.87	20.01	27.14	40.87	2.89	3.92	5.91	232
Average	**33097**	**7.72**	**15.69**	**21.90**	**32.56**	**2.32**	**3.23**	**4.80**	**234**

Summer Season

Year	Resident Service Area EDUs	Historical Summer Season Flows (mgd)				Historical Peaking Factors From Average			Flow per EDU
		Median	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	6.82	7.77	9.17	10.94	1.14	1.34	1.60	226
2001	31031	7.08	9.10	9.31	12.70	1.29	1.31	1.79	228
2002	30471	7.38	8.65	9.00	10.97	1.17	1.22	1.49	242
2003	30494	6.93	10.69	9.88	9.17	1.54	1.43	1.32	227
2004	30830	7.00	7.90	9.26	10.73	1.13	1.32	1.53	227
2005	30987	7.10	10.13	12.40	14.65	1.43	1.75	2.06	229
2006	31931	6.97	10.09	9.21	9.60	1.45	1.32	1.38	218
2007	33097	5.93	8.43	11.63	16.95	1.42	1.96	2.86	179
2008	34835	5.63	8.27	8.47	9.67	1.47	1.50	1.72	162
2009	34552	7.05	9.65	13.13	16.21	1.37	1.86	2.30	204
2010	35808	7.00	13.43	17.27	20.76	1.92	2.47	2.97	195
2011	37802	6.60	11.76	10.22	11.05	1.78	1.55	1.67	175
2012	38197	6.92	11.47	12.39	17.38	1.66	1.79	2.51	181
Average	**33097**	**6.80**	**9.80**	**10.87**	**13.14**	**1.44**	**1.60**	**1.94**	**207**

Winter Season

Year	Resident Service Area EDUs	Historical Winter Season Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Flow per EDU
		Median	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	8.57	11.38	15.55	19.52	1.67	2.28	2.86	283
2001	31031	8.72	17.50	22.99	26.06	2.47	3.25	3.68	281
2002	30471	9.90	14.60	18.94	27.89	1.98	2.57	3.78	325
2003	30494	10.89	14.58	21.61	39.61	2.10	3.12	5.72	357
2004	30830	8.53	13.68	15.97	19.37	1.95	2.28	2.77	277
2005	30987	8.58	14.31	23.87	40.49	2.02	3.36	5.70	277
2006	31931	11.31	20.89	26.26	34.14	3.00	3.77	4.90	354
2007	33097	8.85	15.27	19.77	32.04	2.58	3.33	5.40	267
2008	34835	8.61	15.12	19.83	30.21	2.69	3.52	5.37	247
2009	34552	8.83	12.61	24.88	43.14	1.79	3.53	6.12	256
2010	35808	11.11	17.65	25.65	37.90	2.52	3.66	5.41	310
2011	37802	10.36	16.35	22.29	32.00	2.48	3.38	4.85	274
2012	38197	11.07	20.01	27.14	40.87	2.89	3.92	5.91	290
Average	**33097**	**9.64**	**15.69**	**21.90**	**32.56**	**2.32**	**3.23**	**4.80**	**292**

Table B-3
Tri-City WPCP
Influent Flow Characterization

Average Annual

Year	Resident Service Area EDUs	Historical Average Annual Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Annual Flow per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835	8.07	15.12	19.83	30.21	2.54	3.33	5.08	232
2009	34552	8.78	12.61	24.88	43.14	1.69	3.33	5.78	254
2010	35808	10.55	17.65	25.65	37.90	2.11	3.06	4.53	295
2011	37802	9.40	16.35	22.29	32.00	2.30	3.13	4.49	249
2012	38197	10.29	20.01	27.14	40.87	2.63	3.57	5.38	269
Average	**36239**	**9.42**	**16.35**	**23.96**	**36.82**	**2.25**	**3.29**	**5.05**	**260**

Summer Season

Year	Resident Service Area EDUs	Historical Summer Season Flows (mgd)				Historical Peaking Factors From Average			Flow per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835	5.95	8.27	8.47	9.67	1.39	1.42	1.63	171
2009	34552	7.47	9.65	13.13	16.21	1.29	1.76	2.17	216
2010	35808	8.37	13.43	17.27	20.76	1.60	2.06	2.48	234
2011	37802	7.12	11.76	10.22	11.05	1.65	1.44	1.55	188
2012	38197	7.60	11.47	12.39	17.38	1.51	1.63	2.29	199
Average	**36239**	**7.30**	**10.92**	**12.30**	**15.01**	**1.49**	**1.66**	**2.02**	**202**

Winter Season

Year	Resident Service Area EDUs	Historical Winter Season Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Flow per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835	10.22	15.12	19.83	30.21	2.54	3.33	5.08	293
2009	34552	10.11	12.61	24.88	43.14	1.69	3.33	5.78	293
2010	35808	12.78	17.65	25.65	37.90	2.11	3.06	4.53	357
2011	37802	11.72	16.35	22.29	32.00	2.30	3.13	4.49	310
2012	38197	13.00	20.01	27.14	40.87	2.63	3.57	5.38	340
Average	**36239**	**11.57**	**16.35**	**23.96**	**36.82**	**2.25**	**3.29**	**5.05**	**319**

Table B-4
Tri-City WPCP
Influent Flow Characterization

Average Annual

Year	Resident Service Area EDUs	Historical Average Annual Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Annual Flow per EDU
		Median	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835	6.56	15.12	19.83	30.21	2.69	3.52	5.37	188
2009	34552	7.45	12.61	24.88	43.14	1.79	3.53	6.12	216
2010	35808	9.36	17.65	25.65	37.90	2.52	3.66	5.41	261
2011	37802	8.05	16.35	22.29	32.00	2.48	3.38	4.85	213
2012	38197	8.87	20.01	27.14	40.87	2.89	3.92	5.91	232
Average	**36239**	**8.06**	**16.35**	**23.96**	**36.82**	**2.47**	**3.60**	**5.53**	**222**

Summer Season

Year	Resident Service Area EDUs	Historical Summer Season Flows (mgd)				Historical Peaking Factors From Average			Flow per EDU
		Median	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835	5.63	8.27	8.47	9.67	1.47	1.50	1.72	162
2009	34552	7.05	9.65	13.13	16.21	1.37	1.86	2.30	204
2010	35808	7.00	13.43	17.27	20.76	1.92	2.47	2.97	195
2011	37802	6.60	11.76	10.22	11.05	1.78	1.55	1.67	175
2012	38197	6.92	11.47	12.39	17.38	1.66	1.79	2.51	181
Average	**36239**	**6.64**	**10.92**	**12.30**	**15.01**	**1.64**	**1.83**	**2.23**	**183**

Winter Season

Year	Resident Service Area EDUs	Historical Winter Season Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Flow per EDU
		Median	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835	8.61	15.12	19.83	30.21	2.69	3.52	5.37	247
2009	34552	8.83	12.61	24.88	43.14	1.79	3.53	6.12	256
2010	35808	11.11	17.65	25.65	37.90	2.52	3.66	5.41	310
2011	37802	10.36	16.35	22.29	32.00	2.48	3.38	4.85	274
2012	38197	11.07	20.01	27.14	40.87	2.89	3.92	5.91	290
Average	**36239**	**10.00**	**16.35**	**23.96**	**36.82**	**2.47**	**3.60**	**5.53**	**275**

Table B-5
Tri-City WPCP
Dry Weather Flow Evaluation

Monthly Average

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd) June	July	August	Sept	Oct	Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
2000	30231	6.57	7.13	6.97	6.75	7.10	6.90	6.57	228	217
2001	31031	7.12	7.22	7.20	6.85	7.57	7.19	6.85	232	221
2002	30471	8.03	7.36	7.36	7.46	6.08	7.26	6.08	238	200
2003	30494	7.00	6.79	6.87	6.84	7.02	6.90	6.79	226	223
2004	30830	7.20	6.85	7.69	7.24	7.93	7.38	6.85	239	222
2005	30987	7.83	7.08	6.82	6.61	7.44	7.16	6.61	231	213
2006	31931	7.34	6.84	7.13	6.81	6.09	6.84	6.09	214	191
2007	33097	5.80	5.71	5.66	6.06	8.26	6.30	5.66	190	171
2008	34835	6.55	5.56	5.65	5.37	5.63	5.75	5.37	165	154
2009	34552	7.08	6.87	7.12	6.88	7.34	7.06	6.87	204	199
2010	35808	11.18	6.76	6.74	7.15	8.32	8.03	6.74	224	188
2011	37802	7.65	6.63	6.39	6.45	6.72	6.77	6.39	179	169
2012	38197	8.07	6.57	6.51	6.62	8.94	7.34	6.51	192	170
Average	**33097**	**7.49**	**6.72**	**6.78**	**6.70**	**7.26**	**6.99**	**6.41**	**213**	**195**

Monthly Median

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd) June	July	August	Sept	Oct	Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
2000	30231	6.41	7.30	6.89	6.70	6.68	6.80	6.41	225	212
2001	31031	6.97	7.26	7.12	6.83	6.88	7.01	6.83	226	220
2002	30471	7.81	7.23	7.35	7.40	5.73	7.10	5.73	233	188
2003	30494	6.98	6.80	6.86	6.94	7.00	6.92	6.80	227	223
2004	30830	6.92	6.85	7.28	7.16	7.74	7.19	6.85	233	222
2005	30987	7.75	7.09	6.85	6.45	7.06	7.04	6.45	227	208
2006	31931	7.20	6.82	7.25	6.77	6.06	6.82	6.06	214	190
2007	33097	5.75	5.68	5.58	5.93	7.39	6.07	5.58	183	169
2008	34835	6.15	5.56	5.48	5.32	5.52	5.61	5.32	161	153
2009	34552	6.95	6.95	7.08	6.77	7.01	6.95	6.77	201	196
2010	35808	10.20	6.75	6.75	6.99	7.09	7.56	6.75	211	189
2011	37802	7.09	6.50	6.39	6.44	6.67	6.62	6.39	175	169
2012	38197	7.74	6.60	6.48	6.51	8.34	7.13	6.48	187	170
Average	**33097**	**7.22**	**6.72**	**6.72**	**6.63**	**6.86**	**6.83**	**6.34**	**208**	**193**

Monthly Minimum

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd) June	July	August	Sept	Oct	Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
2000	30231	6.02	5.96	6.50	6.24	6.20	6.18	5.96	205	197
2001	31031	6.66	6.60	6.62	6.38	6.56	6.56	6.38	212	206
2002	30471	7.45	6.68	6.67	6.95	4.95	6.54	4.95	215	162
2003	30494	6.63	6.23	6.57	6.07	5.65	6.23	5.65	204	185
2004	30830	6.57	6.26	6.60	6.56	6.87	6.57	6.26	213	203
2005	30987	5.97	6.73	6.02	6.01	6.29	6.20	5.97	200	193
2006	31931	6.50	6.28	6.43	6.41	5.03	6.13	5.03	192	158
2007	33097	5.48	5.17	5.15	5.37	6.25	5.48	5.15	166	156
2008	34835	5.42	5.21	5.11	5.06	5.27	5.21	5.06	150	145
2009	34552	6.65	6.49	6.60	6.04	6.44	6.44	6.04	187	175
2010	35808	6.77	6.09	6.41	6.26	6.38	6.38	6.09	178	170
2011	37802	6.46	6.05	6.02	5.82	5.90	6.05	5.82	160	154
2012	38197	7.02	5.65	6.05	6.09	6.29	6.22	5.65	163	148
Average	**33097**	**6.43**	**6.11**	**6.21**	**6.10**	**6.01**	**6.17**	**5.69**	**188**	**173**

Table B-6
Tri-City WPCP
Dry Weather Flow Evaluation

Monthly Average

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd)					Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
		June	July	August	Sept	Oct				
2008	34835	6.55	5.56	5.65	5.37	5.63	5.75	5.37	165	154
2009	34552	7.08	6.87	7.12	6.88	7.34	7.06	6.87	204	199
2010	35808	11.18	6.76	6.74	7.15	8.32	8.03	6.74	224	188
2011	37802	7.65	6.63	6.39	6.45	6.72	6.77	6.39	179	169
2012	38197	8.07	6.57	6.51	6.62	8.94	7.34	6.51	192	170
Average	**36239**	**8.11**	**6.48**	**6.48**	**6.49**	**7.39**	**6.99**	**6.38**	**193**	**176**

Monthly Median

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd)					Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
		June	July	August	Sept	Oct				
2008	34835.053	6.15	5.56	5.48	5.32	5.52	5.61	5.32	161	153
2009	34551.6835	6.95	6.95	7.08	6.77	7.01	6.95	6.77	201	196
2010	35808.2412	10.20	6.75	6.75	6.99	7.09	7.56	6.75	211	189
2011	37801.6958	7.09	6.50	6.39	6.44	6.67	6.62	6.39	175	169
2012	38197.3689	7.74	6.60	6.48	6.51	8.34	7.13	6.48	187	170
Average	**36239**	**7.63**	**6.47**	**6.44**	**6.41**	**6.93**	**6.77**	**6.34**	**187**	**175**

Monthly Minimum

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd)					Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
		June	July	August	Sept	Oct				
2008	34835	5.42	5.21	5.11	5.06	5.27	5.21	5.06	150	145
2009	34552	6.65	6.49	6.60	6.04	6.44	6.44	6.04	187	175
2010	35808	6.77	6.09	6.41	6.26	6.38	6.38	6.09	178	170
2011	37802	6.46	6.05	6.02	5.82	5.90	6.05	5.82	160	154
2012	38197	7.02	5.65	6.05	6.09	6.29	6.22	5.65	163	148
Average	**36239**	**6.46**	**5.90**	**6.04**	**5.85**	**6.06**	**6.06**	**5.73**	**167**	**158**

Table B-7
Tri-City WPCP
Dry Weather Flow Evaluation

Monthly Average

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd) June	July	August	Sept	Oct	Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
2000	30231		7.13	6.97	6.75		6.95	6.75	230	223
2001	31031		7.22	7.20	6.85		7.09	6.85	228	221
2002	30471		7.36	7.36	7.46		7.39	7.36	243	242
2003	30494		6.79	6.87	6.84		6.83	6.79	224	223
2004	30830		6.85	7.69	7.24		7.26	6.85	235	222
2005	30987		7.08	6.82	6.61		6.84	6.61	221	213
2006	31931		6.84	7.13	6.81		6.93	6.81	217	213
2007	33097		5.71	5.66	6.06		5.81	5.66	176	171
2008	34835		5.56	5.65	5.37		5.53	5.37	159	154
2009	34552		6.87	7.12	6.88		6.96	6.87	201	199
2010	35808		6.76	6.74	7.15		6.88	6.74	192	188
2011	37802		6.63	6.39	6.45		6.49	6.39	172	169
2012	38197		6.57	6.51	6.62		6.57	6.51	172	170
Average	**33097**		**6.72**	**6.78**	**6.70**		**6.73**	**6.58**	**205**	**201**

Monthly Median

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd) June	July	August	Sept	Oct	Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
2000	30231		7.30	6.89	6.70		6.96	6.70	230	222
2001	31031		7.26	7.12	6.83		7.07	6.83	228	220
2002	30471		7.23	7.35	7.40		7.33	7.23	240	237
2003	30494		6.80	6.86	6.94		6.87	6.80	225	223
2004	30830		6.85	7.28	7.16		7.10	6.85	230	222
2005	30987		7.09	6.85	6.45		6.80	6.45	219	208
2006	31931		6.82	7.25	6.77		6.95	6.77	218	212
2007	33097		5.68	5.58	5.93		5.73	5.58	173	169
2008	34835		5.56	5.48	5.32		5.45	5.32	157	153
2009	34552		6.95	7.08	6.77		6.93	6.77	201	196
2010	35808		6.75	6.75	6.99		6.83	6.75	191	189
2011	37802		6.50	6.39	6.44		6.44	6.39	170	169
2012	38197		6.60	6.48	6.51		6.53	6.48	171	170
Average	**33097**		**6.72**	**6.72**	**6.63**		**6.69**	**6.53**	**204**	**199**

Monthly Minimum

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd) June	July	August	Sept	Oct	Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
2000	30231		5.96	6.50	6.24		6.23	5.96	206	197
2001	31031		6.60	6.62	6.38		6.53	6.38	211	206
2002	30471		6.68	6.67	6.95		6.77	6.67	222	219
2003	30494		6.23	6.57	6.07		6.29	6.07	206	199
2004	30830		6.26	6.60	6.56		6.47	6.26	210	203
2005	30987		6.73	6.02	6.01		6.25	6.01	202	194
2006	31931		6.28	6.43	6.41		6.37	6.28	200	197
2007	33097		5.17	5.15	5.37		5.23	5.15	158	156
2008	34835		5.21	5.11	5.06		5.13	5.06	147	145
2009	34552		6.49	6.60	6.04		6.38	6.04	185	175
2010	35808		6.09	6.41	6.26		6.25	6.09	175	170
2011	37802		6.05	6.02	5.82		5.96	5.82	158	154
2012	38197		5.65	6.05	6.09		5.93	5.65	155	148
Average	**33097**		**6.11**	**6.21**	**6.10**		**6.14**	**5.96**	**187**	**182**

Table B-8
Tri-City WPCP
Dry Weather Flow Evaluation

Monthly Average

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd)					Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
		June	July	August	Sept	Oct				
2008	34835		5.56	5.65	5.37		5.53	5.37	159	154
2009	34552		6.87	7.12	6.88		6.96	6.87	201	199
2010	35808		6.76	6.74	7.15		6.88	6.74	192	188
2011	37802		6.63	6.39	6.45		6.49	6.39	172	169
2012	38197		6.57	6.51	6.62		6.57	6.51	172	170
Average	**36239**		**6.48**	**6.48**	**6.49**		**6.48**	**6.38**	**179**	**176**

Monthly Median

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd)					Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
		June	July	August	Sept	Oct				
2008	34835.1		5.56	5.48	5.32		5.45	5.32	157	153
2009	34551.7		6.95	7.08	6.77		6.93	6.77	201	196
2010	35808.2		6.75	6.75	6.99		6.83	6.75	191	189
2011	37801.7		6.50	6.39	6.44		6.44	6.39	170	169
2012	38197.4		6.60	6.48	6.51		6.53	6.48	171	170
Average	**36239**		**6.47**	**6.44**	**6.41**		**6.44**	**6.34**	**178**	**175**

Monthly Minimum

Year	Resident Service Area EDUs	Dry Weather Flows Monthly Average (mgd)					Monthly Average	Min Month	Monthly Average Flow per EDU	Min Month per EDU
		June	July	August	Sept	Oct				
2008	34835		5.21	5.11	5.06		5.13	5.06	147	145
2009	34552		6.49	6.60	6.04		6.38	6.04	185	175
2010	35808		6.09	6.41	6.26		6.25	6.09	175	170
2011	37802		6.05	6.02	5.82		5.96	5.82	158	154
2012	38197		5.65	6.05	6.09		5.93	5.65	155	148
Average	**36239**		**5.90**	**6.04**	**5.85**		**5.93**	**5.73**	**164**	**158**

ATTACHMENT C
Determine 10-yr Summer & 5-yr Winter Rainfall

Attachment C
Tri-City WPCP
Determine 10-yr Summer & 5-yr Winter Rainfall

Background

The ODEQ criteria for determining the Maximum Month Wet Weather and Maximum Month Dry Weather rainfalls is to use the Climatography No. 20 for the local weather station. The Oregon City weather station has data in Climatography No. 20. In addition to this data, the rainfall data for the WWTP were evaluated and a probability of monthly precipitation was developed. This analysis was compared to the Oregon City weather station data. This evaluation was done to provide the best fit for rainfall data that is representative of the treatment plant.

Evaluation

In this evaluation, the rainfall for the treatment plant for the period 1990 - 2012 was evaluated against the Oregon City weather station Climatography No. 20 statistics. These statistics were evaluated to determine the 10-year summer and 5-year winter storms for the Tri-City service area, as specified in the DEQ Guidelines.

STEP 1: Review Monthly Average Daily Flows

Year	Summer Season		Winter Season		
	May	Oct	January	November	December
2000	7.40	6.75	10.59	7.53	9.11
2001	7.72	7.57	7.40	11.28	15.95
2002	7.51	6.08	14.26	6.28	10.75
2003	7.35	7.02	12.85	8.42	14.44
2004	6.60	7.93	13.68	8.23	9.81
2005	9.88	7.44	8.26	10.95	14.25
2006	7.87	6.09	20.50	16.15	13.02
2007	6.83	8.26	10.96	9.11	15.13
2008	6.88	5.63	14.72	8.02	9.82
2009	9.49	7.34	12.41	11.27	11.09
2010	10.10	6.72	14.44	12.76	17.61
2011	8.85	6.72	13.66	9.65	8.57
2012	8.99	8.94	14.98	15.11	19.54
Median	7.72	7.02	13.66	9.65	13.02
Ave	8.11	7.11	12.98	10.37	13.01

STEP 2: Determine Statistical 5-year Winter and 10-year Summer Monthly Rainfalls

Station	Statistical Rainfall Events			
	Winter		Summer	
	May	Oct	Dec	Jan
Tri-City WPCP	3.97	4.68	7.02	8.31
Oregon City, OR Station	4.41	6.27	10.08	10.28
Climatograhpy No 20	4.42	6.89	10.91	11.56

Summary

Summer Season - In 12 of the 13 years of study, the May plant flows were higher than the October Flows. The average 5-year summer rainfalls were greater for October. It appears that the higer flows are experienced following the wet season. Therefore, May should be used as the MMDWF month even though the rainfall is higher in October.

Winter Season - In 7 of the 13 years of study, the January flows were higher than the November and December rainfall. The January rainfall is statisticly higer than the December rainfall. Therefore, January will be used for the MMWWF month.

Conclusion

Weather Station

In this analysis, it appears that the Tri-City WPCP weather station receives less rainfall than the Oregon City station. The Oregon City station is most likely more representative of the services area. The statistic for this station are more up-to-date than the Climatography No. 20. Therefore, the probability of monthly rainfall occurrence for the Oregon City, OR weather station that was developed from the historical data will be used for this analysis.

MMDWF

An analysis of rainfall shows that the October is the highest rainfall month. Flows at the treatment plant showed the May flows as the highest month flows over the past thirteen years (2000 - 2012). The highest monthly flow recorded in the 13-year period was in May. Therefore, the lower statistical May monthly rainfall will be used. The May 10-year probable rainfall of 4.41-in for the Oregon City weather station will be used to determine the MMDWF.

MMWWF

An analysis of plant flows shows that January had the highest monthly flow for 12 of the 13 years (2000 - 2012) evaluated. The statistical rainfall for the Oregon City weather station shows that January is the highest rainfall month for the service area. The January 5-year probable rainfall of 10.28-in for the Oregon City weather station will be used to determine the MMWWF.

Table C-1

Tri-City WPCP

PROBABILITY THAT THE MONTHLY PRECIPITATION WILL BE EQUAL TO OR LESS THAN THE INDICATED PRECIPITATION AMOUNT

MONTHLY PRECIPITATION (INCHES)

Probability Level	JAN	FEB	MAR	APR	MAY	JUN	SEP	OCT	NOV	DEC
0.05	1.55	1.23	2.12	1.80	1.01	0.54	0.17	0.94	2.21	2.87
0.1	1.98	1.58	2.84	2.11	1.04	0.66	0.33	1.36	2.37	3.28
0.2	3.76	2.26	3.30	2.21	1.11	0.70	0.71	1.75	3.46	3.66
0.3	4.56	2.46	3.57	2.42	1.21	0.78	0.76	2.17	4.57	4.18
0.4	5.12	2.91	3.82	2.52	1.72	0.82	1.09	2.82	4.79	4.91
0.5	5.45	3.08	3.92	2.62	1.84	1.20	1.23	3.01	4.90	5.94
0.6	5.72	3.63	4.01	2.82	2.55	1.28	1.32	3.36	5.82	6.55
0.7	6.21	4.07	4.88	3.00	2.75	1.53	1.39	3.43	5.85	7.76
0.8	7.02	4.22	6.13	3.41	2.94	2.03	1.50	4.07	6.29	8.31
0.9	8.02	4.53	6.64	3.92	3.97	2.76	1.69	4.68	7.75	8.99
0.95	8.87	4.81	7.70	4.38	4.32	2.95	2.00	5.42	9.21	9.37

NOTES:

1) This table not available in the form of Climatography of the United States No. 20 for this station.
2) This table was developed by taking the respective percentiles for total monthly rainfall data for the years 1994-2008
3) These statistics are from rainfall data taken at the WWTP

Table C-2
Oregon City, OR Station
STATION NO. 356334
PROBABILITY THAT THE MONTHLY PRECIPITATION WILL BE EQUAL TO OR LESS THAN THE INDICATED PRECIPITATION AMOUNT
MONTHLY PRECIPITATION (INCHES)

Probability Level	JAN	FEB	MAR	APR	MAY	JUN	SEP	OCT	NOV	DEC
0.05	1.65	1.33	1.85	1.20	0.61	0.49	0.14	0.60	1.89	3.05
0.1	2.13	2.13	2.93	1.40	0.97	0.64	0.38	1.17	2.50	3.42
0.2	3.50	3.18	3.36	1.80	1.39	0.75	0.62	1.94	3.77	4.21
0.3	5.35	3.64	3.87	2.41	1.75	1.05	1.01	2.74	5.42	5.16
0.4	5.98	4.33	4.36	2.66	2.11	1.41	1.21	3.22	6.20	6.58
0.5	7.69	4.51	4.94	3.40	2.30	1.67	1.58	3.68	6.70	7.39
0.6	8.65	4.94	5.34	3.69	2.57	1.95	1.72	4.14	7.34	8.56
0.7	9.17	5.53	5.86	4.02	3.28	2.09	2.36	4.62	7.89	9.51
0.8	10.08	6.70	6.31	4.77	3.91	2.46	3.02	5.65	9.65	10.28
0.9	11.38	8.22	7.19	5.58	4.41	3.44	3.77	6.27	11.32	11.44
0.95	13.64	8.99	8.07	5.85	4.99	3.79	3.85	7.27	12.41	12.71

NOTES:
1) This table not available in the form of Climatography of the United States No. 20 for this station.
2) Data for period 1971 - 2008

Table C-3
Oregon City Rain Gage Climatography of the United States No. 20

CLIMATOGRAPHY OF THE UNITED STATES NO. 20

OREGON CITY, OR

PERIOD: 1951-80
ELEVATION: 167 FT

CLIMATOLOGICAL SUMMARY

	TEMPERATURE (F)															PRECIPITATION TOTALS (INCHES)											
	MEANS			EXTREMES						MEAN NUMBER OF DAYS				DEGREE DAYS		*	*					SNOW			MEAN NUMBER OF DAYS		
										MAX		MIN															
	* DAILY MAXIMUM	* DAILY MINIMUM	* MONTHLY	RECORD HIGHEST	YEAR	DAY	RECORD LOWEST	YEAR	DAY	90 AND ABOVE	32 AND BELOW	32 AND BELOW	0 AND BELOW	* HEATING BASE 65	* COOLING BASE 65	MEAN	GREATEST MONTHLY	YEAR	GREATEST DAILY	YEAR	DAY	MEAN	MAXIMUM MONTHLY	YEAR	.10 OR MORE	.50 OR MORE	1.00 OR MORE
JAN	45.9	34.4	40.2	64+	58	15	9+	57	27	0	2	12	0	769	0	8.11	16.77	53	2.86	74	15	2.7	18.9	69	14	5	2
FEB	51.7	36.9	44.3	73+	68	29	13+	79	2	0	0	7	0	580	0	5.14	11.74	61	3.13	68	19	.4	5.2	62	11	3	1
MAR	55.5	38.0	46.8	77+	64	29	22	71	1	0	0	5	0	564	0	4.99	9.43	57	2.09	63	29	.7	11.2	51	12	3	1
APR	62.0	41.1	51.5	91+	57	29	28+	72	2	0	0	1	0	405	0	3.37	9.44	69	2.20	69	18	.0	.0		8	2	0
MAY	69.4	46.1	57.8	96	63	20	31+	54	1	1	0	0	0	232	9	2.64	5.80	60	1.58	63	06	.0	.0		7	1	0
JUN	75.1	51.3	63.3	99+	61	17	37+	76	3	2	0	0	0	107	56	1.87	4.48	69	1.93	69	23	.0	.0		4	1	0
JUL	82.4	54.4	68.4	107	56	19	41+	76	2	6	0	0	0	23	129	.56	2.82	74	.99	74	08	.0	.0		2	0	0
AUG	81.2	54.3	67.8	106+	77	17	41+	51	29	5	0	0	0	44	131	1.24	4.95	68	2.43	56	25	.0	.0		3	1	0
SEP	76.1	51.1	63.6	101+	58	7	33+	65	17	2	0	0	0	98	56	2.08	4.50	69	1.86	51	30	.0	.0		4	1	0
OCT	64.8	45.0	54.9	94	70	3	24+	71	28	0	0	1	0	313	0	3.79	7.69	56	2.40	55	09	.0	.0		9	2	1
NOV	53.4	39.2	46.3	73	70	2	9+	55	15	0	0	5	0	561	0	6.59	14.21	73	3.35	60	24	.2	2.0	78	12	4	2
DEC	47.5	36.1	41.8	66+	80	30	6+	64	17	0	1	8	0	719	0	8.02	14.78	64	3.22	64	22	1.2	13.6	68	14	6	2
YEAR	63.8	44.0	53.9	107	JUL 56	19	6	DEC 64	17	16	3	39	0	4415	381	48.40	16.77	JAN 53	3.35	NOV 60	24	5.2	18.9	JAN 69	100	29	9

*FROM 1951-80 NORMALS

ESTIMATED VALUE BASED ON DATA FROM SURROUNDING STATIONS

+ ALSO ON EARLIER DATES.

DEGREE DAYS TO SELECTED BASE TEMPERATURES (F)

BASE	HEATING DEGREE DAYS												
BELOW	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
65	769	580	564	405	232	107	23	44	98	313	561	719	4415
60	614	440	409	259	113	37	0	10	30	166	411	564	3053
57	521	356	316	177	64	15	0	0	12	93	321	471	2346
55	466	305	260	129	38	8	0	0	6	58	267	409	1946
50	324	181	130	46	7	0	0	0	0	8	140	262	1098

BASE	COOLING DEGREE DAYS												
ABOVE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
55	7	5	6	24	125	257	415	397	264	55	6	0	1561
57	0	0	0	12	89	204	353	339	210	28	0	0	1235
60	0	0	0	0	45	136	264	252	138	7	0	0	842
65	0	0	0	0	9	56	129	131	56	0	0	0	381
70	0	0	0	0	0	13	43	52	12	0	0	0	120

DERIVED FROM THE 1951-80 MONTHLY NORMALS

PROBABILITY THAT THE MONTHLY PRECIPITATION WILL BE EQUAL TO OR LESS THAN THE INDICATED PRECIPITATION AMOUNT

MONTHLY PRECIPITATION (INCHES)

PROBABILITY LEVELS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.05	2.22	1.95	2.16	.88	.90	.34	.00	.00	.14	.93	1.86	2.96
.10	2.99	2.43	2.61	1.19	1.15	.51	.00	.00	.35	1.29	2.49	3.71
.20	4.16	3.11	3.24	1.68	1.51	.78	.04	.12	.68	1.84	3.44	4.79
.30	5.18	3.68	3.75	2.11	1.82	1.04	.12	.29	.99	2.33	4.26	5.70
.40	6.18	4.23	4.23	2.54	2.12	1.30	.22	.49	1.31	2.82	5.06	6.56
.50	7.23	4.78	4.72	2.98	2.42	1.58	.34	.74	1.66	3.33	5.91	7.43
.60	8.40	5.38	5.24	3.48	2.75	1.90	.48	1.06	2.07	3.91	6.84	8.39
.70	9.77	6.08	5.83	4.07	3.14	2.28	.67	1.48	2.57	4.59	7.93	9.50
.80	11.56	6.97	6.58	4.83	3.64	2.80	.95	2.07	3.24	5.48	9.36	10.91
.90	14.37	8.33	7.73	6.04	4.42	3.62	1.41	3.11	4.34	6.89	11.59	13.09
.95	16.99	9.58	8.77	7.17	5.13	4.41	1.88	4.17	5.41	8.22	13.68	15.09

THESE VALUES WERE DETERMINED FROM THE INCOMPLETE GAMMA DISTRIBUTION.

ATTACHMENT D
Determine Flow Peaking Factors

Attachment D
Tri-City WPCP
Determine Flow Peaking Factors

Background

Peaking factors to establish future flows need to be determined for planning. Two methods were used to determine flow peaking factors. These methods are the ODEQ Guidance and Historical Peaking Factors. This analysis will determine the final values to be used based on the results of the two methods.

Peaking factors can be developed from an evaluation of historical flows. Peaking factors are determined for each variable as follows:
-- Maximum Month Flow (MMF) -- Max. 30-day Average flow / Average Day Dry Weather flow
-- Maximum Week Flow (MWF) -- Max. 7-day Average Flow / Average Day Dry Weather Flow
-- Maximum Day Flow (MDF) -- Max. day flow / Average Day Dry Weather Flow

An analysis of plant flows for the period of time between January 2000 thorough Dec 2012 was performed to determine the historical peaking factors. Data was analyzed for the annual, winter season and summer season conditions.

Evaluation

In this evaluation, the results of the historical Peaking Factors and those developed using the DEQ Methodology were compared.

The dry weather flows (DWF) that is used to determine the peaking factor is the average flow for the period May 1 - Oct 31 as stated in the NPDES Permit. These flows are affected by rainfall, especially in the months of May, June and October. To mitigate the affects of RDII affected flows, the analysis was also done using the median of the plant influent flows for this period.

The peaking factors were calculated for both the 13-year period and recent 5-year period to determine if there were anys system changes that may have affected the peaking factors.

The average peaking factor for each period as well as the maximum peaking factor were determined. Typically, the maximum peaking factor for a period is used as that demonstrates the worst case flow. In the 5-year and 13-year data sets, the maximum month flows are to be based on a 5-year and 10-year event for winter and summer, respectively. Therefore, the maximum peaking factors are the peaking factors to be used.

Method	Average DWF			Median DWF		
	MMDWF	MMWWF	Max Day	MMDWF	MMWWF	Max Day
Historical						
Average						
2000 - 2012	1.36	2.19	4.54	1.44	2.32	4.80
2008 - 2012	1.49	2.25	5.05	1.64	2.47	5.53
Median						
2000 - 2012	1.33	2.11	4.86	1.43	2.47	5.37
90 percentile						
2000 - 2012	1.59	2.61	5.62	1.76	2.85	5.87
Maximum						
2000 - 2012	1.65	2.98	5.78	1.92	3.00	6.12
DEQ						
2000 - 2012	1.55	2.35		1.70	2.55	5.87

Conclusion

The peaking factors calculated from the historical data for the period 2000 - 1013 were determined. All peaking factors have been based on the dry weather flow, not the dry season flow. The dry weather flow is the low flow period not affected by RDII in July, August and September. The values for the previous 5-year period 2008 - 2012 were used because they included the affects of the Intertie I project where flows were diverted to Tri-City WPCP by the Withicome PS in 2009. The values developed for MMDWF, MMWWF and Peak Day Flow using the DEQ Methodology were used for those values.

All peaking factors are based on the average of the median dry season flow (average dry weather flow) for the most recent 5-year period 2008-2012. This value is 6.64-mgd.

MMDWF = 1.70 --- Follows DEQ criteria for the data set from 2008 - 2012, but using the median dry season flow instead of the average dry season flow. This value is higher than the average of the MMDWF peaking factor based on average DWF for the period 2000 - 2012 of 1.55. The value for the most recent 5-year period was used as it included addional flows from the diversion and the median was used as it better represents the true dry weather flow as determined in Attachment B.

MMWWF = 2.55 --- Follows DEQ criteria for the data set from 2008 - 2012. This was lower than the 90% value from 2006 which was skewed by an abnormal flow event. This value also is slightly higher than the historical average peaking factor of 2.32.

PDF or Max. Day Q = 5.87 --- Fits DEQ methodology and is fairly consistent with the Histroical data for the study period.

PHF = 8.4 -- The Peak Hour Peaking Factor is determined by dividing the peak hour flow of 56.1-mgd by the average dry weather flow of 6.64-mgd resulting in a peaking factor of 8.4.

Flow Peaking Factors

Variable	Max Month	Max Week	Max Day	Peak Hour
Ave Annual	2.47	3.60	5.53	
Dry Season	1.70	1.83	2.23	
Wet Season	2.55	3.60	5.87	7.20

Table D-1
Tri-City WPCP
Statistical Peaking Factor Evaluation

Based on Average Dry Season Flows

Year	ADWF	MMDWF	MMDW Peaking Factor	MMWWF	MMWW Peaking Factor	Max Day Q	MD Peaking Factor
2000	6.99	7.77	1.11	11.38	1.63	19.52	2.79
2001	7.28	9.10	1.25	17.50	2.40	26.06	3.58
2002	7.30	8.65	1.18	14.60	2.00	27.89	3.82
2003	6.98	10.69	1.53	14.58	2.09	39.61	5.67
2004	7.24	7.90	1.09	13.68	1.89	19.37	2.68
2005	7.61	10.13	1.33	14.31	1.88	40.49	5.32
2006	7.02	10.09	1.44	20.89	2.98	34.14	4.86
2007	6.39	8.43	1.32	15.27	2.39	32.04	5.01
2008	5.95	8.27	1.39	15.12	2.54	30.21	5.08
2009	7.47	9.65	1.29	12.61	1.69	43.14	5.78
2010	8.37	13.43	1.60	17.65	2.11	37.90	4.53
2011	7.12	11.76	1.65	16.35	2.30	32.00	4.49
2012	7.60	11.47	1.51	20.01	2.63	40.87	5.38
Average							
2000 - 2012	7.18	9.80	1.36	15.69	2.19	32.56	4.54
2008 - 2012	7.30	10.92	1.49	16.35	2.25	36.82	5.05
Median							
2000 - 2012	7.24	9.65	1.33	15.12	2.11	32.04	4.86
90 Percentile							
2000 - 2012	7.61	11.70	1.59	19.54	2.61	40.79	5.62
Maximum							
2000 - 2012	8.37	13.43	1.65	20.89	2.98	43.14	5.78

Based on Median Dry Weather Flows

Year	Median DWF	MMDWF	MM Peaking Factor	MWWF	MW Peaking Factor	Max Day Q	MD Peaking Factor
2000	6.82	7.77	1.14	11.38	1.67	19.52	2.86
2001	7.08	9.10	1.29	17.50	2.47	26.06	3.68
2002	7.38	8.65	1.17	14.60	1.98	27.89	3.78
2003	6.93	10.69	1.54	14.58	2.10	39.61	5.72
2004	7.00	7.90	1.13	13.68	1.95	19.37	2.77
2005	7.10	10.13	1.43	14.31	2.02	40.49	5.70
2006	6.97	10.09	1.45	20.89	3.00	34.14	4.90
2007	5.93	8.43	1.42	15.27	2.58	32.04	5.40
2008	5.63	8.27	1.47	15.12	2.69	30.21	5.37
2009	7.05	9.65	1.37	12.61	1.79	43.14	6.12
2010	7.00	13.43	1.92	17.65	2.52	37.90	5.41
2011	6.60	11.76	1.78	16.35	2.48	32.00	4.85
2012	6.92	11.47	1.66	20.01	2.89	40.87	5.91
Average							
2000 - 2012	6.80	9.80	1.44	15.69	2.32	32.56	4.80
2008 - 2012	6.64	10.92	1.64	16.35	2.47	36.82	5.53
Median							
2000 - 2012	6.97	9.65	1.43	15.12	2.47	32.04	5.37
90 Percentile							
2000 - 2012	7.10	11.70	1.76	19.54	2.85	40.79	5.87
Maximum							
2000 - 2012	7.38	13.43	1.92	20.89	3.00	43.14	6.12
2008 - 2012	7.05	13.43	1.92	20.01	2.89	43.14	6.12

Table D-2
Tri-City WPCP
Influent Flow Characterization

Average Annual

Year	Resident Service Area Population	Historical Average Annual Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Annual Flow per Capita
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	31064	8.09	11.38	15.55	19.52	1.63	2.22	2.79	260
2001	31891	8.71	17.50	22.99	26.06	2.40	3.16	3.58	273
2002	31353	8.99	14.60	18.94	27.89	2.00	2.59	3.82	287
2003	30917	9.43	14.58	21.61	39.61	2.09	3.10	5.67	305
2004	31133	8.51	13.68	15.97	19.37	1.89	2.21	2.68	273
2005	31581	7.63	14.31	23.87	40.49	1.88	3.14	5.32	242
2006	32252	10.03	20.89	26.26	34.14	2.98	3.74	4.86	311
2007	32782	8.51	15.27	19.77	32.04	2.39	3.09	5.01	260
2008	33619	8.07	15.12	19.83	30.21	2.54	3.33	5.08	240
2009	34715	8.78	12.61	24.88	43.14	1.69	3.33	5.78	253
2010	36346	10.55	17.65	25.65	37.90	2.11	3.06	4.53	290
2011	38605	9.40	16.35	22.29	32.00	2.30	3.13	4.49	243
2012	39011	10.29	20.01	27.14	40.87	2.63	3.57	5.38	264
Average	**33482**	**9.00**	**15.69**	**21.90**	**32.56**	**2.19**	**3.05**	**4.54**	**269**

Summer Season

Year	Resident Service Area Population	Historical Summer Season Flows (mgd)				Historical Peaking Factors From Average			Flow per Capita
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	31064	6.99	7.77	9.17	10.94	1.11	1.31	1.57	225
2001	31891	7.28	9.10	9.31	12.70	1.25	1.28	1.74	228
2002	31353	7.30	8.65	9.00	10.97	1.18	1.23	1.50	233
2003	30917	6.98	10.69	9.88	9.17	1.53	1.42	1.31	226
2004	31133	7.24	7.90	9.26	10.73	1.09	1.28	1.48	233
2005	31581	7.61	10.13	12.40	14.65	1.33	1.63	1.93	241
2006	32252	7.02	10.09	9.21	9.60	1.44	1.31	1.37	218
2007	32782	6.39	8.43	11.63	16.95	1.32	1.82	2.65	195
2008	33619	5.95	8.27	8.47	9.67	1.39	1.42	1.63	177
2009	34715	7.47	9.65	13.13	16.21	1.29	1.76	2.17	215
2010	36346	8.37	13.43	17.27	20.76	1.60	2.06	2.48	230
2011	38605	7.12	11.76	10.22	11.05	1.65	1.44	1.55	184
2012	39011	7.60	11.47	12.39	17.38	1.51	1.63	2.29	195
Average	**33482**	**7.18**	**9.80**	**10.87**	**13.14**	**1.36**	**1.51**	**1.82**	**215**

Winter Season

Year	Resident Service Area Population	Historical Winter Season Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Flow per Capita
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	31064	9.20	11.38	15.55	19.52	1.63	2.22	2.79	296
2001	31891	10.16	17.50	22.99	26.06	2.40	3.16	3.58	319
2002	31353	10.71	14.60	18.94	27.89	2.00	2.59	3.82	342
2003	30917	11.93	14.58	21.61	39.61	2.09	3.10	5.67	386
2004	31133	9.79	13.68	15.97	19.37	1.89	2.21	2.68	314
2005	31581	9.95	14.31	23.87	40.49	1.88	3.14	5.32	315
2006	32252	13.64	20.89	26.26	34.14	2.98	3.74	4.86	423
2007	32782	10.67	15.27	19.77	32.04	2.39	3.09	5.01	325
2008	33619	10.22	15.12	19.83	30.21	2.54	3.33	5.08	304
2009	34715	10.11	12.61	24.88	43.14	1.69	3.33	5.78	291
2010	36346	12.78	17.65	25.65	37.90	2.11	3.06	4.53	352
2011	38605	11.72	16.35	22.29	32.00	2.30	3.13	4.49	304
2012	39011	13.00	20.01	27.14	40.87	2.63	3.57	5.38	333
Average	**33482**	**11.07**	**15.69**	**21.90**	**32.56**	**2.19**	**3.05**	**4.54**	**331**

Table D-3
Tri-City WPCP
Influent Flow Characterization

Average Annual

Year	Resident Service Area Population	Historical Average Annual Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Annual Flow per Capita
		Median	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	31064	7.25	11.38	15.55	19.52	1.67	2.28	2.86	233
2001	31891	7.46	17.50	22.99	26.06	2.47	3.25	3.68	234
2002	31353	7.68	14.60	18.94	27.89	1.98	2.57	3.78	245
2003	30917	7.45	14.58	21.61	39.61	2.10	3.12	5.72	241
2004	31133	7.53	13.68	15.97	19.37	1.95	2.28	2.77	242
2005	31581	7.63	14.31	23.87	40.49	2.02	3.36	5.70	242
2006	32252	8.05	20.89	26.26	34.14	3.00	3.77	4.90	250
2007	32782	7.02	15.27	19.77	32.04	2.58	3.33	5.40	214
2008	33619	6.56	15.12	19.83	30.21	2.69	3.52	5.37	195
2009	34715	7.45	12.61	24.88	43.14	1.79	3.53	6.12	215
2010	36346	9.36	17.65	25.65	37.90	2.52	3.66	5.41	258
2011	38605	8.05	16.35	22.29	32.00	2.48	3.38	4.85	209
2012	39011	8.87	20.01	27.14	40.87	2.89	3.92	5.91	227
Average	**33482**	**7.72**	**15.69**	**21.90**	**32.56**	**2.32**	**3.23**	**4.80**	**231**

Summer Season

Year	Resident Service Area Population	Historical Summer Season Flows (mgd)				Historical Peaking Factors From Average			Flow per Capita
		Median	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	31064	6.82	7.77	9.17	10.94	1.14	1.34	1.60	220
2001	31891	7.08	9.10	9.31	12.70	1.29	1.31	1.79	222
2002	31353	7.38	8.65	9.00	10.97	1.17	1.22	1.49	235
2003	30917	6.93	10.69	9.88	9.17	1.54	1.43	1.32	224
2004	31133	7.00	7.90	9.26	10.73	1.13	1.32	1.53	225
2005	31581	7.10	10.13	12.40	14.65	1.43	1.75	2.06	225
2006	32252	6.97	10.09	9.21	9.60	1.45	1.32	1.38	216
2007	32782	5.93	8.43	11.63	16.95	1.42	1.96	2.86	181
2008	33619	5.63	8.27	8.47	9.67	1.47	1.50	1.72	167
2009	34715	7.05	9.65	13.13	16.21	1.37	1.86	2.30	203
2010	36346	7.00	13.43	17.27	20.76	1.92	2.47	2.97	193
2011	38605	6.60	11.76	10.22	11.05	1.78	1.55	1.67	171
2012	39011	6.92	11.47	12.39	17.38	1.66	1.79	2.51	177
Average	**33482**	**6.80**	**9.80**	**10.87**	**13.14**	**1.44**	**1.60**	**1.94**	**205**

Winter Season

Year	Resident Service Area Population	Historical Winter Season Flows (mgd)				Historical Peaking Factors From Summer Season Flow			Flow per Capita
		Median	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	31064	8.57	11.38	15.55	19.52	1.67	2.28	2.86	276
2001	31891	8.72	17.50	22.99	26.06	2.47	3.25	3.68	273
2002	31353	9.90	14.60	18.94	27.89	1.98	2.57	3.78	316
2003	30917	10.89	14.58	21.61	39.61	2.10	3.12	5.72	352
2004	31133	8.53	13.68	15.97	19.37	1.95	2.28	2.77	274
2005	31581	8.58	14.31	23.87	40.49	2.02	3.36	5.70	272
2006	32252	11.31	20.89	26.26	34.14	3.00	3.77	4.90	351
2007	32782	8.85	15.27	19.77	32.04	2.58	3.33	5.40	270
2008	33619	8.61	15.12	19.83	30.21	2.69	3.52	5.37	256
2009	34715	8.83	12.61	24.88	43.14	1.79	3.53	6.12	254
2010	36346	11.11	17.65	25.65	37.90	2.52	3.66	5.41	306
2011	38605	10.36	16.35	22.29	32.00	2.48	3.38	4.85	268
2012	39011	11.07	20.01	27.14	40.87	2.89	3.92	5.91	284
Average	**33482**	**9.64**	**15.69**	**21.90**	**32.56**	**2.32**	**3.23**	**4.80**	**289**

ATTACHMENT E
Determine 5-yr Winter & 10-yr Summer Flows – DEQ Methodology

Attachment E
Tri-City WPCP
DETERMINE 5-YR WINTER AND 10-YEAR SUMMER FLOWS
DEQ Methodology

Background

DEQ has established guidelines for determining the statistical Max. Month Dry Weather Flow (MMDWF) and Max. Month Wet Weather Flow (MMWWF) for a treatment plant. These guidelines outline a procedure where historical flows and rainfall are used to develop a relationship that is used to determine plant flows based on rainfall.

Flows are developed by creating a scatter plot of the total monthly rainfall against the average monthly flow. A linear regression is performed on this data to develop an equation that represents the system. This regression formula is then used to determine the MMWWF and MMDWF using a probable rainfall. The probable rainfall for the MMDWF is the historical 10-year October monthly rainfall and for the MMWWF it is the 5-year November rainfall (See Attachment C).

An analysis to develop the 5-year rainfall and the 10-year rainfall was performed. The results from this evaluation (Attachment C) were: 10-yr May storm - 4.41-inches, 5-yr January storm 10.28-inches (Oregon City Weather Station 356334).

In this analysis, flow and rainfall data for the period form 2000 - 2012 was used.

Evaluation

The DEQ document is a guideline for performing this analysis. It recommends the use of January - May flow and rainfall data. This is the typical period where rainfall affects flows in Western Oregon. In the case of the Tri-City WPCP, the high RDII experienced in the system affects plant flows during all rainfall events, not just the events when the ground becomes saturated. In addition, the highest "statistical" rainfall month is December, with November the third highest rainfall month. Therefore, rainfall and flow data for the months of November and December were included in this analysis.

In this analysis, plots for each of the study years (Jan - May and Nov - Dec data), for the period 2000 - 2012 and for the period 2008 - 2012 were developed. A regression was developed for each year. In addition, the MMWWF and MMDWF was calculated for each.

In addition, a peaking factor for each, the MMDWF and MMWWF, was calculated using the average dry weather flow (ADWF) of 6.64-mgd for the period of study. The results are as follows:

Calculated from Plot Regressions (DEQ Methodology)

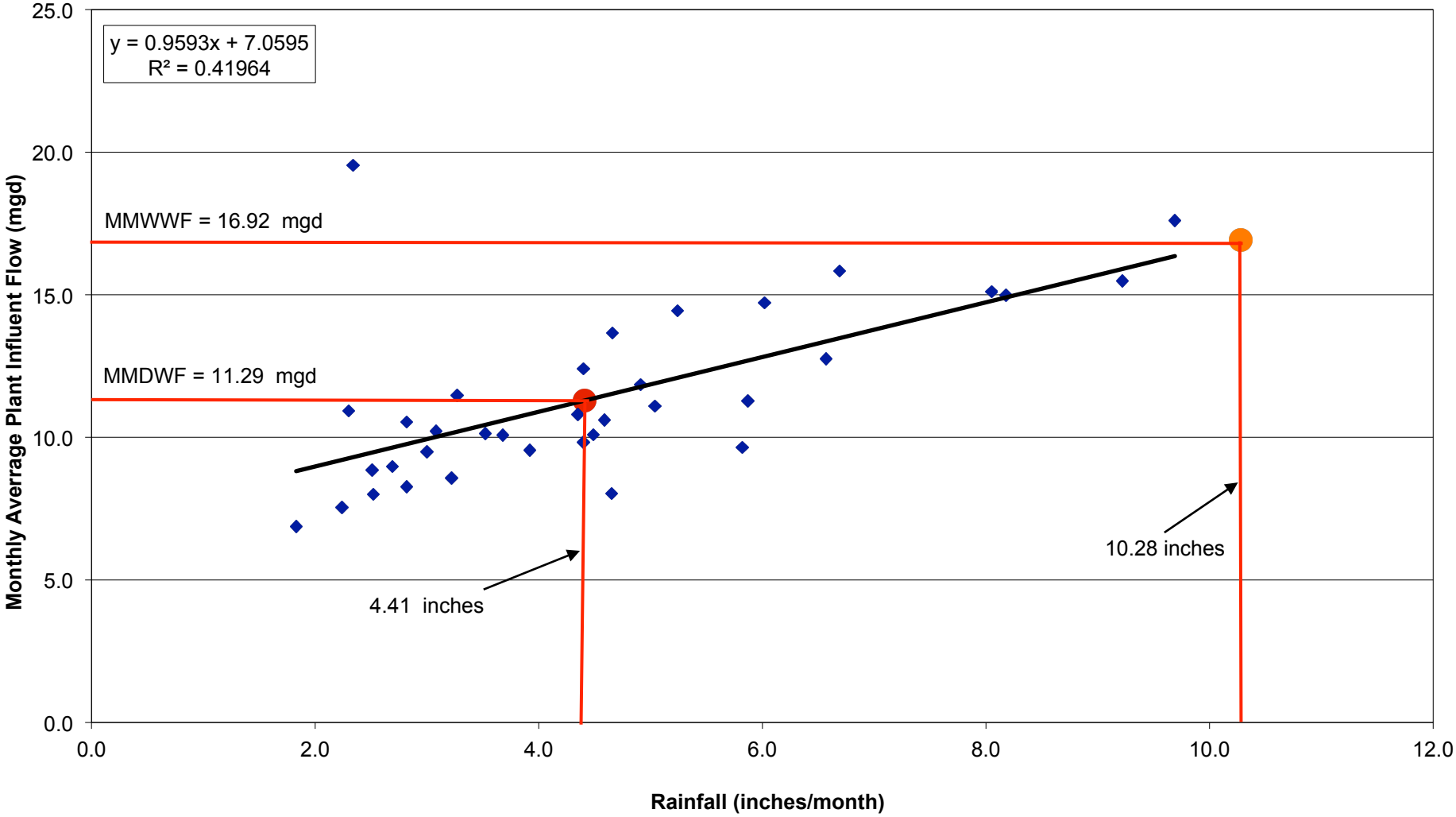
Condition	ADWF	MMDWF	Peaking Factor	MMWWF	Peaking Factor
ADWF Based on May - Oct Average					
2008 - 2012	7.30	11.29	1.55	16.92	2.32
2000 - 2012	7.18	10.93	1.52	16.85	2.35
ADWF Based on May - Oct Median Flow					
2008 - 2012	6.64	11.29	1.70	16.92	2.55
2000 - 2012	6.80	10.93	1.61	16.85	2.48
Annual Based on Summer Season Average Flows					
2000	6.99	9.51	1.36	14.81	2.12
2001	7.28	11.44	1.57	19.22	2.64
2002	7.30	10.35	1.42	14.90	2.04
2003	6.98	10.76	1.54	15.21	2.18
2004	7.24	11.62	1.60	19.61	2.71
2005	7.61	10.47	1.38	15.41	2.03
2006	7.02	11.75	1.67	17.85	2.54
2007	6.39	10.87	1.70	18.07	2.83
2008	5.95	10.55	1.77	17.25	2.90
2009	7.47	10.64	1.42	17.22	2.31
2010	8.37	11.52	1.38	17.85	2.13
2011	7.12	10.99	1.54	18.99	2.67
2012	7.60	13.33	1.75	15.55	2.05

Conclusion

The peaking factors for the 5-year winter (MMWWF) and the 10-year summer (MMDWF) flows were developed using the DEQ methodology for the two periods from 2000 - 2012 and 2008 - 2012. The data for the most recent 5-year period of 2008-2012 was used for the final results. The results for both study periods was similar. The median dry season flow for the same period was used as the base flow to calculate the peaking factor. The conclusions for this analysis are as follows:

- MMDWF = 11.29 mgd
- MMWWF = 16.92 mgd
- MMDWF Peaking Factor = 1.70
- MMWWF Peaking Factor = 2.55

Figure E-1
Tri-City WPCP
Average Plant Flow vs. Winter Rainfall
(Jan - May, Nov - Dec, 2004 - 2008)



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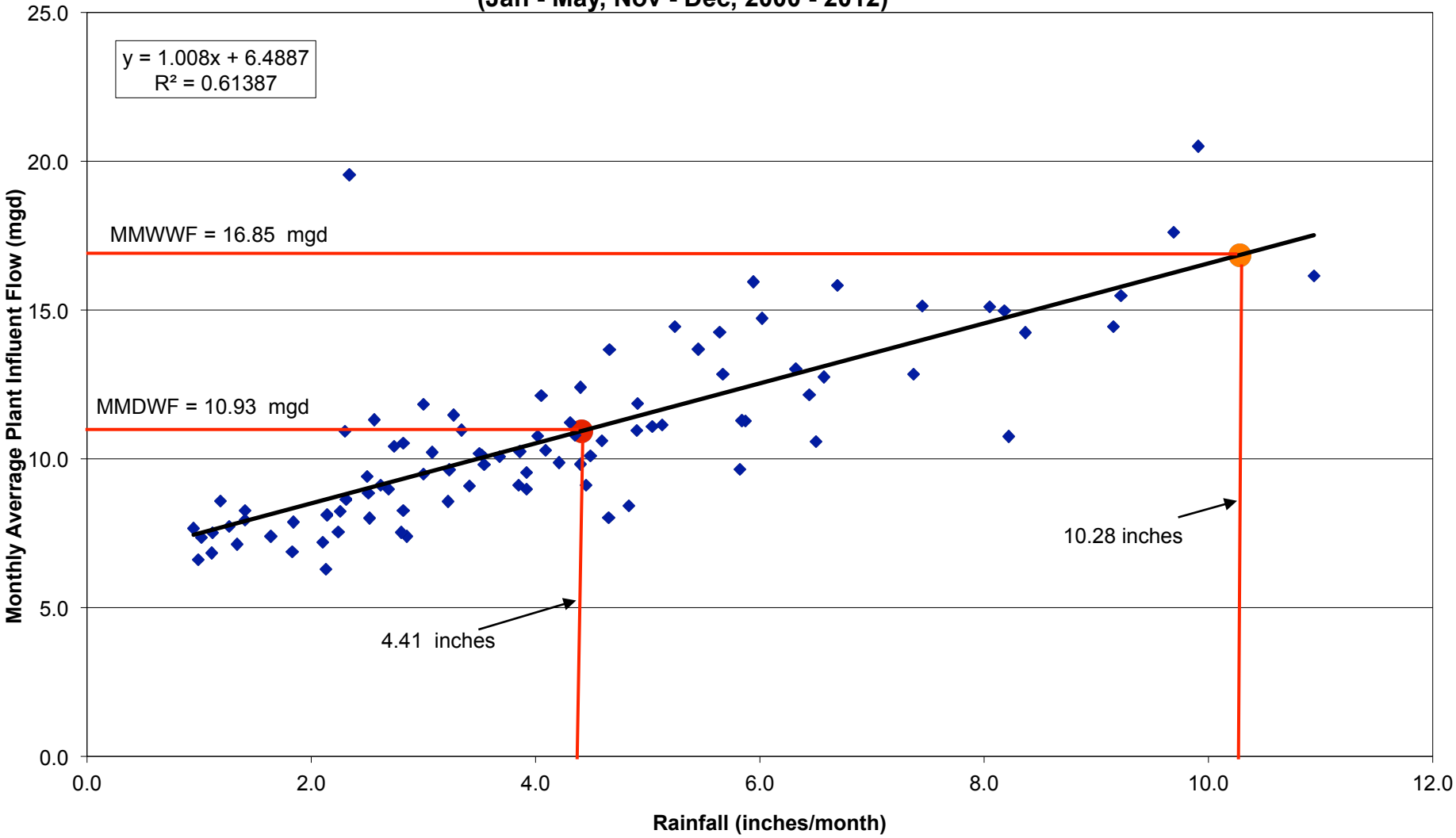
File Name: Attach E - TC 10-Yr Summer & 5-Yr Winter Flows.xls
Sheet Name: Fig E1

Figure E-2
Tri-City WPCP
Average Plant Flow vs. Winter Rainfall
(Jan - May, Nov - Dec, 2000 - 2012)



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File Name: Attach E - TC 10-Yr Summer & 5-Yr Winter Flows.xls
Sheet Name: Fig E2

ATTACHMENT F
Determine Max Day Flow ($PDAF_5$)

Attachment F
Tri-City WPCP
Determine Max Day Flow ($PDAF_5$)

Background

ODEQ has established a procedure for deteriming the probable maximum day flow for a wastewater treatment plant. This is done by using the statistical 5-year, 24-hour storm. The storm is used to calculate a flow using a regression from a scatter plot of the existing peak daily flows and rainfalls that occurred during saturated ground conditions.

In this analysis, a scatter plot of the daily rainfall vs. daily flow was developed for the 13-year period 2000 through 2012 and again for the most recent 5-year period 2008 through 2012. A scatter plot was developed for each case when the rainfall was greater than 0.5-in, 1-in, 1.5-in and 2.0-inches. A linear regression was calculated on each plot and a formula was determined. This formula was used to determine the peak daily flow for the 5-year, 24-hour storm in each case.

5-Year, 24-Hour Duration Storm

The 5-year, 24-hour duration storm (winter and annual storm) can be obtained from NOAA in Atlas 2, Volume X for this region. As shown on the attached map, the 5-yr, 24-hr storm is estimated to be 3.0 inches for this area.

The NOAA maps are not very sensitive, so a detailed analysis of the rainfall received at the Oregon City and Tri-City WPCP weather stations was evaluted. Based on this analyis, it was determined that a 5-yr, 24-hr storm of 2.5-inches best represents the Tri-City Service Area.

Evaluation

The DEQ Methodology suggests using the daily flow data for the months of January through May. In this analysis, the flow data for the period December through May was used because it is more representative of the Tri-City WPCP System with high RDII. See Attachment C.

The results of this analysis for the period 2000 - 2012 is:

Results from DEQ Methodology

2000 - 2012			
0.5-inch	35.20	mgd	Fig 1
1.0-inch	35.45	mgd	Fig 2
1.5-inches	38.63	mgd	Fig 3
2.0-inches	37.45	mgd	Fig 4

In addition, the same analysis was performed only using the flow and rainfall data for the period from 2008 - 2012.

2008 - 2012			
0.5-inch	37.82	mgd	Fig 5
1.0-inch	38.99	mgd	Fig 6
1.5-inches	38.54	mgd	Fig 7
2.0-inches	37.45	mgd	Fig 8

This analysis using the DEQ Methodology shows the highest peak flow when the 1.0-inch and greater rainfall events are included in the data set. The analysis shows that the peak day flow is 39.0-mgd.

Results from Historical Data Evaluation

An evaluation of the data and daily peaking factors was performed for each year between 2000 and 2012. This evaluation is sumamrized in Table F1. The results of this evaluation showed:

Period	Peak Day Flow (mgd)	Rainfall (in)
2000 - 2012	43.14	2.88
2008 - 2012	43.14	2.88

The peak daily flow observed over the 13-year evaluation period was 43.14-mgd in 2009 at a rainfall of 3.88-inches.

Scaling the peak daily flow of 43.14-mgd observed at the plant to the 2.5-inch statistical rainfall results in a flow of 37.45-mgd. This is slightly lower than the result of 38.99-mgd from the DEQ methodology, but is within a reasonable range.

The five highest flows treated at the Tri-City WPCP during the period 2000 - 2013 were evaluated in detail. These flows were:

- 39.61-mgd on January 31, 2003. This flow followed three days of high rainfall of 1.15, 1.06 and 1.14-inches. This high flow event is shown in Figure 9.

- 43.14-mgd on January 1, 2009. This flow occurred with a rainfall of 2.88-inches. This high flow event is shown in Figure 10.

- 29.23-mgd on March 1, 2011. This flow occurred with a rainfall of 1.64-inches. This high flow event is shown in Figure 11.

- 40.87-mgd on January 19, 2012. This flow occurred following three days of heavy rainfall of 1.71, 0.82 and 1.76-inches. This high flow event is shown in Figure 12.

- 39.15-mgd on November 19, 2012. This flow occurred following four days of significant rainfall of 0.63, 0.69, 1.99 and 0.59-inches. This high flow event is shown in Figure 13.

The historical rainfall events shown in Figures 9 - 13, clearly demonstrate the system PDF characteristics determined with the PDF value developed using the DEQ Methodology. This data substantiates a PDF of 39.0-mgd and a 5-yr, 24-hr storm of 2.5-inches.

Conclusion

The 5-year, 24-hour statistical rainfall used in the DEQ analysis was 2.5-inches based on an analysis of the historical rainfall

This calculated PDF using the DEQ statistically derived method is 39.0-mgd using rainfall greater than 1.0-inches for the 2008-2012 period. The peak flow exerienced at the treatment plant over the 13-year study period was 43.14-mgd with a rainfall of 2.88-mgd. This equates to a flow of 37.45-mgd at 2.5-inches of rainfall.

Based on this analysis, the value derived from the DEQ methodology of 39.0-mgd will be used.

The data on Table F-1 shows the median dry season flow for the 2008-2012 period as 6.64-mgd. The daily peaking factor using the peak day flow of 39.0-mgd is 5.87.

Design Peak Daily Flow (PDF) = 39.0-mgd
Design Peak Day Peaking Factor (PDF) = 5.87

Table F-1

Tri-City WPCP

Statistical Peaking Factor Evaluation

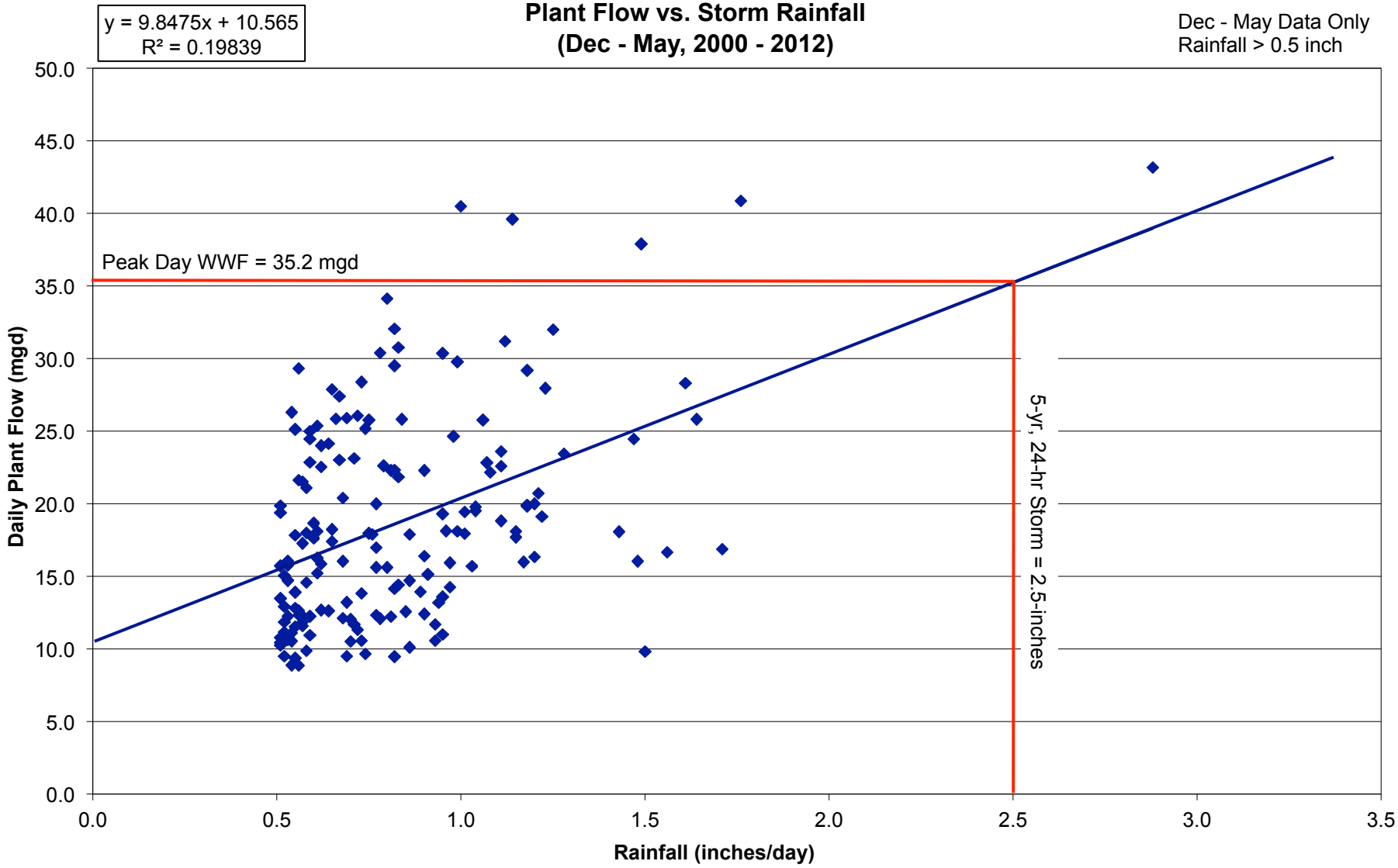
Based on Average Dry Weather Flows

Year	ADWF	MMDWF	MMDW Peaking Factor	MMWWF	MMWW Peaking Factor	Max Day Flow	Max Day Peaking Factor
2000	6.99	7.77	1.11	11.38	1.63	19.52	2.79
2001	7.28	9.10	1.25	17.50	2.40	26.06	3.58
2002	7.30	8.65	1.18	14.60	2.00	27.89	3.82
2003	6.98	10.69	1.53	14.58	2.09	39.61	5.67
2004	7.24	7.90	1.09	13.68	1.89	19.37	2.68
2005	7.61	10.13	1.33	14.31	1.88	40.49	5.32
2006	7.02	10.09	1.44	20.89	2.98	34.14	4.86
2007	6.39	8.43	1.32	15.27	2.39	32.04	5.01
2008	5.95	8.27	1.39	15.12	2.54	30.21	5.08
2009	7.47	9.65	1.29	12.61	1.69	43.14	5.78
2010	8.37	13.43	1.60	17.65	2.11	37.90	4.53
2011	7.12	11.76	1.65	16.35	2.30	32.00	4.49
2012	7.60	11.47	1.51	20.01	2.63	40.87	5.38
Maximum							
2000 - 2012	8.37	13.43	1.65	20.89	2.98	43.14	5.78
2008 - 2012	8.37	13.43	1.65	20.01	2.63	43.14	5.78
Average Based Peaking Factors							
2000 - 2012	7.18	9.80	1.36	15.69	2.19	32.56	4.54
2008 - 2012	7.30	10.92	1.49	16.35	2.25	36.82	5.05

Based on Median Dry Weather Flows

Year	Median DWF	MMDWF	MMDW Peaking Factor	MMWWF	MMWW Peaking Factor	Max Day Flow	Max Day Peaking Factor
2000	6.82	7.77	1.14	11.38	1.67	19.52	2.86
2001	7.08	9.10	1.29	17.50	2.47	26.06	3.68
2002	7.38	8.65	1.17	14.60	1.98	27.89	3.78
2003	6.93	10.69	1.54	14.58	2.10	39.61	5.72
2004	7.00	7.90	1.13	13.68	1.95	19.37	2.77
2005	7.10	10.13	1.43	14.31	2.02	40.49	5.70
2006	6.97	10.09	1.45	20.89	3.00	34.14	4.90
2007	5.93	8.43	1.42	15.27	2.58	32.04	5.40
2008	5.63	8.27	1.47	15.12	2.69	30.21	5.37
2009	7.05	9.65	1.37	12.61	1.79	43.14	6.12
2010	7.00	13.43	1.92	17.65	2.52	37.90	5.41
2011	6.60	11.76	1.78	16.35	2.48	32.00	4.85
2012	6.92	11.47	1.66	20.01	2.89	40.87	5.91
Maximum							
2000 - 2012	7.38	13.43	1.92	20.89	3.00	43.14	6.12
2008 - 2012	7.05	13.43	1.92	20.01	2.89	43.14	6.12
Median Based Peaking Factors							
2000 - 2012	6.80	13.43	1.97	20.89	3.07	43.14	6.34
2008 - 2012	6.64	13.43	2.02	20.01	3.01	43.14	6.50

Figure F1
Tri-City WPCP
Plant Flow vs. Storm Rainfall
(Dec - May, 2000 - 2012)



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File Name: Attach F - TC DEQ PDF Calculation.xls
Sheet Name: Fig 1

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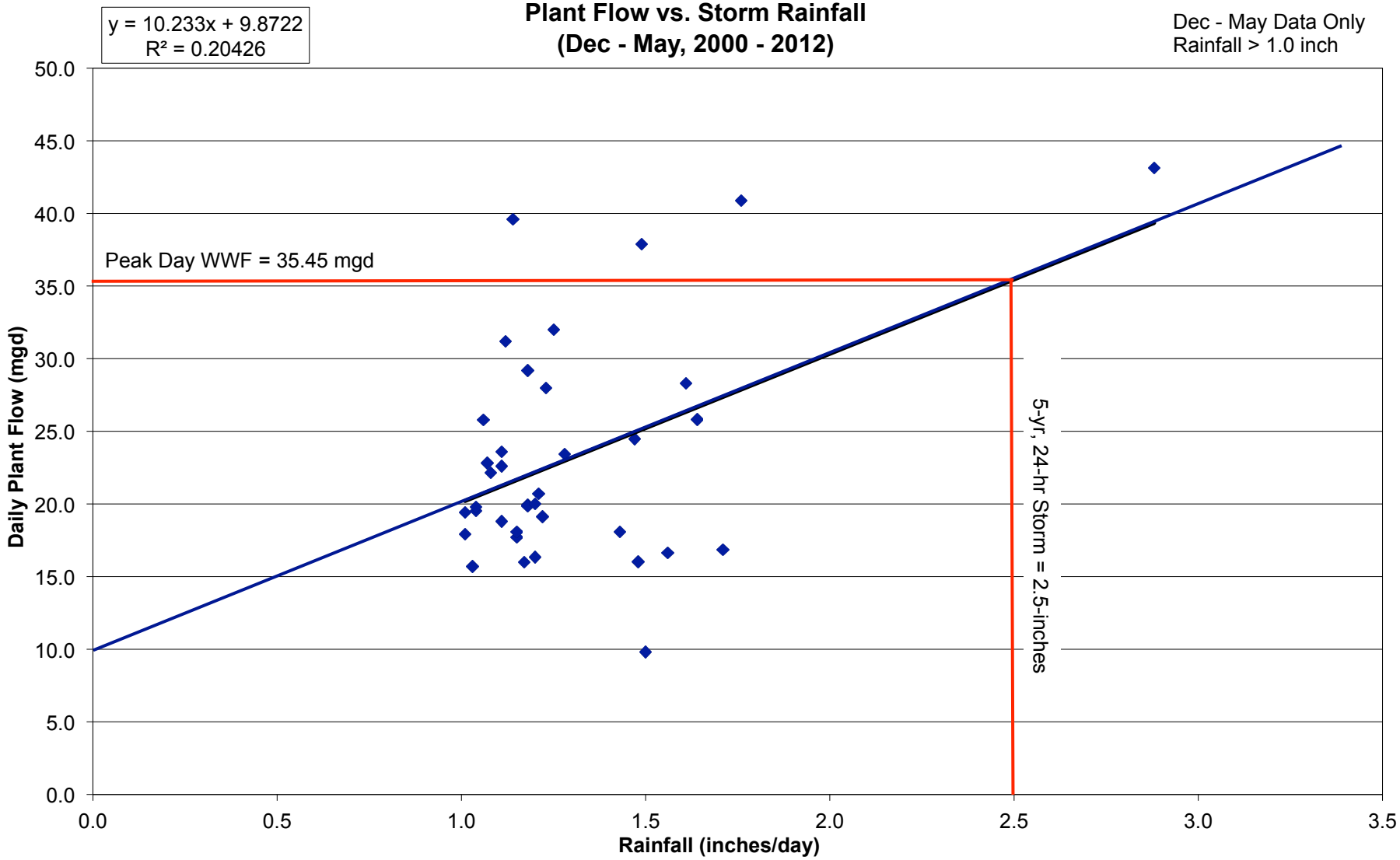
Figure F2
Tri-City WPCP
Plant Flow vs. Storm Rainfall
(Dec - May, 2000 - 2012)



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Sheet Name: Fig 2

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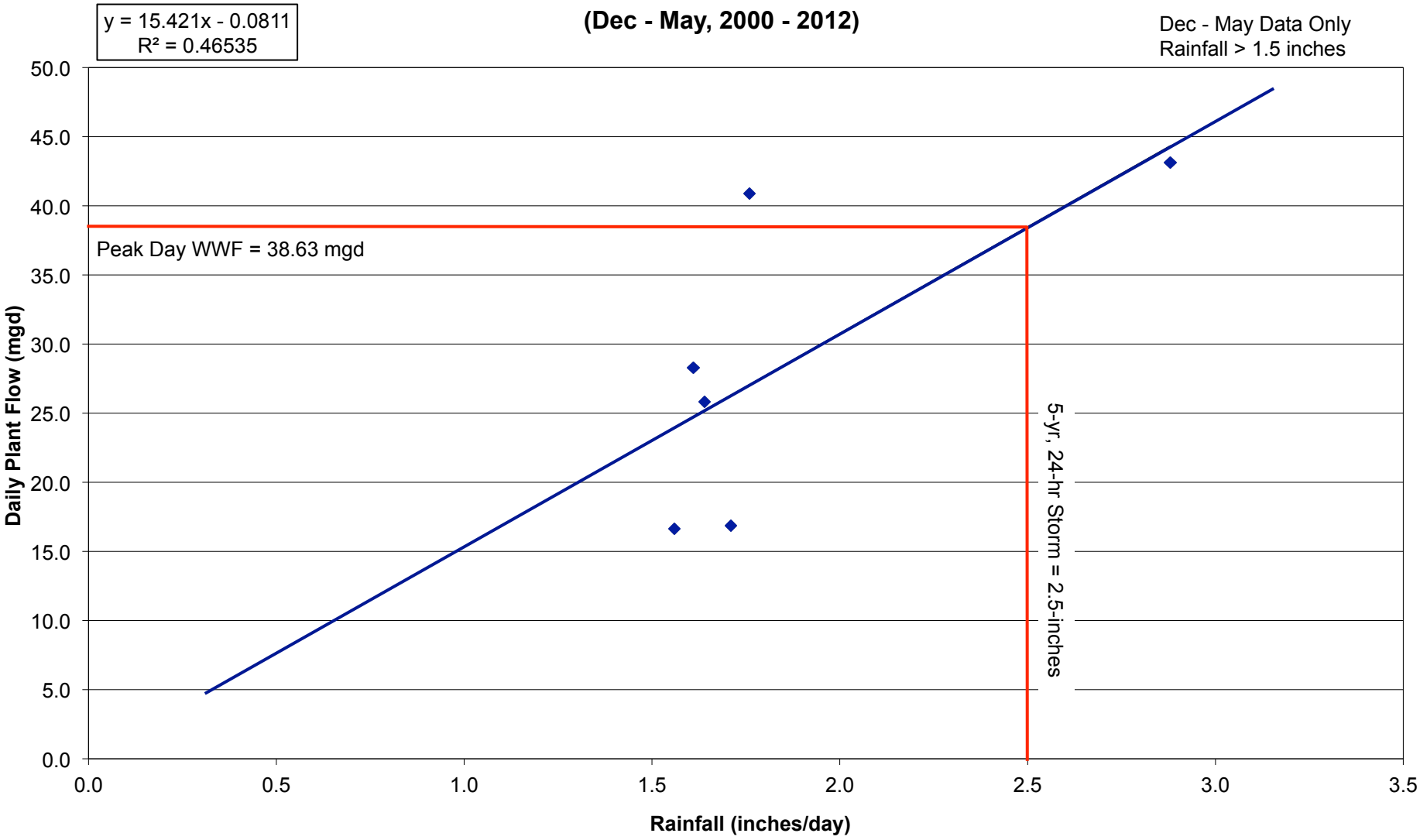
Figure F3
Tri-City WPCP
Plant Flow vs. Storm Rainfall
(Dec - May, 2000 - 2012)



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Sheet Name: Fig 3

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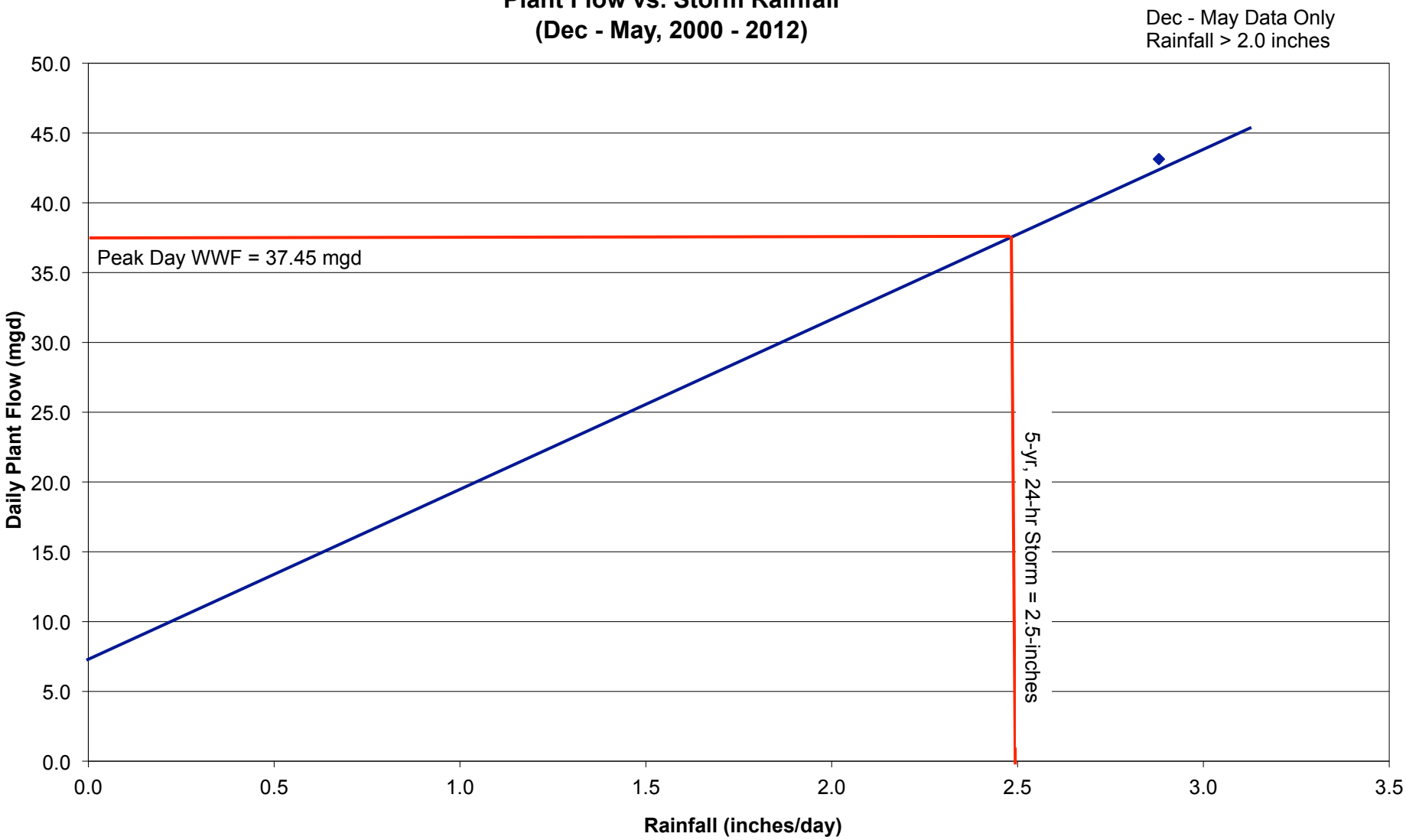
Figure F4
Tri-City WPCP
Plant Flow vs. Storm Rainfall
(Dec - May, 2000 - 2012)



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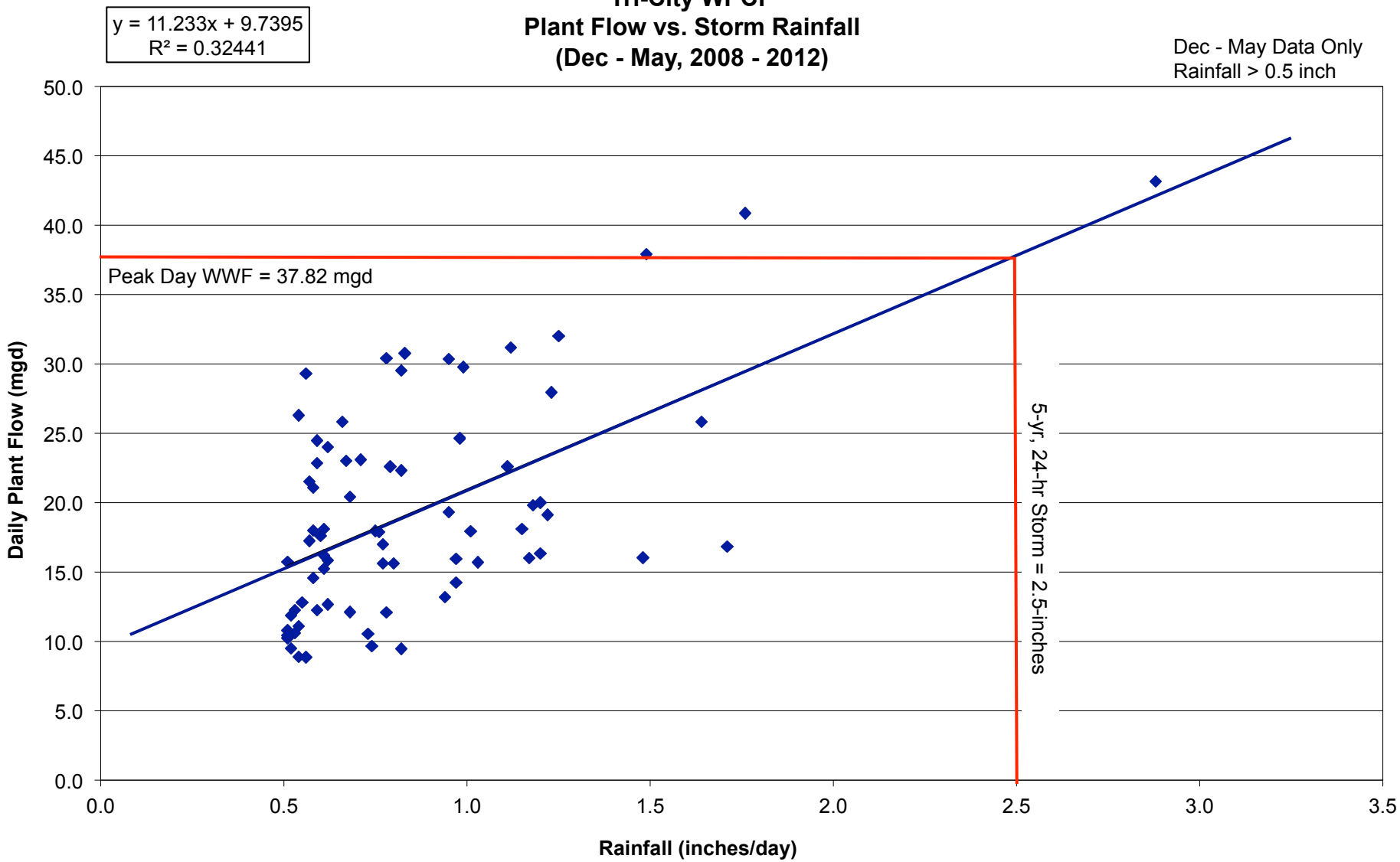
File Name: Attach F - TC DEQ PDF Calculation.xls
Sheet Name: Fig 4

4/1/13

Figure F5
Tri-City WPCP
Plant Flow vs. Storm Rainfall
(Dec - May, 2008 - 2012)



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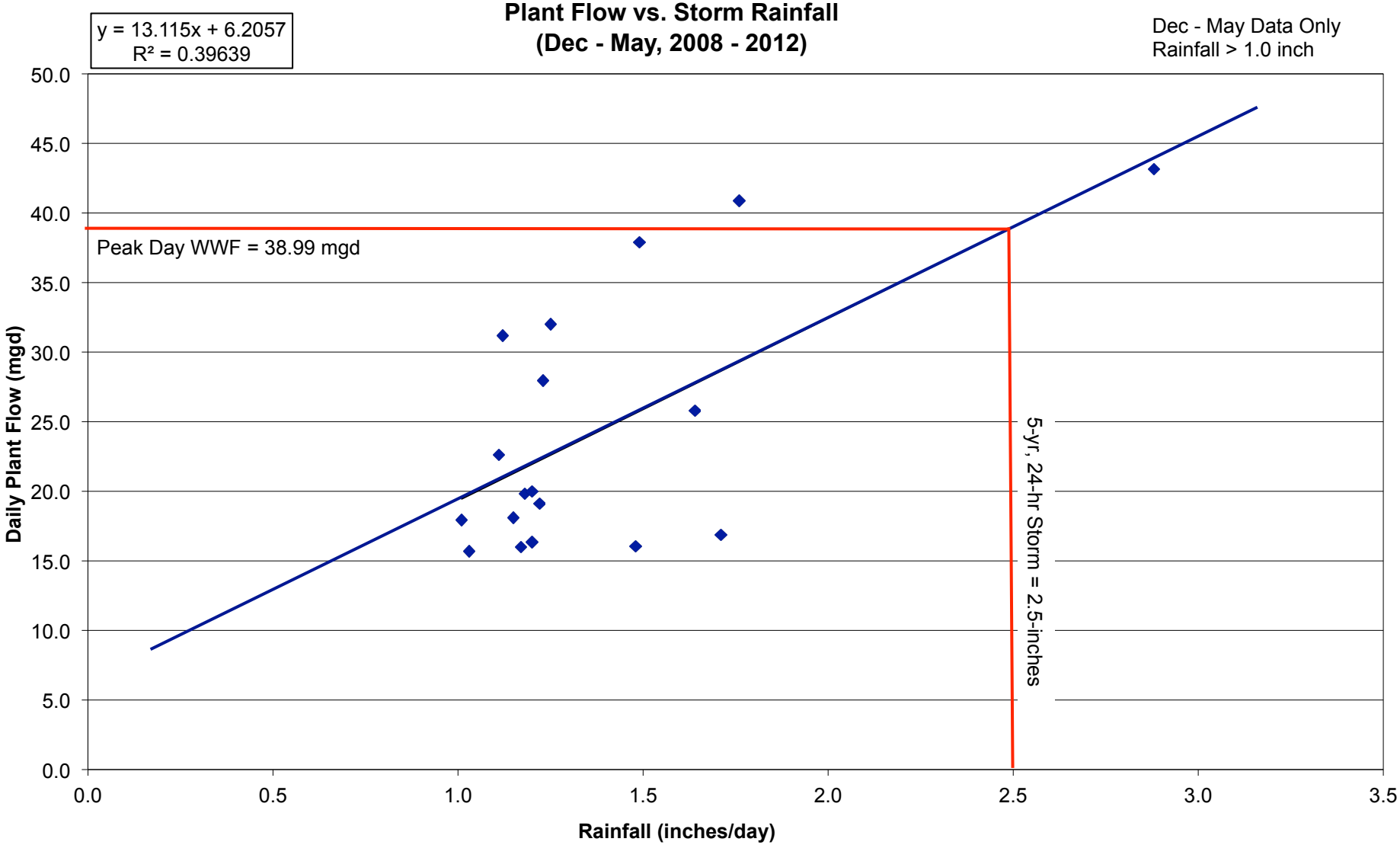
File Name: Attach F - TC DEQ PDF Calculation.xls
Sheet Name: Fig 5

4/1/13

Figure F6
Tri-City WPCP
Plant Flow vs. Storm Rainfall
(Dec - May, 2008 - 2012)



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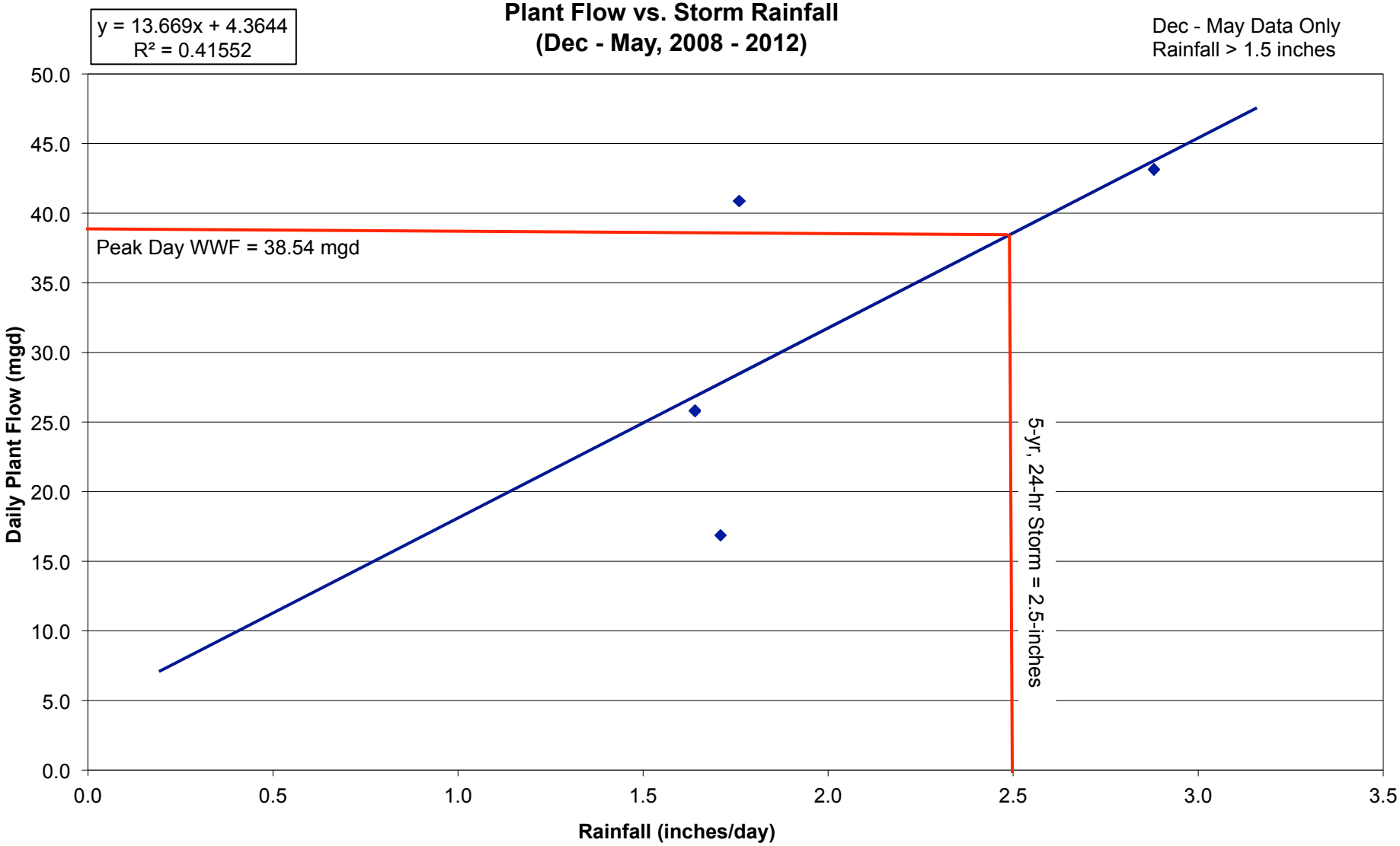
Sheet Name: Fig 6

4/1/13

Figure F7
Tri-City WPCP
Plant Flow vs. Storm Rainfall
(Dec - May, 2008 - 2012)



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File Name: Attach F - TC DEQ PDF Calculation.xls
Sheet Name: Fig 7

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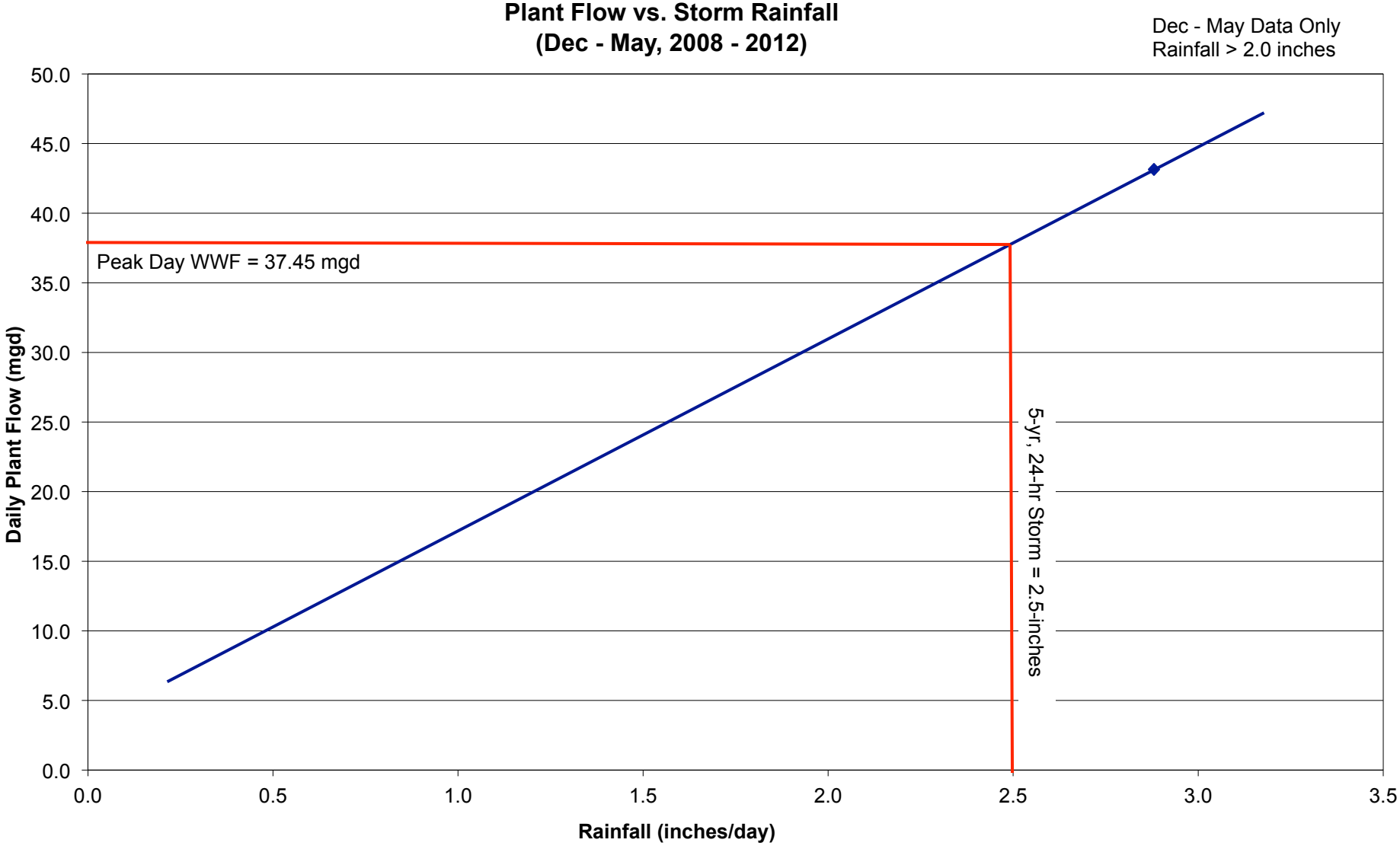
Figure F8
Tri-City WPCP
Plant Flow vs. Storm Rainfall
(Dec - May, 2008 - 2012)



Richwine Environmental, Inc.
File Name: Attach F - TC DEQ PDF Calculation.xls
Sheet Name: Fig 8

4/1/13

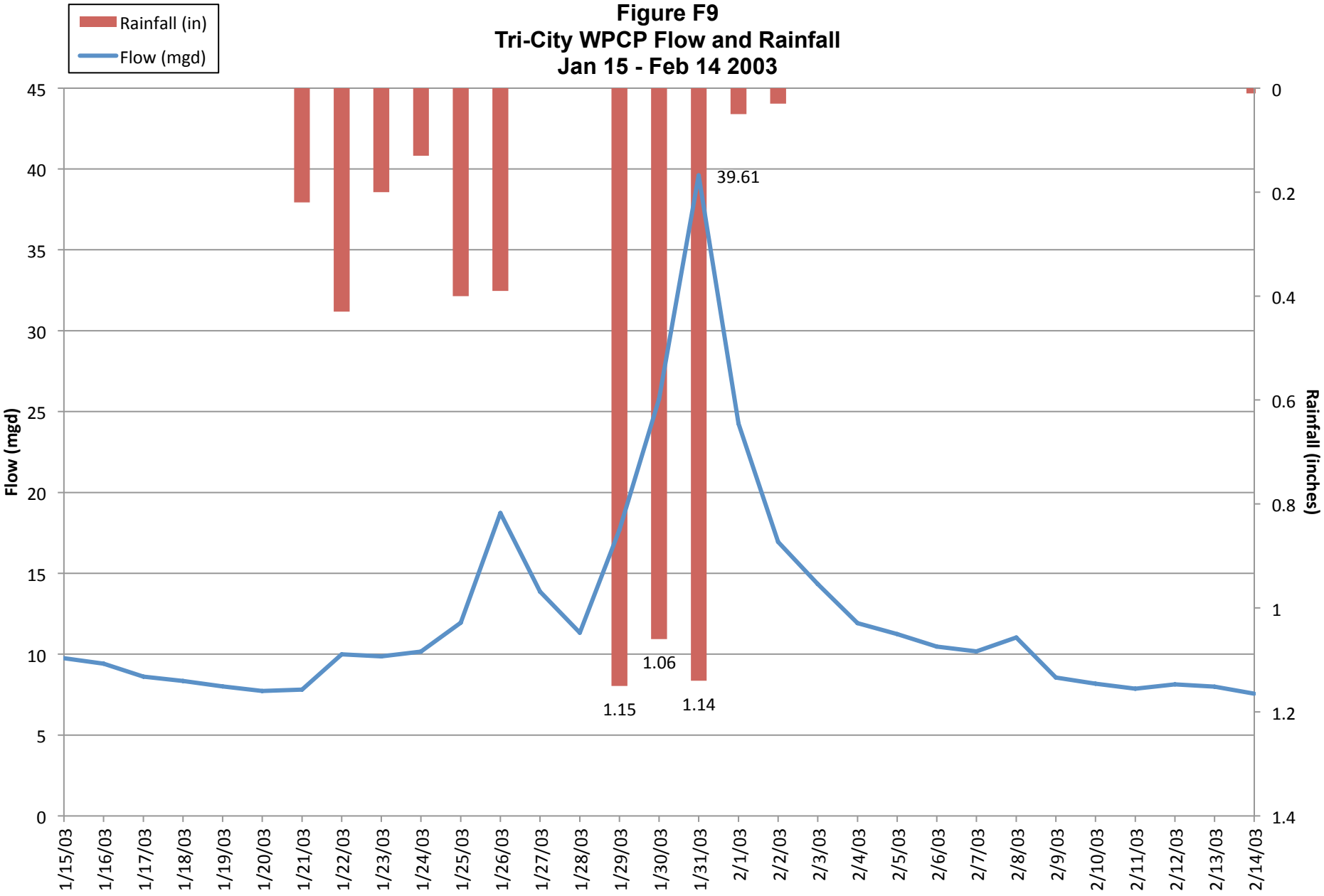


Figure F9
Tri-City WPCP Flow and Rainfall
Jan 15 - Feb 14 2003
Rainfall (in)
Flow (mgd)
Flow (mgd)
Rainfall (inches)
39.61
1.06
1.15
1.14
45
40
35
30
25
20
15
10
5
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1/15/03
1/16/03
1/17/03
1/18/03
1/19/03
1/20/03
1/21/03
1/22/03
1/23/03
1/24/03
1/25/03
1/26/03
1/27/03
1/28/03
1/29/03
1/30/03
1/31/03
2/1/03
2/2/03
2/3/03
2/4/03
2/5/03
2/6/03
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2/10/03
2/11/03
2/12/03
2/13/03
2/14/03

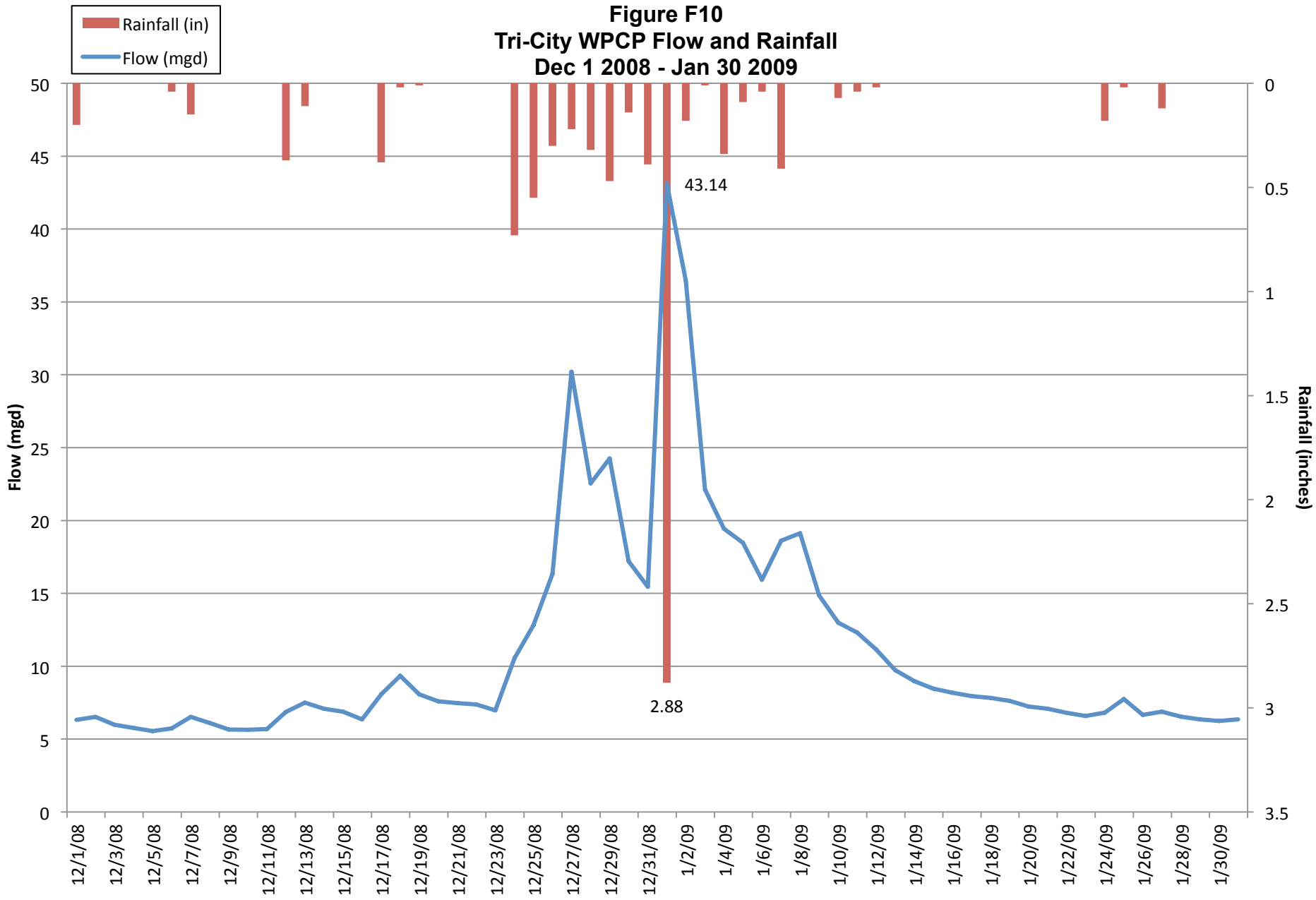
Figure F10
Tri-City WPCP Flow and Rainfall
Dec 1 2008 - Jan 30 2009
Rainfall (in)
Flow (mgd)
Flow (mgd)
Rainfall (inches)
43.14
2.88
50
45
40
35
30
25
20
15
10
5
0
0
0.5
1
1.5
2
2.5
3
3.5
12/1/08
12/3/08
12/5/08
12/7/08
12/9/08
12/11/08
12/13/08
12/15/08
12/17/08
12/19/08
12/21/08
12/23/08
12/25/08
12/27/08
12/29/08
12/31/08
1/2/09
1/4/09
1/6/09
1/8/09
1/10/09
1/12/09
1/14/09
1/16/09
1/18/09
1/20/09
1/22/09
1/24/09
1/26/09
1/28/09
1/30/09

ATTACHMENT G
Determine Peak Hour Flow (PHF)

Attachment G
Tri-City WPCP
Determine Peak Hour Flow (PHF)

Background

Five high flow events were recorded at the Tri-City WPCP in the study period between 2000 and 2012. Each of these flow events were evaluated in the PDF evaluation summarized in Attachment F.

Hourly data for three of the five high flow events was available in the plants Historian database. This data has been evaluated to determine the peak hourly flows for the treatment plant.

Evaluation

The hourly rainfall measured at the weather station located at the Tri-City WPCP was plotted with the hourly influent flow received at the treatment plant for the peak flow events that hourly data was available.

March 1, 2011

The February 28, 2011 high flow event occurred following 24-hours of consistent rainfall over 0.05-inches per hour with a peak rainfall of 0.514-inches in three hours. During this rainfall event, the plant flow peaked at 39.9-mgd.

January 19, 2012

The January 19, 2012 high flow event occurred during a second day of high rainfall. A peak rainfall of 0.246 inches occurred on January 18. After some relief, another storm on January 19, deposited eight straight hours of rain over 0.15-inches per hour. This resulted in a peak plant influent flow of 56.1-mgd. This was an abnormal event with rainfall exceeding a 5-year, 24-hour flow event over a 3-day period.

November 19, 2012

The November 19, 2012 high flow event occurred during an extremely high rainfall. In addition, an addiitonal 8-mgd of flow was transferred to the plant through the new Intertie II pump station. This high flow event of 55.8-mgd occurred following four straight hours of rain over 0.20 inches per hour with a peak hour rainfall of 0.365-inches.

Conclusion

This analysis is to provide a peaking factor for the Tri-City Service District System. Based on this, an influent flow of 47.8-mgd (55.8-8) will be used for the November 19, 2012 high flow event. Therefore, the highest peak flows received at the treatment plant for the 13-year study period were 39.9, 56.1 and 47.8-mgd.

This analysis shows that the highest peak hour flow occuring in the study period between 2000 and 2012 was 47.8-mgd under a design storm event. This value will be used as the peak hour flow.

The average dry weather flow used to determine the peaking factor is 6.64-mgd. Using this value, the PHF peaking factor is 7.2 (47.8/6.64).

Design Peak Daily Flow (PDF) = 47.8-mgd
Design Peak Day Peaking Factor (PDF) = 7.2

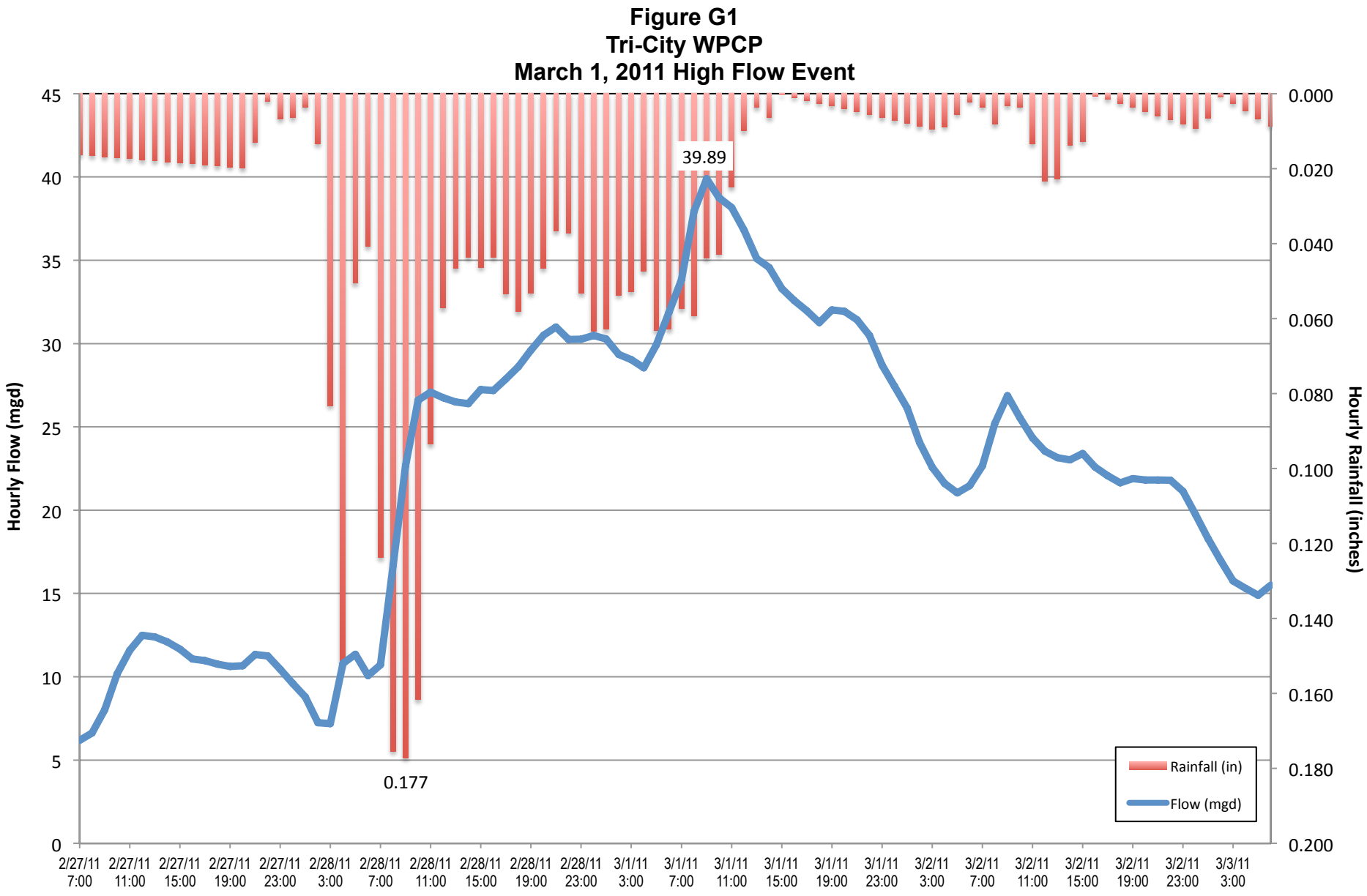
Figure G1
Tri-City WPCP
March 1, 2011 High Flow Event
Hourly Flow (mgd)
Hourly Rainfall (inches)
39.89
0.177
Rainfall (in)
Flow (mgd)
45
40
35
30
25
20
15
10
5
0
0.000
0.020
0.040
0.060
0.080
0.100
0.120
0.140
0.160
0.180
0.200
2/27/11 7:00
2/27/11 11:00
2/27/11 15:00
2/27/11 19:00
2/27/11 23:00
2/28/11 3:00
2/28/11 7:00
2/28/11 11:00
2/28/11 15:00
2/28/11 19:00
2/28/11 23:00
3/1/11 3:00
3/1/11 7:00
3/1/11 11:00
3/1/11 15:00
3/1/11 19:00
3/1/11 23:00
3/2/11 3:00
3/2/11 7:00
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3/2/11 19:00
3/2/11 23:00
3/3/11 3:00

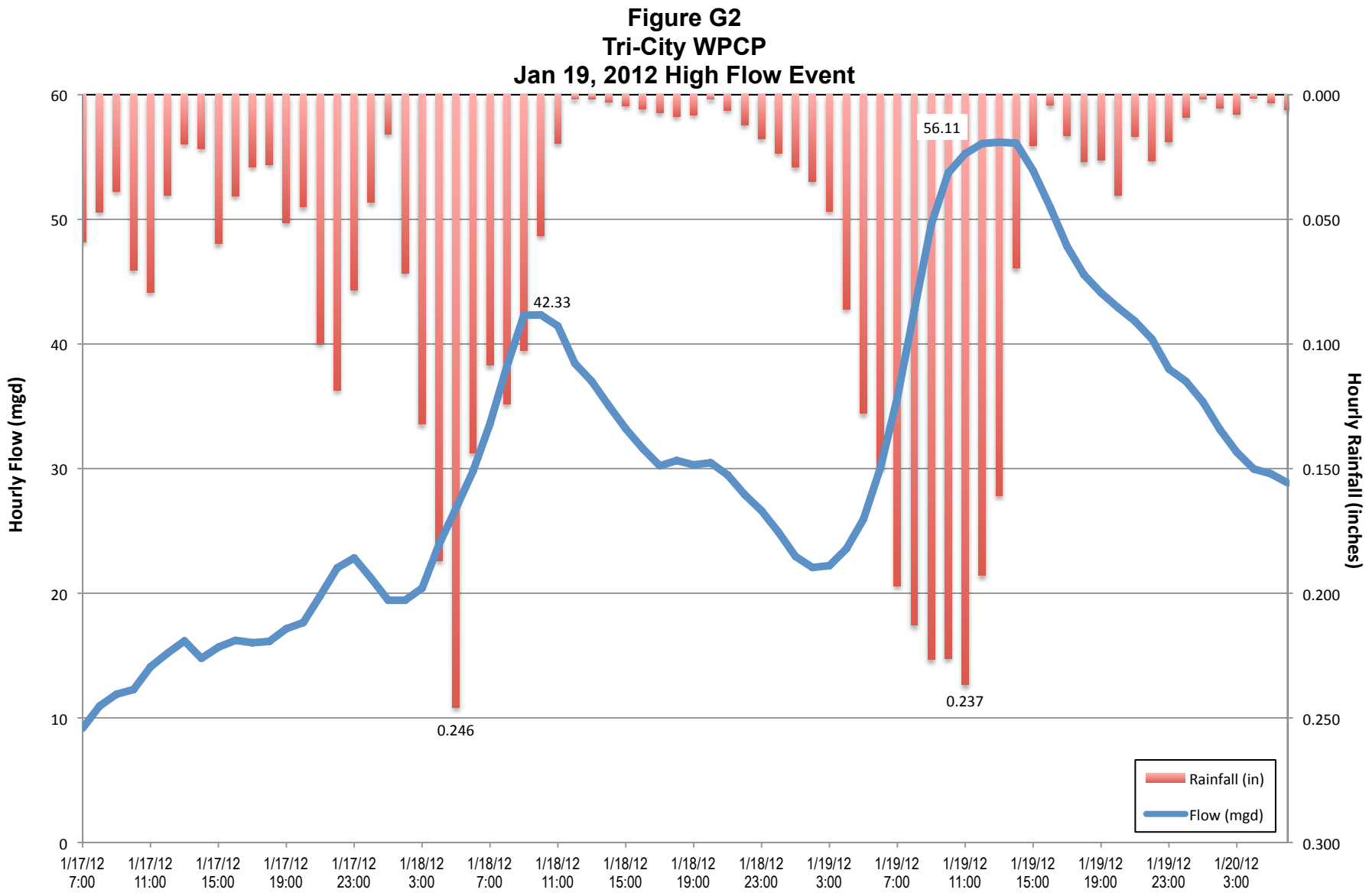
Figure G2
Tri-City WPCP
Jan 19, 2012 High Flow Event
Hourly Flow (mgd)
Hourly Rainfall (inches)
60
50
40
30
20
10
0
0.000
0.050
0.100
0.150
0.200
0.250
0.300
42.33
56.11
0.246
0.237
Rainfall (in)
Flow (mgd)
1/17/12 7:00
1/17/12 11:00
1/17/12 15:00
1/17/12 19:00
1/17/12 23:00
1/18/12 3:00
1/18/12 7:00
1/18/12 11:00
1/18/12 15:00
1/18/12 19:00
1/18/12 23:00
1/19/12 3:00
1/19/12 7:00
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1/19/12 15:00
1/19/12 19:00
1/19/12 23:00
1/20/12 3:00

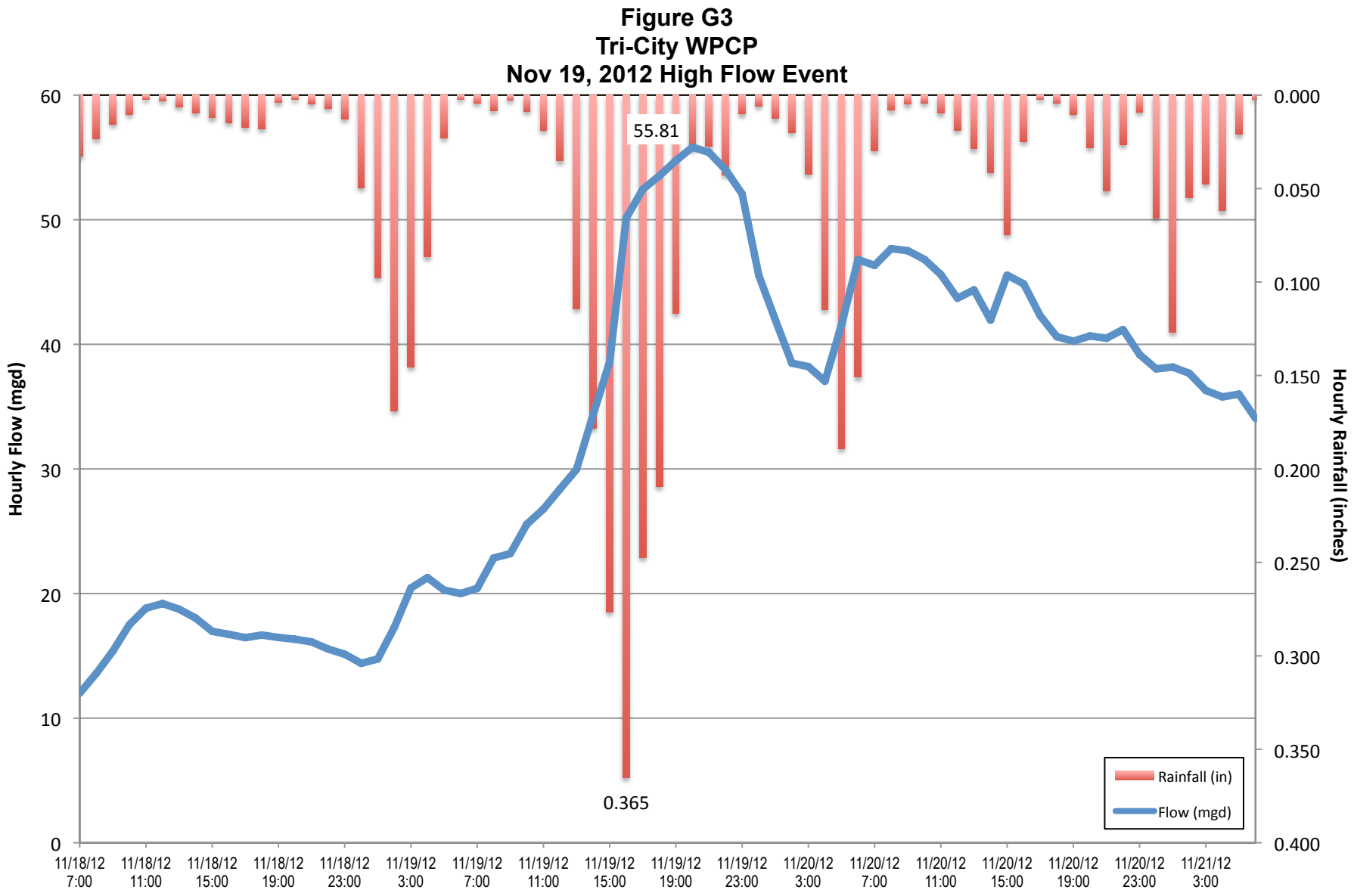
Figure G3
Tri-City WPCP
Nov 19, 2012 High Flow Event
Hourly Flow (mgd)
Hourly Rainfall (inches)
55.81
0.365
Rainfall (in)
Flow (mgd)
60
50
40
30
20
10
0
0.000
0.050
0.100
0.150
0.200
0.250
0.300
0.350
0.400
11/18/12 7:00
11/18/12 11:00
11/18/12 15:00
11/18/12 19:00
11/18/12 23:00
11/19/12 3:00
11/19/12 7:00
11/19/12 11:00
11/19/12 15:00
11/19/12 19:00
11/19/12 23:00
11/20/12 3:00
11/20/12 7:00
11/20/12 11:00
11/20/12 15:00
11/20/12 19:00
11/20/12 23:00
11/21/12 3:00

ATTACHMENT H
Determine Peaking Factors and Per Capita Loads for BOD_5

Attachment H
Tri-City WPCP
Determine Peaking Factors and EDU Loads for BOD_5

Background

Peaking factors and per capita loads are necessary to characterize the influent wastewater and project loads into the future. Projections are made assuming that these characteristics remain the same.

Evaluaion

Peaking Factors

Peaking factors are determined as follows:
-- Max Month -- Maximum 30 day average / Average Day
-- Max Week -- Maximum 7-day average / Average Day
-- Max Day -- Maximum day / Average Day

In this analysis, the loads for the period between January 2000 and December 2012 were evaluated. The max. month, max. week and max day values were developed for each of the seasonal conditions. The peaking factor for each year were calculated and an average of the peaking factors was determined. The average for the previous 5-year period were used to determine the BOD peaking factors to be used in the study.

Period	Max. Month	Max. Week	Max. Day
Average Annual	1.21	1.43	2.77
Summer Season	1.14	1.30	2.15
Winter Season	1.16	1.37	2.43

Per Capita Loads

Per capita loads are calculated by taking the average day load and dividing it by the EDUs for the Service District of the respective year as developed in Attachment A. The average of the values calculated for each of the years between January 2008 and December 2012 (most recent 5-year period) was used as the per capita load.

Period	Per EDU Load
Average Annual	0.46
Summer Season	0.46
Winter Season	0.46

Conclusion

The peaking factors and per capita loads for BOD_5 were calculated and are summarized in the tables above.

Table H-1
Tri-City WPCP
Influent BOD Characterization

Average Annual

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	24773	38191	53685	128603	1.54	2.17	5.19	0.82
2001	31031	26208	41185	64195	72570	1.57	2.45	2.77	0.84
2002	30471	24989	45215	55792	70713	1.81	2.23	2.83	0.82
2003	30494	16136	19613	22090	36759	1.22	1.37	2.28	0.53
2004	30830	16419	24527	50553	82253	1.49	3.08	5.01	0.53
2005	30987	15551	16892	18254	32253	1.09	1.17	2.07	0.50
2006	31931	15394	16864	18792	32216	1.10	1.22	2.09	0.48
2007	33097	15603	23615	31739	41145	1.51	2.03	2.64	0.47
2008	34835	13855	18535	23484	49116	1.34	1.69	3.55	0.40
2009	34552	15249	18522	21920	50468	1.21	1.44	3.31	0.44
2010	35808	16539	18890	21626	42781	1.14	1.31	2.59	0.46
2011	37802	18274	21431	24620	41272	1.17	1.35	2.26	0.48
2012	38197	19430	22897	26909	41845	1.18	1.38	2.15	0.51
Average	**33097**	**18340**	**25106**	**33358**	**55538**	**1.34**	**1.76**	**2.98**	**0.56**

Summer Season

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	27027	38191	53685	107501	1.41	1.99	3.98	0.89
2001	31031	27241	41185	64195	72570	1.51	2.36	2.66	0.88
2002	30471	22884	34537	41348	56111	1.51	1.81	2.45	0.75
2003	30494	17153	19613	22090	36759	1.14	1.29	2.14	0.56
2004	30830	16184	18452	19915	26256	1.14	1.23	1.62	0.52
2005	30987	15496	16892	18202	32253	1.09	1.17	2.08	0.50
2006	31931	15526	16864	18571	25273	1.09	1.20	1.63	0.49
2007	33097	14085	21766	21225	22920	1.55	1.51	1.63	0.43
2008	34835	13194	15264	17434	31635	1.16	1.32	2.40	0.38
2009	34552	16297	18522	21920	50468	1.14	1.35	3.10	0.47
2010	35808	16490	18250	20386	27262	1.11	1.24	1.65	0.46
2011	37802	17405	20506	22291	27620	1.18	1.28	1.59	0.46
2012	38197	20325	22897	26909	41444	1.13	1.32	2.04	0.53
Average	**33097**	**18408**	**23303**	**28321**	**42929**	**1.24**	**1.47**	**2.23**	**0.56**

Winter Season

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average Dry Season Flow			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	22451	33903	46901	128603	1.51	2.09	5.73	0.74
2001	31031	25134	28236	41505	62593	1.12	1.65	2.49	0.81
2002	30471	27349	45215	55792	70713	1.65	2.04	2.59	0.90
2003	30494	15114	17800	18440	36264	1.18	1.22	2.40	0.50
2004	30830	16663	24527	50553	82253	1.47	3.03	4.94	0.54
2005	30987	15607	16720	18254	24069	1.07	1.17	1.54	0.50
2006	31931	15259	16425	18792	32216	1.08	1.23	2.11	0.48
2007	33097	17147	23615	31739	41145	1.38	1.85	2.40	0.52
2008	34835	14527	18535	23484	49116	1.28	1.62	3.38	0.42
2009	34552	14190	15980	17227	25329	1.13	1.21	1.78	0.41
2010	35808	16588	18890	21626	42781	1.14	1.30	2.58	0.46
2011	37802	19194	21431	24620	41272	1.12	1.28	2.15	0.51
2012	38197	18518	21359	26359	41845	1.15	1.42	2.26	0.48
Average	**33097**	**18288**	**23280**	**30407**	**52169**	**1.25**	**1.63**	**2.80**	**0.56**

Table H-2
Tri-City WPCP
Influent BOD Characterization

Average Annual

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835	13855	18535	23484	49116	1.34	1.69	3.55	0.40
2009	34552	15249	18522	21920	50468	1.21	1.44	3.31	0.44
2010	35808	16539	18890	21626	42781	1.14	1.31	2.59	0.46
2011	37802	18274	21431	24620	41272	1.17	1.35	2.26	0.48
2012	38197	19430	22897	26909	41845	1.18	1.38	2.15	0.51
Average	**36239**	**16669**	**20055**	**23712**	**45096**	**1.21**	**1.43**	**2.77**	**0.46**

Summer Season

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835.053	13194	15264	17434	31635	1.16	1.32	2.40	0.38
2009	34551.68354	16297	18522	21920	50468	1.14	1.35	3.10	0.47
2010	35808.24122	16490	18250	20386	27262	1.11	1.24	1.65	0.46
2011	37801.6958	17405	20506	22291	27620	1.18	1.28	1.59	0.46
2012	38197.36887	20325	22897	26909	41444	1.13	1.32	2.04	0.53
Average	**36239**	**16742**	**19088**	**21788**	**35686**	**1.14**	**1.30**	**2.15**	**0.46**

Winter Season

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average Dry Season Flow			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835.053	14527	18535	23484	49116	1.28	1.62	3.38	0.42
2009	34551.68354	14190	15980	17227	25329	1.13	1.21	1.78	0.41
2010	35808.24122	16588	18890	21626	42781	1.14	1.30	2.58	0.46
2011	37801.6958	19194	21431	24620	41272	1.12	1.28	2.15	0.51
2012	38197.36887	18518	21359	26359	41845	1.15	1.42	2.26	0.48
Average	**36239**	**16603**	**19239**	**22663**	**40069**	**1.16**	**1.37**	**2.43**	**0.46**

Table H-3
Tri-City WPCP
Influent BOD Population Equivalent

Average Annual

Year	Capita Load	Historical Average Annual Loads (lbs/day)				Historical Population Equivalent From Average			
		Average	Maximum Month	Maximum Week	Maximum Day	Average	Maximum Month	Maximum Week	Maximum Day
2008	0.22	13855	18535	23484	49116	62977	84250	106745	223255
2009	0.22	15249	18522	21920	50468	69314	84191	99636	229400
2010	0.22	16539	18890	21626	42781	75177	85864	98300	194459
2011	0.22	18274	21431	24620	41272	83064	97414	111909	187600
2012	0.22	19430	22897	26909	41845	88318	104077	122314	190205
Average	**0.22**	**16669**	**20055**	**23712**	**45096**	**75770**	**91159**	**107781**	**204984**

Summer Season

Year	Capita Load	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average			
		Average	Maximum Month	Maximum Week	Maximum Day	Average	Maximum Month	Maximum Week	Maximum Day
2008	0.22	13194	15264	17434	31635	59973	69382	79245	143795
2009	0.22	16297	18522	21920	50468	74077	84191	99636	229400
2010	0.22	16490	18250	20386	27262	74955	82955	92664	123918
2011	0.22	17405	20506	22291	27620	79114	93209	101323	125545
2012	0.22	20325	22897	26909	41444	92386	104077	122314	188382
Average	**0.22**	**16742**	**19088**	**21788**	**35686**	**76101**	**86763**	**99036**	**162208**

Winter Season

Year	Capita Load	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average Dry Season Flow			
		Average	Maximum Month	Maximum Week	Maximum Day	Average	Maximum Month	Maximum Week	Maximum Day
2008	0.22	14527	18535	23484	49116	66032	84250	106745	223255
2009	0.22	14190	15980	17227	25329	64500	72636	78305	115132
2010	0.22	16588	18890	21626	42781	75400	85864	98300	194459
2011	0.22	19194	21431	24620	41272	87245	97414	111909	187600
2012	0.22	18518	21359	26359	41845	84173	97086	119814	190205
Average	**0.22**	**16603**	**19239**	**22663**	**40069**	**75470**	**87450**	**103015**	**182130**

ATTACHMENT I
Determine Peaking Factors and Per Capita Loads for TSS

Attachment I
Tri-City WPCP
Determine Peaking Factors and EDU Loads for TSS

Background

Peaking factors and per capita loads are necessary to characterize the influent wastewater and project loads into the future. Projections are made assuming that these characteristics remain the same.

Evaluaion

Peaking Factors

Peaking factors are determined as follows:
-- Max Month -- Maximum 30 day average / Average Day
-- Max Week -- Maximum 7-day average / Average Day
-- Max Day -- Maximum day / Average Day

In this analysis, the loads for the period between January 2000 and December 2012 were evaluated. The max. month, max. week and max day values were developed for each of the seasonal conditions. The peaking factor for each year were calculated and an average of the peaking factors was determined. The average for the previous 5-year period were used to determine the TSS peaking factors to be used in the study.

Period	Max. Month	Max. Week	Max. Day
Average Annual	1.29	1.56	2.84
Summer Season	1.13	1.36	2.41
Winter Season	1.25	1.49	2.73

Per Capita Loads

Per capita loads are calculated by taking the average day load and dividing it by the EDUs for the Service District of the respective year as developed in Attachment B. The average of the values calculated for each of the years between January 2008 and December 2012 (most recent 5-year period) was used as the per capita load.

Period	Per EDU Load
Average Annual	0.54
Summer Season	0.53
Winter Season	0.54

Conclusion

The peaking factors and per capita loads for TSS were calculated and are summarized in the tables above.

Table I-1
Tri-City WPCP
Influent TSS Characterization

Average Annual

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	26004	46178	74100	260635	1.78	2.85	10.02	0.86
2001	31031	24730	36324	58386	103933	1.47	2.36	4.20	0.80
2002	30471	35754	79708	120357	262450	2.23	3.37	7.34	1.17
2003	30494	19011	21374	29691	54931	1.12	1.56	2.89	0.62
2004	30830	20090	33991	80581	132955	1.69	4.01	6.62	0.65
2005	30987	18439	21381	26449	66039	1.16	1.43	3.58	0.60
2006	31931	18052	21790	33123	55589	1.21	1.83	3.08	0.57
2007	33097	19377	40641	64239	79766	2.10	3.32	4.12	0.59
2008	34835	15281	23543	31550	62501	1.54	2.06	4.09	0.44
2009	34552	17219	19905	23421	40016	1.16	1.36	2.32	0.50
2010	35808	20944	27426	31185	54609	1.31	1.49	2.61	0.58
2011	37802	20521	24402	27721	48158	1.19	1.35	2.35	0.54
2012	38197	23569	29416	35878	67081	1.25	1.52	2.85	0.62
Average	**33097**	**21461**	**32775**	**48975**	**99128**	**1.48**	**2.19**	**4.31**	**0.66**

Summer Season

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	27573	45944	74100	213037	1.67	2.69	7.73	0.91
2001	31031	24762	36324	58386	79377	1.47	2.36	3.21	0.80
2002	30471	29079	50159	58765	101414	1.72	2.02	3.49	0.95
2003	30494	19579	21374	29691	53399	1.09	1.52	2.73	0.64
2004	30830	19396	22837	26129	53552	1.18	1.35	2.76	0.63
2005	30987	18937	21381	26449	66039	1.13	1.40	3.49	0.61
2006	31931	17606	19510	22730	44341	1.11	1.29	2.52	0.55
2007	33097	15778	30082	27889	38839	1.91	1.77	2.46	0.48
2008	34835	14202	16266	18276	39325	1.15	1.29	2.77	0.41
2009	34552	18161	19905	22756	31565	1.10	1.25	1.74	0.53
2010	35808	20561	23709	28324	53883	1.15	1.38	2.62	0.57
2011	37802	18656	23846	26387	40749	1.28	1.41	2.18	0.49
2012	38197	24430	24377	35878	67081	1.00	1.47	2.75	0.64
Average	**33097**	**20671**	**27363**	**35058**	**67892**	**1.30**	**1.63**	**3.11**	**0.63**

Winter Season

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average Dry Season Flow			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2000	30231	24471	46178	68080	260635	1.89	2.78	10.65	0.81
2001	31031	24696	28443	43311	103933	1.15	1.75	4.21	0.80
2002	30471	42820	79708	120357	262450	1.86	2.81	6.13	1.41
2003	30494	18421	20607	26302	54931	1.12	1.43	2.98	0.60
2004	30830	20806	33991	80581	132955	1.63	3.87	6.39	0.67
2005	30987	17938	19572	25005	47176	1.09	1.39	2.63	0.58
2006	31931	18508	21790	33123	55589	1.18	1.79	3.00	0.58
2007	33097	22995	40641	64239	79766	1.77	2.79	3.47	0.69
2008	34835	16373	23543	31550	62501	1.44	1.93	3.82	0.47
2009	34552	16255	18890	23421	40016	1.16	1.44	2.46	0.47
2010	35808	21330	27426	31185	54609	1.29	1.46	2.56	0.60
2011	37802	22456	24402	27721	48158	1.09	1.23	2.14	0.59
2012	38197	22688	29318	31843	60725	1.29	1.40	2.68	0.59
Average	**33097**	**22289**	**31885**	**46671**	**97188**	**1.38**	**2.01**	**4.09**	**0.68**

Table I-2
Tri-City WPCP
Influent TSS Characterization

Average Annual

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835	15281	23543	31550	62501	1.54	2.06	4.09	0.44
2009	34552	17219	19905	23421	40016	1.16	1.36	2.32	0.50
2010	35808	20944	27426	31185	54609	1.31	1.49	2.61	0.58
2011	37802	20521	24402	27721	48158	1.19	1.35	2.35	0.54
2012	38197	23569	29416	35878	67081	1.25	1.52	2.85	0.62
Average	**36239**	**19507**	**24938**	**29951**	**54473**	**1.29**	**1.56**	**2.84**	**0.54**

Summer Season

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835.053	14202	16266	18276	39325	1.15	1.29	2.77	0.41
2009	34551.68354	18161	19905	22756	31565	1.10	1.25	1.74	0.53
2010	35808.24122	20561	23709	28324	53883	1.15	1.38	2.62	0.57
2011	37801.6958	18656	23846	26387	40749	1.28	1.41	2.18	0.49
2012	38197.36887	24430	24377	35878	67081	1.00	1.47	2.75	0.64
Average	**36239**	**19202**	**21621**	**26324**	**46521**	**1.13**	**1.36**	**2.41**	**0.53**

Winter Season

Year	EDUs	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average Dry Season Flow			Annual BOD per EDU
		Average	Maximum Month	Maximum Week	Maximum Day	Maximum Month	Maximum Week	Maximum Day	
2008	34835.053	16373	23543	31550	62501	1.44	1.93	3.82	0.47
2009	34551.68354	16255	18890	23421	40016	1.16	1.44	2.46	0.47
2010	35808.24122	21330	27426	31185	54609	1.29	1.46	2.56	0.60
2011	37801.6958	22456	24402	27721	48158	1.09	1.23	2.14	0.59
2012	38197.36887	22688	29318	31843	60725	1.29	1.40	2.68	0.59
Average	**36239**	**19820**	**24716**	**29144**	**53202**	**1.25**	**1.49**	**2.73**	**0.54**

Table I-3
Tri-City WPCP
Influent TSS Population Equivalent

Average Annual

Year	Capita Load	Historical Average Annual Loads (lbs/day)				Historical Population Equivalent From Average			
		Average	Maximum Month	Maximum Week	Maximum Day	Average	Maximum Month	Maximum Week	Maximum Day
2008	0.22	15281	23543	31550	62501	69459	107014	143409	284095
2009	0.22	17219	19905	23421	40016	78268	90477	106459	181891
2010	0.22	20944	27426	31185	54609	95200	124664	141750	248223
2011	0.22	20521	24402	27721	48158	93277	110918	126005	218900
2012	0.22	23569	29416	35878	67081	107132	133709	163082	304914
Average	**0.22**	**19507**	**24938**	**29951**	**54473**	**88667**	**113356**	**136141**	**247605**

Summer Season

Year	Capita Load	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average			
		Average	Maximum Month	Maximum Week	Maximum Day	Average	Maximum Month	Maximum Week	Maximum Day
2008	0.22	14202	16266	18276	39325	64555	73936	83073	178750
2009	0.22	18161	19905	22756	31565	82550	90477	103436	143477
2010	0.22	20561	23709	28324	53883	93459	107768	128745	244923
2011	0.22	18656	23846	26387	40749	84800	108391	119941	185223
2012	0.22	24430	24377	35878	67081	111045	110805	163082	304914
Average	**0.22**	**19202**	**21621**	**26324**	**46521**	**87282**	**98275**	**119655**	**211457**

Winter Season

Year	Capita Load	Historical Average Annual Loads (lbs/day)				Historical Peaking Factors From Average Dry Season Flow			
		Average	Maximum Month	Maximum Week	Maximum Day	Average	Maximum Month	Maximum Week	Maximum Day
2008	0.22	16373	23543	31550	62501	74423	107014	143409	284095
2009	0.22	16255	18890	23421	40016	73886	85864	106459	181891
2010	0.22	21330	27426	31185	54609	96955	124664	141750	248223
2011	0.22	22456	24402	27721	48158	102073	110918	126005	218900
2012	0.22	22688	29318	31843	60725	103127	133264	144741	276023
Average	**0.22**	**19820**	**24716**	**29144**	**53202**	**90093**	**112345**	**132473**	**241826**