Plains Midstream Canada Spill
Interim Water Quality Report

(June 18, 2012)

Executive Summary

In response to a pipeline break and subsequent discharge of light crude oil into the Red Deer River near Sundre, Plains Midstream Canada and Alberta Environment and Sustainable Resource Development implemented a surface water quality monitoring program beginning June 8. The following interim report examines results collected up to June 16.

While the booms placed on Gleniffer Lake prevented further downstream movement of visible oil product, dissolved components of the oil were found from Gleniffer Lake downstream to the City of Red Deer. Concentrations of dissolved petroleum hydrocarbons downstream of Gleniffer Lake (where dissolved hydrocarbons were primarily detected) were below the most sensitive applicable water quality guidelines for all parameters with the exception of toluene. Toluene frequently exceeded the protection of aquatic life guideline during the initial days of monitoring, but did not exceed applicable Health Canada drinking water guidelines downstream of Gleniffer Lake. All petroleum hydrocarbons decreased in concentration over time to below detectable quantities by June 16. Examination of data from locations past Red Deer did not find significantly detectable quantities of the examined petroleum hydrocarbons.

Polycyclic aromatic hydrocarbons (PAHs) exhibited a similar trend to the petroleum hydrocarbons, initially entering Gleniffer Lake and then being widely distributed from Gleniffer Lake to Red Deer and subsequently decreasing in concentration. Benz(a)anthracene protection of aquatic life guidelines were exceeded at a number of sites, although concentrations were overall quite low.

Drinking water samples showed a similar pattern for petroleum hydrocarbons with concentrations decreasing to below detection limit by June 14. While drinking water plants did not appear to remove significant quantities of the petroleum hydrocarbons in their treatment process, concentrations of all parameters examined were well below Health Canada drinking water guidelines and thus were unlikely to pose a risk to human health.

At this time, Alberta Environment and Sustainable Resource Development in consultation with Plains Midstream Canada is recommending a gradual reduction in the frequency of sampling to reflect current water quality trends. Due to the exceedances in protection of aquatic life guidelines observed for some parameters, it is further recommended that short and long-term effects on the fish and non-fish biota be examined both upstream and downstream of Gleniffer Lake to determine what, if any, effects these exceedances had on the receiving environment.

Introduction

On June 7, 2012, a pipeline owned and operated by Plains Midstream Canada (Plains) failed and discharged between 1,000 to 3,000 barrels (159,000 to 477,000L) of light crude oil to the Red Deer River near Sundre. In response to the spill, Matrix Solutions Inc (Matrix) was contracted to conduct water quality monitoring beginning June 8, 2012. In addition to sampling conducted by Matrix, Alberta Environment and Sustainable Resource Development (ESRD) also conducted sampling beginning June 8, 2012. The following provides a brief overview of some of the major findings to date. This report focuses on surface water sampling only, including drinking water plant data, but does not include data obtained from groundwater wells.

Sample Locations

Locations from which sample locations were collected by Matrix are indicated in Figures 1 to 4 and in Table 2. Locations sampled by ESRD are provided in Table 1. In general, the sample locations can be broken into several sections:

1. Reference locations – these are sites located upstream of the pipeline breakpoint on the Red Deer River. Concentrations of parameters at reference locations are considered background in nature.
2. Breakpoint to Gleniffer Lake – these locations vary from immediately downstream of the breakpoint location to the entrance at Gleniffer Lake.
3. Gleniffer Lake – Gleniffer Lake is the reservoir contained behind the Dickson Dam. The Red Deer River enters Gleniffer Lake approximately 42km downstream of the breakpoint.
4. Boom 2 and boom 1 – These booms were deployed in response to the spill. Boom 1 is located nearest to the Dickson Dam, while Boom 2 is located across the reservoir between the Carefree and Gleniffer Lake resorts.
5. Dickson Dam to Red Deer – these locations are on the Red Deer River from the Dickson Dam downstream.

Frequency of sampling has varied for individual locations as additional sites were added in response to required water quality sampling requirements. In general, sites are sampled once or twice daily. Samples have been submitted to accredited laboratories for analysis (hydrocarbons submitted to AGAT for Matrix, ALS for ESRD) with rush priority analyses. Despite the high priority placed on these samples, results have generally taken 24 to 48 hours to become available due to other factors such as sampling times (samples collected later in the day are generally not shipped out until the following morning), courier availability and transport time (shipping from central Alberta to Calgary or Edmonton) and report generation time. Thus, it must be kept in mind that water quality data is not real-time data.

Table 1 – ESRD Spill Sample Locations

Site Name	Description	Sample Dates	Latitude (North)	Longitude (West)
RDR at Sundre	Reference location on river u/s of break point	June 9 and 15, 2012	51 47 41	114 38 15
RDR at Garrington	d/s of break point but u/s of reservoir	June 9 and 15, 2012	51 56 30	114 29 00
Gleniffer Lake profile (west)	Reservoir site, upstream of Carefree Resort boom (CP2). Sampled at shallow, mid and deep depths.	June 15, 2012	52 02 01	114 30 41
Gleniffer Lake profile (east)	Reservoir site, downstream of Carefree Resort boom. Sampled at shallow, mid and deep depths.	June 8, 9 and 15, 2012	52 02 56	114 13 04
RDR at Hwy 54	d/s of dam, near Anthony Henday intake	June 9 and 15, 2012	52 04 10	113 59 10
RDR at Hwy 2	u/s of City of Red Deer. Approximately 2km u/s of drinking water intake.	June 9 and 15, 2012	52 15 36	113 52 49
RDR at Nevis	Hwy 11A crossing, upstream of Stettler.	June 15, 2012	52 26 78	113 59 03
RDR at Morrin	Hwy 27, upstream of Drumheller.	June 15, 2012	51 65 11	112 90 38
RDR at Jenner	Near Hwy 884, near Jenner.	June 15, 2012	50 83 80	111 17 79

Results

Table 2 and Figures 5 to 14 provide the results for surface water quality sampling conducted by Matrix and ESRD up to June 15. Table 3 provides results from ESRD sampling on June 8, 9 and 15, 2012. At this time, results are being presented for a select number of petroleum hydrocarbon parameters (benzene, ethylbenzene, toluene and total xylenes) and polycyclic aromatic hydrocarbons (2-methynaphthalene, fluorene, naphthalene, phenanthrene and benz(a)anthracene). From scans of preliminary data, these parameters have been present in quantifiable amounts on a routine basis. Most other hydrocarbon parameters have remained below analytical detection limits the majority of the time. In addition, most of the parameters selected have associated water quality guidelines to which values can be compared.

When summarizing and plotting data, the general convention for water quality parameters for which values are indicated as being below analytical detection limits is to use one-half the detection limit as a surrogate value. While this is generally acceptable for parameters known to exist naturally in waters, hydrocarbons are not a natural part of the make-up of water in the Red Deer River and Gleniffer Lake. Thus, for data falling below analytical detection limits, a value of zero was assigned.

Petroleum Hydrocarbons

In general, there appears to have been a progression of the selected hydrocarbons from the breakpoint to downstream of the Dickson Dam. June 8 Matrix data indicates that all of the detectable hydrocarbons were contained upstream of the CP2 boom. ESRD data collected from Gleniffer Lake downstream of the CP2 boom on June 8 also did not find detectable quantities of the selected hydrocarbons.

On June 9, both Matrix and ESRD data showed a progression of hydrocarbons extending from Gleniffer Lake downstream. Concentrations upstream of Gleniffer Lake but downstream of the breakpoint were relatively low indicating that the majority of the hydrocarbons had been carried into the reservoir. As indicated by both Matrix and ESRD data, CP2 and CP1 booms did not appear to effectively mitigate migration of the selected hydrocarbons downstream. ESRD data indicates a larger concentration of the hydrocarbons at mid-depths in the reservoir. Given that these lighter weight hydrocarbons are dissolved in water, it would not be expected that these parameters would be retained behind the booms. Other data and field observations indicate that the booms were effective at retaining free oil product upstream.

Susbsequent sampling by Matrix on June 10 to 16 showed a similar pattern with very little hydrocarbons present from the breakpoint to Gleniffer Lake, but present in measurable quantities from Gleniffer Lake to the furthest point downstream. June 12 to 16 did show a marked decreased in concentrations at all sites indicating that the selected hydrocarbons have moved past the last point of measurement, been diluted by further inputs from the Red Deer River, or reduced through removal of accumulated oil from which these hydrocarbons originate.

With respect to guidelines, the protection of aquatic life (PAL) toluene guideline of 0.002mg/L was the most frequently exceeded of the four parameters. The toluene guideline was exceeded approximately 8% of the time in all ESRD samples (2 exceedances in 25 samples) and approximately 22% of the time in all Matrix samples (65 exceedances in 293 samples). Both sets of data showed a reduction in frequency of guideline exceedance since June 12 as toluene concentrations dropped. The associated guidelines for benzene, xylenes and ethylbenzene were rarely exceeded. Given that the CCME toluene PAL guideline is based on a 27-d LC_{50} for rainbow trout and multiplied by a safety factor of 0.1, and that toluene does not bioaccumulate, the risk to receiving environment organisms over a short-term period is relatively low.

It is worth noting that the toluene drinking water guideline of 0.024mg/L was exceeded on only one occasion to date at the Carefree Resort site (SW5) upstream of Boom 2 on June 8, 2012. This guideline is an odour threshold guideline and is generally applied for aesthetics as opposed to health risk concerns. Concentrations downstream of the Dickson Dam were, in general, an order of magnitude below the drinking water guideline. Thus, toluene is not expected to pose a risk to drinking water sources downstream of the Dickson Dam.

Polycyclic aromatic hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) showed a similar pattern to the petroleum hydrocarbons with detectable quantities found upstream of the CP2 boom on June 8, then progressing to widespread distribution from the breakpoint down to Red Deer by June 11. Data on PAHs was not collected or was unavailable from Plains subsequent to June 11, however ESRD data collected on June 15 showed a significant reduction in concentration of the selected PAH parameters. While some PAHs occurred in trace amounts upstream of the breakpoint location, the consistent pattern relative to the petroleum hydrocarbon data indicates that the PAHs detected downstream of the breakpoint were from spilled product.

Protection of aquatic life guidelines for PAHs were available for all of the PAHs examined except for 2-methylnaphthalene. All PAHs were below the applicable guidelnies with this exception of benz(a)anthracene which exceeded the applicable guideline of 0.000018mg/L in most instances when detected (all on June 11). However, it should be kept in mind that the guideline is very low level and near the analytical capabilities of the labs used. Thus detection of any amount of this parameter generally results in an exceedance.

Downstream Effects

Given detectable concentrations of petroleum hydrocarbons and PAHs downstream to Red Deer, the question of what far field concentrations was raised. On June 15, both ESRD and Matrix conducted further downstream sampling past Red Deer. ESRD hydrologists provided time of travel estimates based on flows from June 8 to 11 to the three ESRD locations (Table 4).

Table 4
Time of Travel Estimates, Red Deer River, June 8 to 11, 2012

Reach	Travel Time (days)	
	Low flow estimate	High flow estimate
Dickson Dam to Nevis	1.0	1.0
Dickson Dam to Morrin	1.4	1.5
Dickson Dam to Jenner	3.1	3.9

Based on Table 4, it was estimated that hydrocarbons detected on June 11 downstream of the Dickson Dam would potentially have travelled as far as the Jenner site. However, with the exception of minute quantities of naphthalene at the Nevis site, all concentrations were below detection limits.

Drinking Water Treatment Plants

Samples were collected from the Anthony Henday and Red Deer drinking water treatment plants as both plants are located downstream of the Dickson Dam and draw water from the Red Deer River. As with other surface water samples, only the selected petroleum hydocarbons and polycyclic aromatic hydrocarbons were chosen as all other hydrocarbon parameters were largely below detection limits on all dates. Samples were collected from raw intake water, pre-chlorination, and post treatment. Results from drinking water plant sampling are provided in Table 5 and graphically in Figures 15 to 18.

All four selected petroleum hydrocarbons showed peak concentrations corresponding to those occurring in the river samples, with concentrations generally being higher at the upstream Anthony Henday plant relative to Red Deer. Concentration of benzene, toluene or xylenes did not appreciable decrease from raw intake water to pre-chlorination to post treatment. However, concentrations dropped to below detection limits at all sampling locations by June 14 and all concentrations prior to this date were well below applicable Health Canada drinking water guidelines (0.005mg/L for benzene, 0.024mg/L for toluene, 0.0024mg/L for ethylbenzene and 0.3mg/L for xylenes). It is also worth noting that with the exception of benzene, all of these guidelines are aesthetic objectives.

PAHs were collected on only one occasion from each plant. Only 2-mehtylnapthalene and naphthalene were found in detectable concentrations, with naphthalene concentrations being well below aquatic life guidelines.

Summary and Recommendations

For the selected petroleum hydrocarbons and PAHs examined in this report, the trend appeared to be one of an initial pulse downstream of the breakpoint but upstream of Gleniffer Lake. Hydrocarbons were carried out of this upper portion of the Red Deer River within a short time span (approximately 36 hours) into Gleniffer Lake. Similar concentrations of the parameters both upstream and downstream of deployed booms indicates that while booms prevented free oil product from moving past, they were ineffective at preventing migration of these dissolved fractions downstream. Significant flows and mixing combined with dissolution into the water column may have resulted in the hydrocarbons being more thoroughly dispersed throughout the water column and were therefore able to flow under deployed blooms.

Toluene and benz(a)anthracene PAL guidelines were most frequently exceeded. Toluene concentrations were an order of magnitude below drinking water aesthetic odour guidelines below Dickson Dam. All other hydrocarbons examined (benzene, xylenes, ethylbenzene, 2-methylnaphthalene, naphthalene, fluorene and phenanthrene) rarely exceeded applicable guidelines. Given that concentrations of toluene and benz(a)anthracene did exceed PAL guidelines, it would be advisable to look at receiving environment effects upstream and downstream of Dickson Dam (both fish and non-fish biota).

Samples collected from the Anthony Henday and Red Deer drinking water treatment plants showed similar patterns in initial peaks of petroleum hydrocarbons, and subsequently declining to below detection limits within four days of initial sampling. Concentrations did not appreciable decline from the raw water intake to finished water, however all concentrations were significantly lower than applicable drinking water guidelines on all dates.

The trends observed in the most data indicate that the pulse of dissolved hydrocarbons has passed through the Red Deer River and subsequently was diluted from further inputs or otherwise lost through physical, chemical or biological removal. With clean-up of the parent product progressing, it is not expected that significant further inputs of the dissolved parameters will be observed. At this point, it is recommended in consultation with Plains and ESRD staff, that the surface water quality program be revised in order to reflect current data needs. Additional focused sampling efforts may be required if areas of contamination are identified or during flushing and removal of the damaged pipeline section to ensure further product and its derivatives are not flushed into the aquatic receiving environment.

Table 2
ater Chemistry Data for Selected Petroleum Hydrocarbons
d Polycyclic Aromatic Hydrocarbons

Easting	Northing	Benzene	Toluene	Ethylbenzene	Total Xylenes	2-Methylnaphthalene	Fluorene	Naphthalene	Phenanthrene	Benz[a]anthracene
682967	5740459	0	0	0	0	0.00002		0.00002		
663726	5744016	0	0	0	0	0.00002		0.00003		
663720	5744081	0.0009	0.0015	0	0.0017	0.00119	0.00017	0.00042	0.00027	
672970	5757549	0.0006	0.0011	0	0.0013	0.00047	0.00006	0.00023	0.0001	
672864	5757649	0.0005	0.001	0	0.0015	0.00048	0.00007	0.00024	0.0001	
684718	5764578	0.001	0.0025	0	0.0022	0.00261	0.00039	0.00128	0.00074	
685933	5766437	0.0127	0.0314	0.0042	0.0265	0.00623	0.00034	0.0047	0.00046	
686055	5768362	0	0	0	0	0.00001		0.00001		
687378	5766953	0	0	0	0			0.00001		
690999	5770696	0	0	0	0			0.00001		
690999	5770696	0	0	0	0			0.00002		
691076	5771000	0	0	0	0			0.00001		
691076	5771000	0	0	0	0			0.00002		

Easting	Northing	Benzene	Toluene	Ethylbenzene	Total Xylenes	2-Methylnaphthalene	Fluorene	Naphthalene	Phenanthrene	Benz[a]anthracene
682967	5740459	0	0	0	0	0.00001		0.00001	0.00001	
682967	5740459	0	0	0	0			0.00001		
663726	5744016	0	0	0	0	0.00001		0.00002	0.00001	
663726	5744016	0	0	0	0					
663720	5744081	0	0.0012	0	0	0.00003		0.00004	0.00001	
663720	5744081	0	0.0008	0	0.0008	0.00008		0.00004		
672864	5757649	0	0.0012	0	0.0009	0.00015	0.00002	0.0001	0.00005	
672864	5757649	0	0.0009	0	0.0009	0.00007	0.00001	0.00003	0.00002	
684718	5764578	0	0	0	0	0.00014	0.00002	0.00008	0.00007	
684718	5764578	0	0	0	0	0.00007	0.00001	0.00003	0.00003	
685933	5766437	0.0014	0.0043	0.0006	0.0031	0.00068	0.00006	0.0005	0.00011	
685933	5766437	0	0.0004	0	0.00095	0.0001	0.00002	0.0001	0.00003	
686055	5768362	0.0009	0.0026	0.0005	0.0023	0.00027		0.00019	0.00003	
686055	5768362	0.0015	0.0044	0.0009	0.0048	0.00019	0.00001	0.00013	0.00002	
687378	5766953	0.0011	0.0045	0.0008	0.0034	0.00051		0.00034	0.00004	
687378	5766953	0	0.0021	0.0015	0.0007	0.00011		0.00008	0.00001	
		0.0008	0.0033	0.0012	0.0035	0.0002		0.00019		
690999	5770696	0.00175	0.00475	0.00085	0.00455	0.0005	0.00003	0.00039	0.00004	

690999	5770696	0.0013	0.0031	0.0008	0.0022					
691076	5771000	0.0018	0.0079	0.0009	0.0064	0.00079	0.00006	0.00061	0.00007	
691076	5771000	0.0022	0.0059	0.0008	0.0052					

Easting	Northing	Benzene	Toluene	Ethylbenzene	Total Xylenes	2-Methylnaphthalene	Fluorene	Naphthalene	Phenanthrene	Benz[a]anthracene
682967	5740459	0	0	0	0					
682967	5740459	0	0	0	0					
663726	5744016	0	0	0	0					
663720	5744081	0	0	0	0					
663720	5744081	0	0	0	0					
663720	5744081	0	0.0037	0	0.0029					
672864	5757649	0	0	0	0					
672864	5757649	0	0	0	0					
684718	5764578	0	0	0	0					
684718	5764578	0	0	0	0					
685933	5766437	0	0	0	0					
685933	5766437	0	0	0	0					
686055	5768362	0.002	0.0051	0.0007	0.0051					
686055	5768362	0.0034	0.0093	0.0007	0.0064					

687378	5766953	0	0.0009	0	0					
687378	5766953	0	0	0	0					
690990	5770089	0.002	0.0048	0.0007	0.0048	0.00072		0.00047		
690637	5770210	0.0023	0.0052	0	0.0049	0.00074		0.0005		
690827	5770193	0.0019	0.0046	0.0009	0.0055	0.00072		0.00050		
690827	5770193	0.003	0.0085	0.0011	0.0098	0.00108		0.00079		
690827	5770193	0.002	0.0048	0.0007	0.0054	0.00069		0.00051		
690999	5770696	0.0005	0.0017	0	0.0012					
690999	5770696	0.0011	0.0023	0	0.0017					
691076	5771000	0.0023	0.0053	0.0007	0.004					
691076	5771000	0.0015	0.0034	0	0.0025					
		0.0016	0.0035	0	0.0031					
704928	5771371	0.0021	0.005	0.0007	0.0052					
704928	5771371	0.0014	0.003	0	0.0025					
296940	5781061	0.0008	0.0024	0	0.0021					
303437	5793884	0.001	0.002	0	0.0018					

Easting	Northing	Benzene	Toluene	Ethylbenzene	Total Xylenes	2-Methylnaphthalene	Fluorene	Naphthalene	Phenanthrene	Benz[a]anthracene
682967	5740459	0	0	0	0					

682967	5740459	0	0	0	0			0.00001		
663726	5744016	0	0	0	0					
663726	5744016	0	0	0	0					
663720	5744081	0	0	0	0	0.0001		0.00007	0.00002	
663720	5744081	0	0.0007	0	0.0012	0.00018	0.00002	0.00012	0.00004	
672864	5757649	0	0	0	0	0.0001		0.00005	0.00003	
672864	5757649	0	0	0	0	0.00012		0.00007		
684718	5764578	0	0	0	0	0.00015		0.00006	0.00004	
684718	5764578	0	0	0	0	0.00011		0.00007		
685933	5766437	0	0.0014	0	0	0.00018		0.0001	0.00005	
685933	5766437	0	0	0	0					
685695	5767561	0.0011	0.0026	0	0.0032	0.00056	0.00004	0.00041	0.00008	
685748	5767183	0	0.0011	0	0.0008	0.00035	0.00003	0.00024	0.00007	
685748	5767183	0	0	0	0	0.00015	0.00002	0.00008	0.00006	0.0001
685748	5767183	0	0	0	0	0.00023	0.00003	0.00014	0.00006	0.00009
685825	5767051	0.0023	0.0051	0.0005	0.0063	0.00088	0.00006	0.00069	0.00009	0.00006
689169	5768376	0.0009	0.0031	0.0005	0.0036	0.00053	0.00003	0.00044	0.00005	0.00007
688947	5768939	0.002	0.0039	0.0006	0.0048	0.00056	0.00003	0.00048	0.00005	0.00006

688947	5768939	0.0021	0.0042	0.0006	0.0053	0.00073	0.00005	0.00058	0.00008	0.00006
688947	5768939	0.0007	0.0012	0	0.0019	0.00031	0.00003	0.00022	0.00007	
686055	5768362	0.0025	0.0074	0.0009	0.0054	0.00197	0.0001	0.00153	0.00014	
686055	5768362	0.003	0.0068	0.0013	0.0076					
687378	5766953	0.001	0.0033	0.0005	0.0023	0.00099	0.00007	0.00070	0.00012	
687378	5766953	0.0011	0.0022	0	0.0031					
690990	5770089	0.0018	0.0035	0.0006	0.0043	0.0006	0.00004	0.00052	0.00005	0.00006
690827	5770193	0.0025	0.0062	0.0007	0.0066	0.00087	0.00005	0.00073	0.00006	0.00006
690827	5770193	0.004	0.011	0.0015	0.0123	0.00135	0.00007	0.00109	0.0001	0.00006
690827	5770193	0.002	0.0039	0.0006	0.0048	0.00065	0.00004	0.00051	0.00007	0.00006
690637	5770210	0.0025	0.0056	0.0006	0.0063	0.00082	0.00004	0.00070	0.00006	0.00006
688745	5769447	0.0019	0.0039	0.0006	0.0049	0.00058	0.00003	0.00050	0.00005	
690999	5770696	0.0007	0.0018	0	0.0008	0.00046	0.00003	0.00038	0.00004	
690999	5770696	0.0011	0.0028	0.0006	0.0027					
691076	5771000	0.0018	0.0042	0.0005	0.0029	0.00098	0.00005	0.00082	0.00006	
691076	5771000	0.0034	0.0076	0.0012	0.0084					
		0.002	0.0045	0	0.0059	0.00078		0.00074		
704928	5771371	0.00185	0.0036	0.0007	0.00315					

704928	5771371	0.0013	0.0035	0	0.0041	0.00055		0.00055		
704928	5771371	0.0013	0.0032	0	0.0039					
296940	5781061	0.0014	0.0037	0.0006	0.004					
296940	5781061	0.0013	0.0032	0.0005	0.0041					
303437	5793884	0.0011	0.0027	0	0.0038					
303437	5793884	0.0013	0.0028	0	0.0036					

Easting	Northing	Benzene	Toluene	Ethylbenzene	Total Xylenes	2-Methylnaphthalene	Fluorene	Naphthalene	Phenanthrene	Benz[a]anthracene
682967	5740459	0	0	0	0					
682967	5740459	0	0	0	0					
663726	5744016	0	0	0	0					
663726	5744016	0	0	0	0					
663726	5744081	0	0.001	0	0					
663726	5744081	0	0	0	0					
672864	5757649	0	0	0	0					
672864	5757649	0	0	0	0					
684718	5764578	0	0	0	0					
684718	5764578	0	0	0	0					
685933	5766437	0	0	0	0.0018					

685933	5766437	0	0	0	0
685695	5767561	0	0	0	0
685748	5767183	0	0	0	0
685748	5767183	0	0	0	0
685748	5767183	0	0	0	0
685825	5767051	0	0.0009	0	0
689169	5768376	0.001	0.0023	0	0.0045
688947	5768939	0.0006	0.001	0	0.0016
688947	5768939	0.0008	0.0011	0	0.0021
688947	5768939	0.0007	0.0013	0	0.0028
676441	5761144	0	0	0	0
686055	5768362	0.0011	0.0012	0	0.0023
686055	5768362	0.0008	0.001	0	0.0022
687378	5766953	0.0008	0.0008	0	0.0031
687378	5766953	0.0008	0.0007	0	0.0017
690990	5770089	0.0012	0.0022	0	0.0029
690827	5770193	0.0011	0.0026	0	0.0037

Easting	Northing	Benzene	Toluene	Ethylbenzene	Total Xylenes	2-Methylnaphthalene	Fluorene	Naphthalene	Phenanthrene	Benz[a]anthracene
690827	5770193	0	0.0005	0	0.0017					
690827	5770193	0	0.0007	0	0.0016					
690637	5770210	0.0017	0.0038	0.0005	0.004					
688745	5769447	0.0015	0.0035	0	0.0049					
690999	5770696	0.001	0.0011	0	0.0037					
690999	5770696	0.0016	0.0042	0.001	0.008					
691076	5771000	0.0013	0.0023	0	0.0028					
691076	5771000	0.0021	0.0038	0.0007	0.0044					
695659	5773319	0.0009	0.0019	0.0006	0.0036					
695659	5773319	0.0014	0.0022	0.0005	0.0034					
695659	5773319	0.0015	0.0017	0.0007	0.0049					
704928	5771371	0	0.0006	0	0.0006					
704928	5771371	0.0009	0.0018	0	0.0018					
296940	5781061	0	0	0	0					
296940	5781061	0	0.0012	0	0.0014					
303437	5793884	0	0	0	0					
303437	5793884	0	0	0	0					

682967	5740459	0	0	0	0
663726	5744016	0	0	0	0
663726	5744081	0	0	0	0
672864	5757649	0	0	0	0
676441	5761144	0	0	0	0
684718	5764578	0	0	0	0
685933	5766437	0	0	0	0
686055	5768362	0.0008	0.0011	0	0.0024
686055	5768362	0	0.001	0	0.002
687378	5766953	0.0005	0.0005	0	0.0016
687378	5766953	0	0	0	0.0008
690999	5770696	0.0018	0.003	0.0005	0.0056
690999	5770696	0.0012	0.0014	0	0.004
691076	5771000	0.0023	0.0032	0	0.0062
691076	5771000	0.0012	0.0025	0	0.0039
704928	5771371	0.0009	0.0018	0	0.0016
296940	5781061	0.0009	0.0008	0	0.0009
296940	5781061	0.0007	0.0013	0	0.0025
303437	5793884	0.0006	0.0005	0	0.0012

303437	5793884	0.0007	0.0011	0	0.0024					

Easting	Northing	Benzene	Toluene	Ethylbenzene	Total Xylenes	2-Methylnaphthalene	Fluorene	Naphthalene	Phenanthrene	Benz[a]anthracene
682967	5740459	0	0	0	0					
663726	5744016	0	0	0	0					
663726	5744081	0	0	0	0					
672864	5757649	0	0	0	0					
676441	5761144	0	0	0	0					
684718	5764578	0	0	0	0					
685933	5766437	0	0	0	0					
685695	5767561	0	0	0	0					
685748	5767183	0	0	0	0					
685748	5767183	0	0	0	0					
685748	5767183	0	0	0	0					
685825	5767051	0	0	0	0					
689169	5768376	0	0	0	0					
688947	5768939	0	0	0	0					
688947	5768939	0.0008	0	0	0.0014					

688947	5768939	0.0006	0	0	0.0016
686055	5768362	0.0006	0.0008	0	0.0037
686055	5768362	0	0	0	0.0014
687378	5766953	0	0	0	0
690990	5770089	0.0005	0	0	0.0016
690827	5770193	0.001	0.0006	0	0.0031
690827	5770193	0.0007	0	0	0.0026
690827	5770193	0.0007	0	0	0.0007
690637	5770210	0.0005	0	0	0.0009
688745	5769447	0	0	0	0
690999	5770696	0	0.0007	0	0.0015
690999	5770696	0.0005	0	0	0.0013
691076	5771000	0.0008	0	0	0.0011
695659	5773319	0	0	0	0.0013
704928	5771371	0	0	0	0
296940	5781061	0	0.0029	0	0.0008
296940	5781061	0	0	0	0
303437	5793884	0	0.0029	0	0.0027

303437	5793884	0	0	0	0					

Easting	Northing	Benzene	Toluene	Ethylbenzene	Total Xylenes	2-Methylnaphthalene	Fluorene	Naphthalene	Phenanthrene	Benz[a]anthracene
682967	5740459	0	0	0	0					
682967	5740459	0	0	0	0					
663726	5744016	0	0	0	0					
663726	5744016	0	0	0	0					
663726	5744081	0	0	0	0					
663726	5744081	0	0	0	0					
672864	5757649	0	0	0	0					
672864	5757649	0	0	0	0					
676441	5761144	0	0	0	0					
676441	5761144	0	0	0	0					
684718	5764578	0	0	0	0					
684718	5764578	0	0	0	0					
685933	5766437	0	0	0	0					
685933	5766437	0	0	0	0					
685695	5767561	0	0	0	0					
685748	5767183	0	0	0	0					

685748	5767183	0	0	0	0
685748	5767183	0	0	0	0
685825	5767051	0	0	0	0
689169	5768376	0	0	0	0
688947	5768939	0	0	0	0
688947	5768939	0	0	0	0
688947	5768939	0	0	0	0
686055	5768362	0	0	0	0.002
686055	5768362	0	0	0	0.001
687378	5766953	0	0	0	0
687378	5766953	0	0	0	0
690990	5770089	0	0	0	0
690827	5770193	0	0	0	0.0011
690827	5770193	0	0	0	0.0014
690827	5770193	0	0	0	0.0009
690637	5770210	0	0	0	0.0012
688745	5769447	0	0	0	0.0012
690999	5770696	0	0	0	0.0018

690999	5770696	0	0	0	0.0006					
691076	5771000	0	0	0	0.0026					
691076	5771000	0	0	0	0.0015					
695659	5773319	0	0	0	0.002					
695659	5773319	0	0	0	0.0008					
704928	5771371	0	0	0	0.0014					
704928	5771371	0	0	0	0					
296940	5781061	0	0	0	0.0009					
296940	5781061	0	0	0	0					
		0	0	0	0.00103		0	0.000136	0	
303437	5793884	0	0	0	0.0006					
303437	5793884	0	0	0	0					
358387	5797267	0	0	0	0					
366430	5765558	0	0	0	0					

Easting	Northing	Benzene	Toluene	Ethylbenzene	Total Xylenes	2-Methylnaphthalene	Fluorene	Naphthalene	Phenanthrene	Benz[a]anthracene
682967	5740459	0	0	0	0					
663726	5744016	0	0	0	0					
663726	5744081	0	0	0	0					

672864	5757649	0	0	0	0
676441	5761144	0	0	0	0
684718	5764578	0	0	0	0
685933	5766437	0	0	0	0
686055	5768362	0	0	0	0
687378	5766953	0	0	0	0
690999	5770696	0	0	0	0
691076	5771000	0	0	0	0
695659	5773319	0	0	0	0
704928	5771371	0	0	0	0
296940	5781061	0	0	0	0
303437	5793884	0	0	0	0

Table 3
Deer River Spill Water Quality Data

Date	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Phenanthrene	Fluorene
8-Jun	0	0	0	0	0	0	0
8-Jun	0	0	0	0	0	0	0
8-Jun	0	0	0	0	0	0	0
8-Jun	0	0	0	0	0	0.000052	0
8-Jun	0	0	0	0	0	0	0
9-Jun	0	0	0	0	0	0	0
9-Jun	0	0	0	0	0.000088	0.000056	0
9-Jun	0.00051	0.0011	0	0.00057	0.00015	0	0
9-Jun	0.00487	0.0142	0.00129	0.00945	0.00101	0.000104	0.000089
9-Jun	0	0.00055	0	0	0	0	0
9-Jun	0.00151	0.00378	0	0.00208	0.000372	0.000058	0
9-Jun	0	0.00059	0	0	0.000081	0	0
15-Jun	0	0	0	0	0	0	0
15-Jun	0	0	0	0	0	0	0
15-Jun	0	0	0	0	0	0	0
15-Jun	0	0	0	0	0	0	0
15-Jun	0	0	0	0	0	0	0
15-Jun	0	0.00055	0	0	0.000176	0	0
15-Jun	0	0.00053	0	0.00182	0.000215	0.000053	0
15-Jun	0	0.0005	0	0.00126	0.000169	0.000057	0
15-Jun	0	0	0	0.00103	0.000136	0	0
15-Jun	0	0	0	0.00075	0.00013	0	0
15-Jun	0	0	0	0	0.000061	0	0
15-Jun	0	0	0	0	0	0	0
15-Jun	0	0	0	0	0	0	0

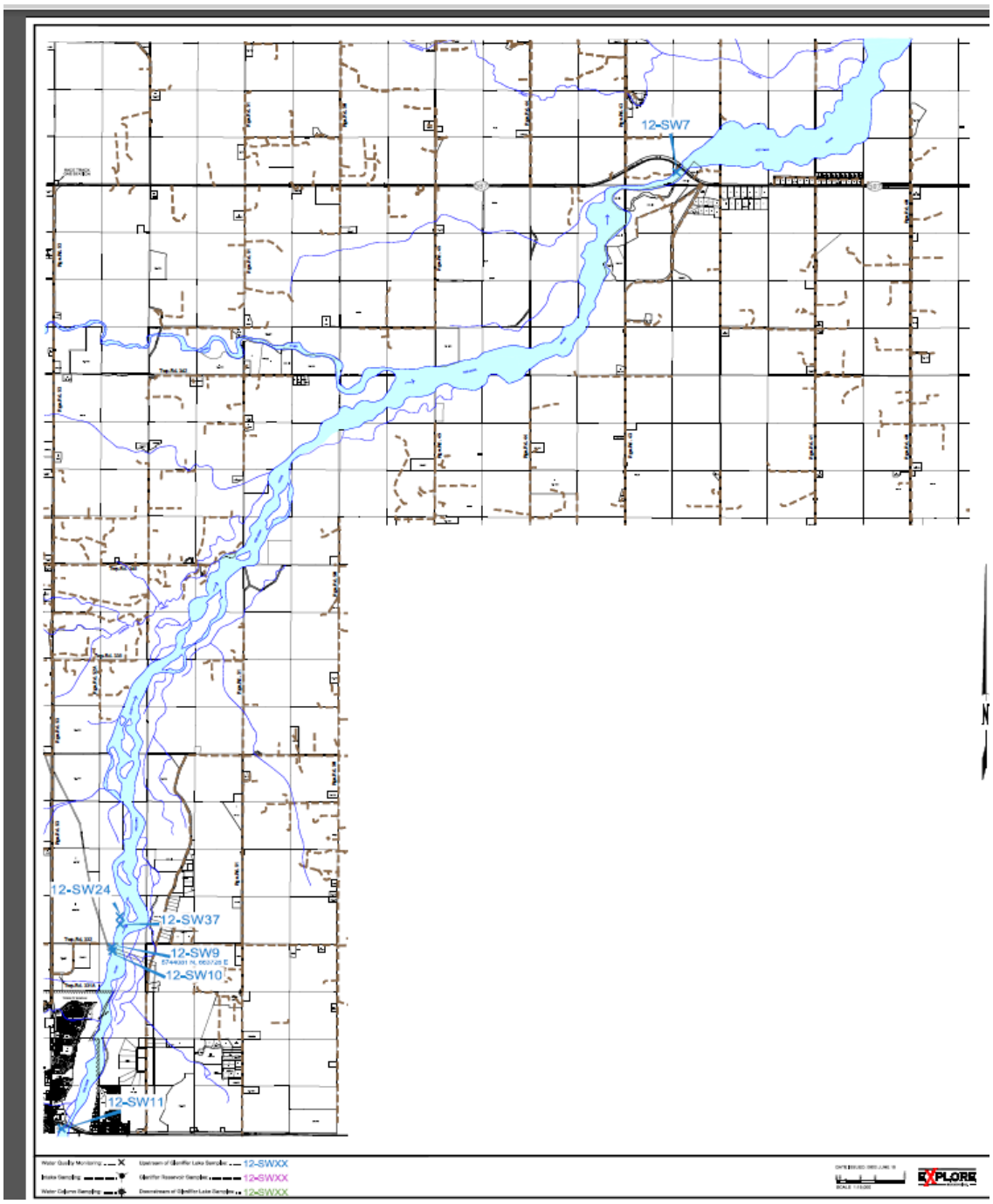
Table 5
stry Data for Selected Petroleum Hydrocarbons
drocarbons, Drinking Water Treatment Plants

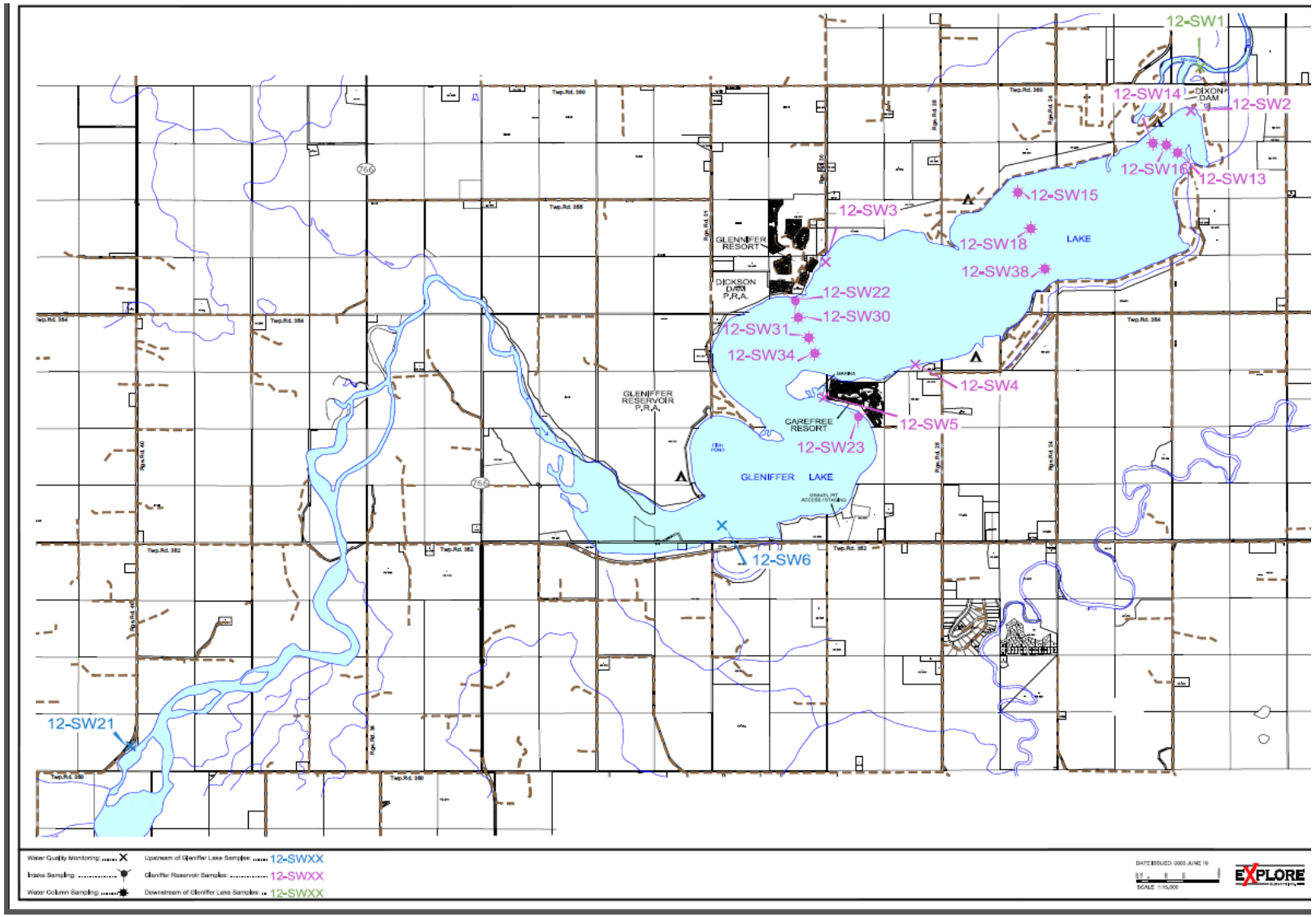
le Number	Benzene	Toluene	Ethylbenzene	Total Xylenes	2-Methylnaphthalene	Fluorene	Benz[a]anthracene	Naphthalene	Phenanthrene
120610126	0.0008	0.0027	0	0.0023	0.00062	0	0	0.00045	0
120610027	0.0011	0.003	0	0.0024	---	---	---	---	---
120611408	0.0017	0.0036	0.0005	0.0039	---	---	---	---	---
120612405	0	0.00087	0	0.00076	---	---	---	---	---
120612416	0.0009	0.0015	0	0.002	---	---	---	---	---
120613406	0.001	0.0014	0.0007	0.0029	---	---	---	---	---
120613415	0.0006	0.0011	0	0.0024	---	---	---	---	---
120614405	0	0	0	0	---	---	---	---	---
120614414	0	0	0	0					
120615407	0	0	0	0					
120615419	0	0	0	0					
120616407	0	0	0	0					
120611406	0.0011	0.00235	0	0.0012	---	---	---	---	---
120611415	0.0015	0.0024	0	0.0006	---	---	---	---	---
120612406	0.00057	0	0	0	---	---	---	---	---
120612418	0	0	0	0	---	---	---	---	---
120613407	0.00076	0.0007	0	0	---	---	---	---	---

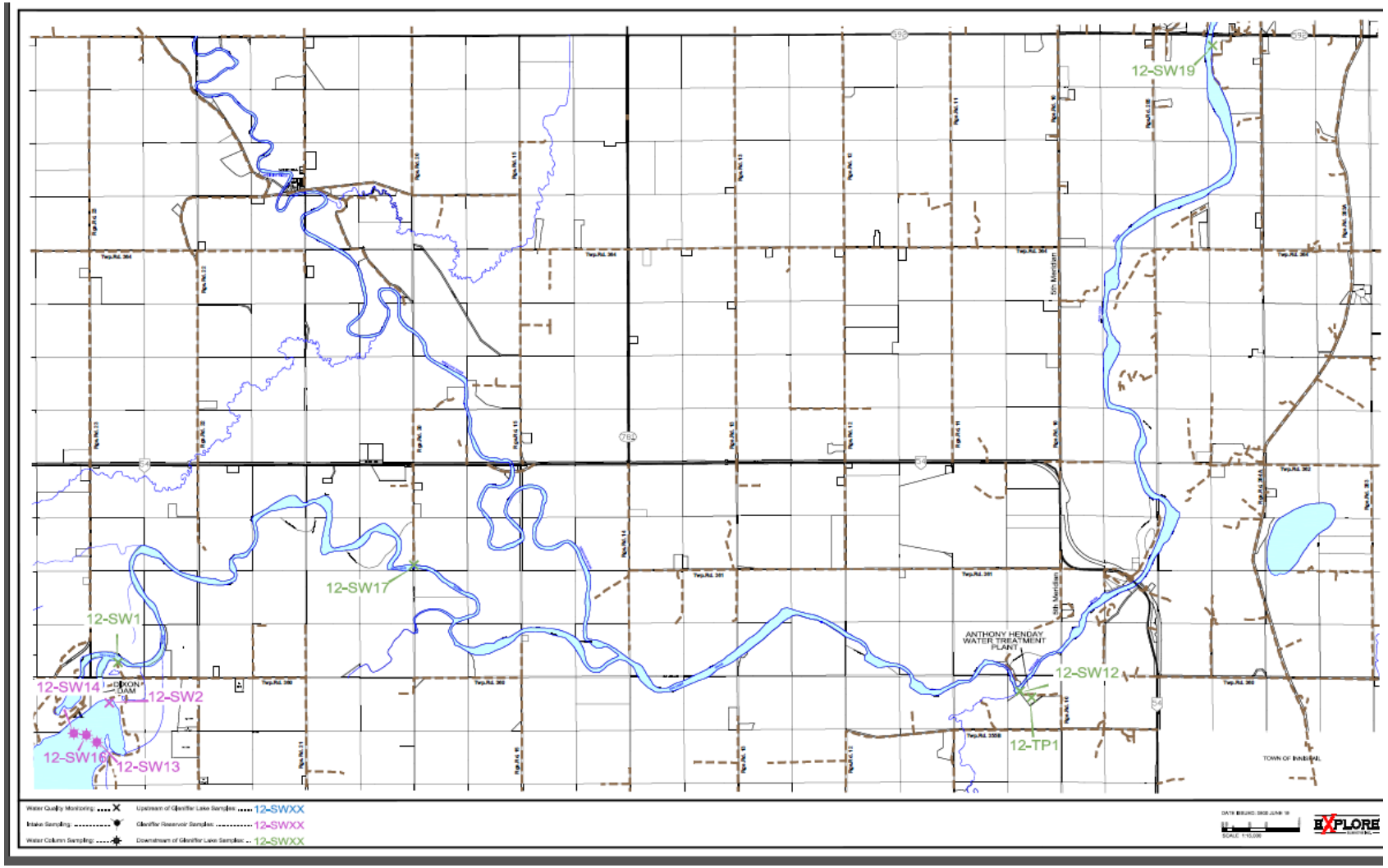
120613417	0.0011	0.0008	0	0	---	---	---	---	---
120614406	0	0	0	0	---	---	---	---	---
120614416	0	0	0	0					
120615409	0	0	0	0	---	---	---	---	---
120615421	0	0	0	0					
120616409	0	0	0	0					
120612410	0	0	0	0	---	---	---	---	---
120612417	0.0007	0.0007	0	0.0008	---	---	---	---	---
120613409	0.0006	0.0006	0	0.0012	---	---	---	---	---
120613416	0.0008	0	0	0.0007	---	---	---	---	---
120614408	0	0	0	0	---	---	---	---	---
120614415	0	0	0	0					
120615408	0	0	0	0					
120615420	0	0	0	0					
120616408	0	0	0	0					
120615411	0.0006	0	0	0					
120610121	0.0006	0.0017	0	0.0015	0.00044	0	0	0.00036	0
120611400	0.001	0.0018	0	0.0018	---	---	---	---	---
120611412	0.0008	0.0021	0	0.0031	---	---	---	---	---
120612400	0.0006	0	0	0	---	---	---	---	---
120612411	0	0	0	0	---	---	---	---	---

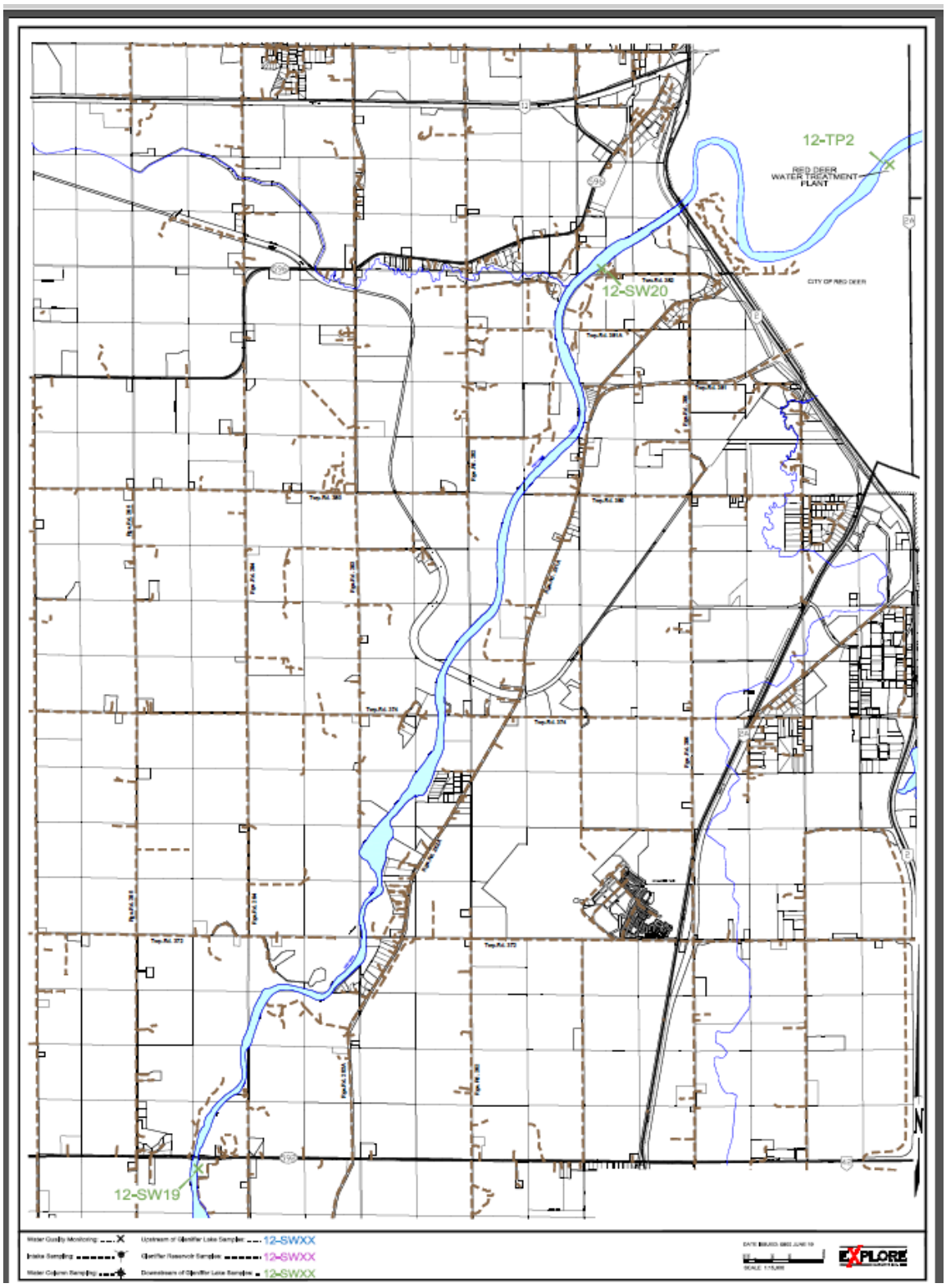
120613400	0.0005	0.0006	0	0	---	---	---	---	---
120613411	0.0007	0.0009	0	0.0023	---	---	---	---	---
120614400	0	0	0	0	---	---	---	---	---
120614410	0	0	0	0					
120615400	0	0	0	0					
120615414	0	0	0	0					
120616400	0	0	0	0					
120611402	0.0007	0.001	0	0.0012	---	---	---	---	---
120611413	0.0006	0.0014	0	0.0024	---	---	---	---	---
120612401	0.00043	0.0005	0	0	---	---	---	---	---
120612412	0	0	0	0	---	---	---	---	---
120613401	0.00061	0.0006	0.0005	0.0017	---	---	---	---	---
120613412	0.0005	0.0009	0	0.0016	---	---	---	---	---
120614401	0	0	0	0	---	---	---	---	---
120614411	0	0	0	0					
120615401	0	0	0	0	---	---	---	---	---
120615415	0	0	0	0					
120616401	0	0	0	0					
120612419	0	0	0	0	---	---	---	---	---
120615403	0	0	0	0					

Figures 1 to 4 – Plains/Matrix Water Quality Sample Locations


12-SW7
12-SW24
12-SW37
12-SW9
12-SW10
12-SW11
12-SWXX
12-SWXX
12-SWXX


12-SW1
12-SW14
DIXON DAM
12-SW2
12-SW16
12-SW13
12-SW15
12-SW3
GLENIFFER RESORT
12-SW18
LAKE
12-SW38
DICKSON DAM P.R.A.
12-SW22
12-SW30
12-SW31
12-SW34
12-SW4
GLENIFFER RESERVOIR P.R.A.
CAREFREE RESORT
12-SW5
12-SW23
GLENIFFER LAKE
12-SW6
12-SW21
Water Quality Monitoring:
Intake Sampling:
Water Column Sampling:
Upstream of Gleniffer Lake Samples: 12-SWXX
Gleniffer Reservoir Samples: 12-SWXX
Downstream of Gleniffer Lake Samples: 12-SWXX
EXPLORE

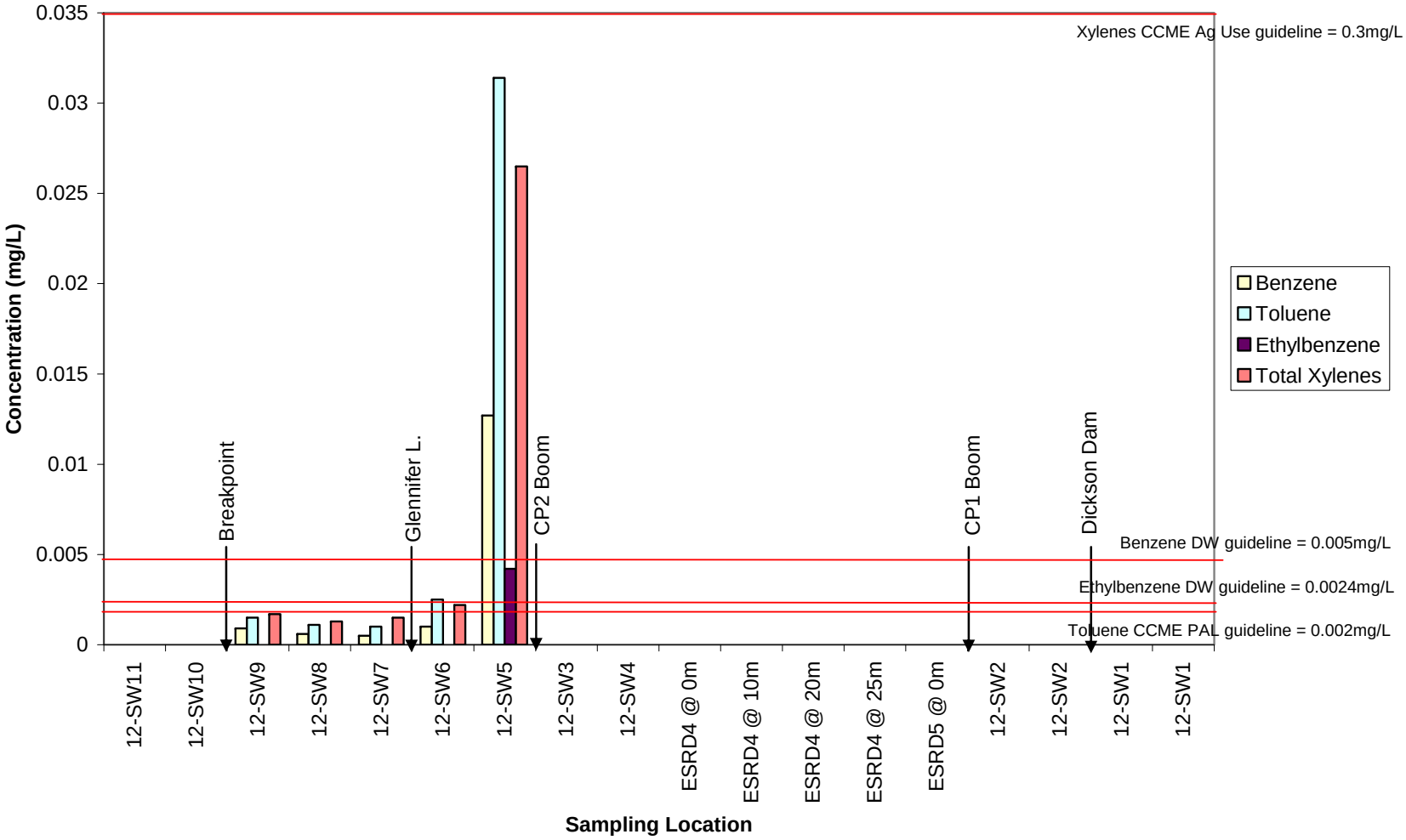

12-SW19
12-SW17
12-SW1
12-SW14
DIXON DAM
12-SW2
12-SW16
12-SW13
ANTHONY HENDAY WATER TREATMENT PLANT
12-SW12
12-TP1
5th Meridian
TOWN OF INNISFAIL
Water Quality Monitoring:
Intake Sampling:
Water Column Sampling:
Upstream of Glenifer Lake Samples: 12-SWXX
Glenifer Reservoir Samples: 12-SWXX
Downstream of Glenifer Lake Samples: 12-SWXX
EXPLORE

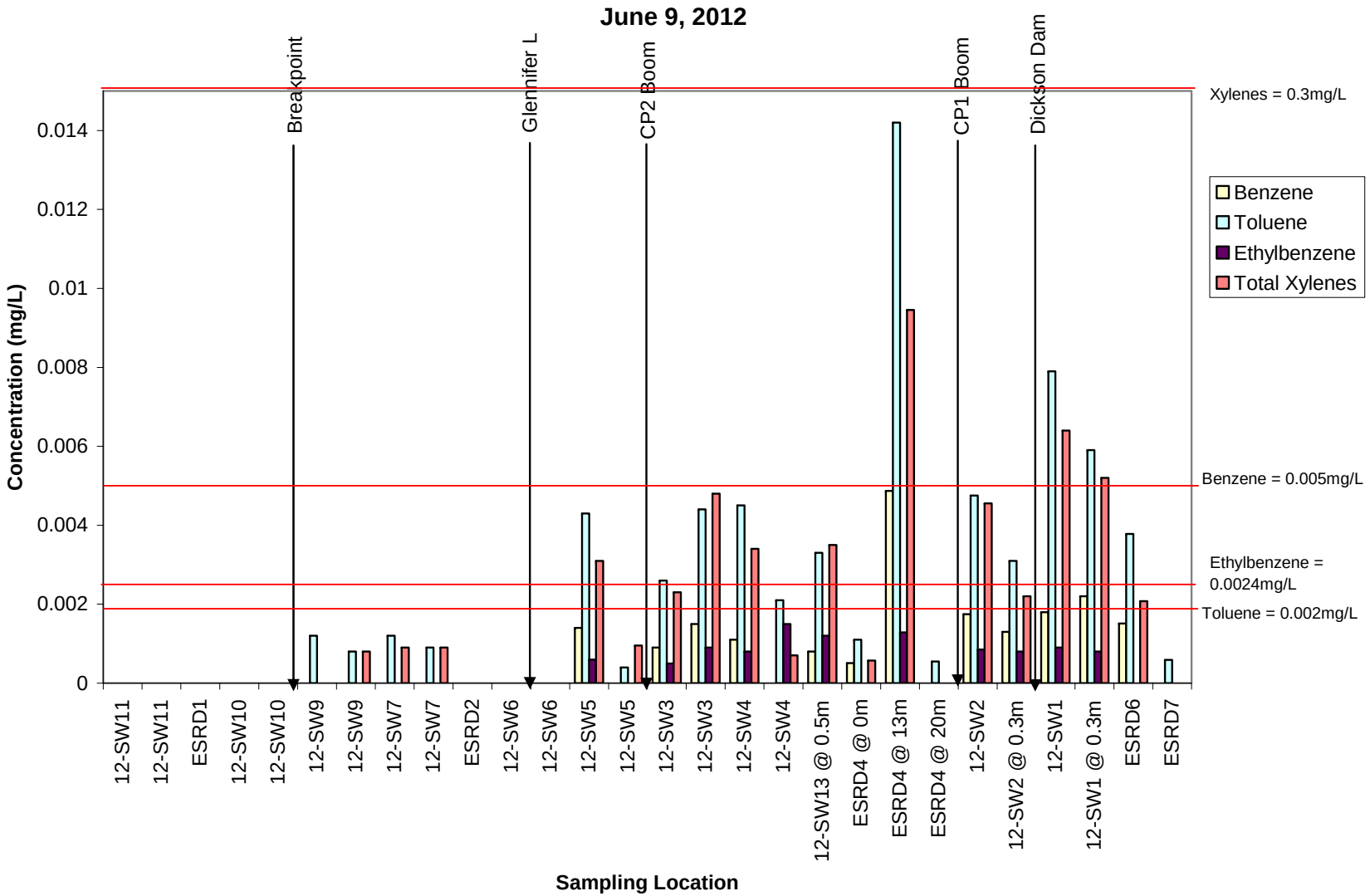

12-TP2
RED DEER
WATER TREATMENT
PLANT
CITY OF RED DEER
12-SW20
12-SW19
12-SWXX
12-SWXX
12-SWXX

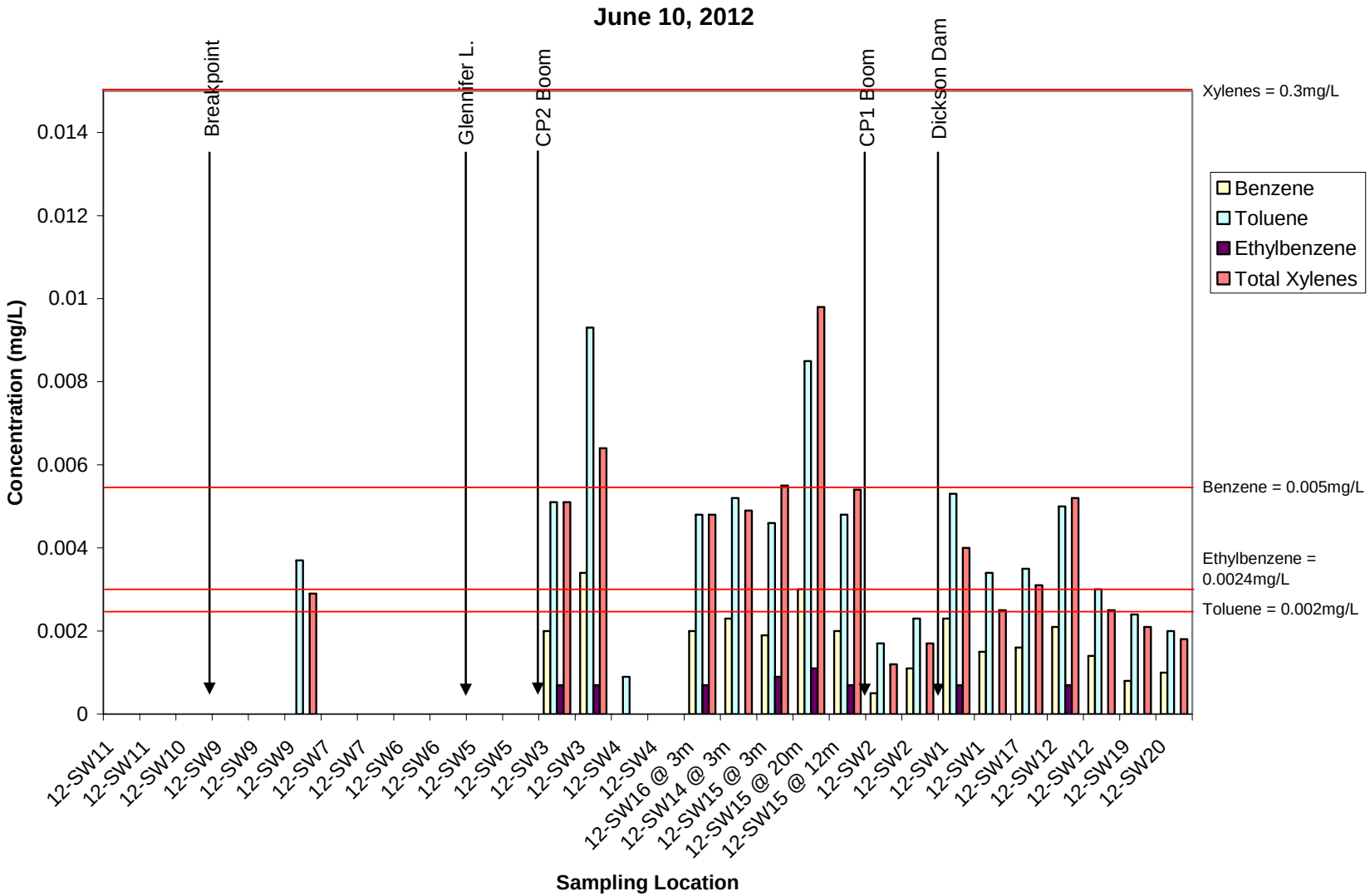
Figures 5 to 14 – Plains/Matrix and ESRD Water Quality Results, June 8-12, 2012

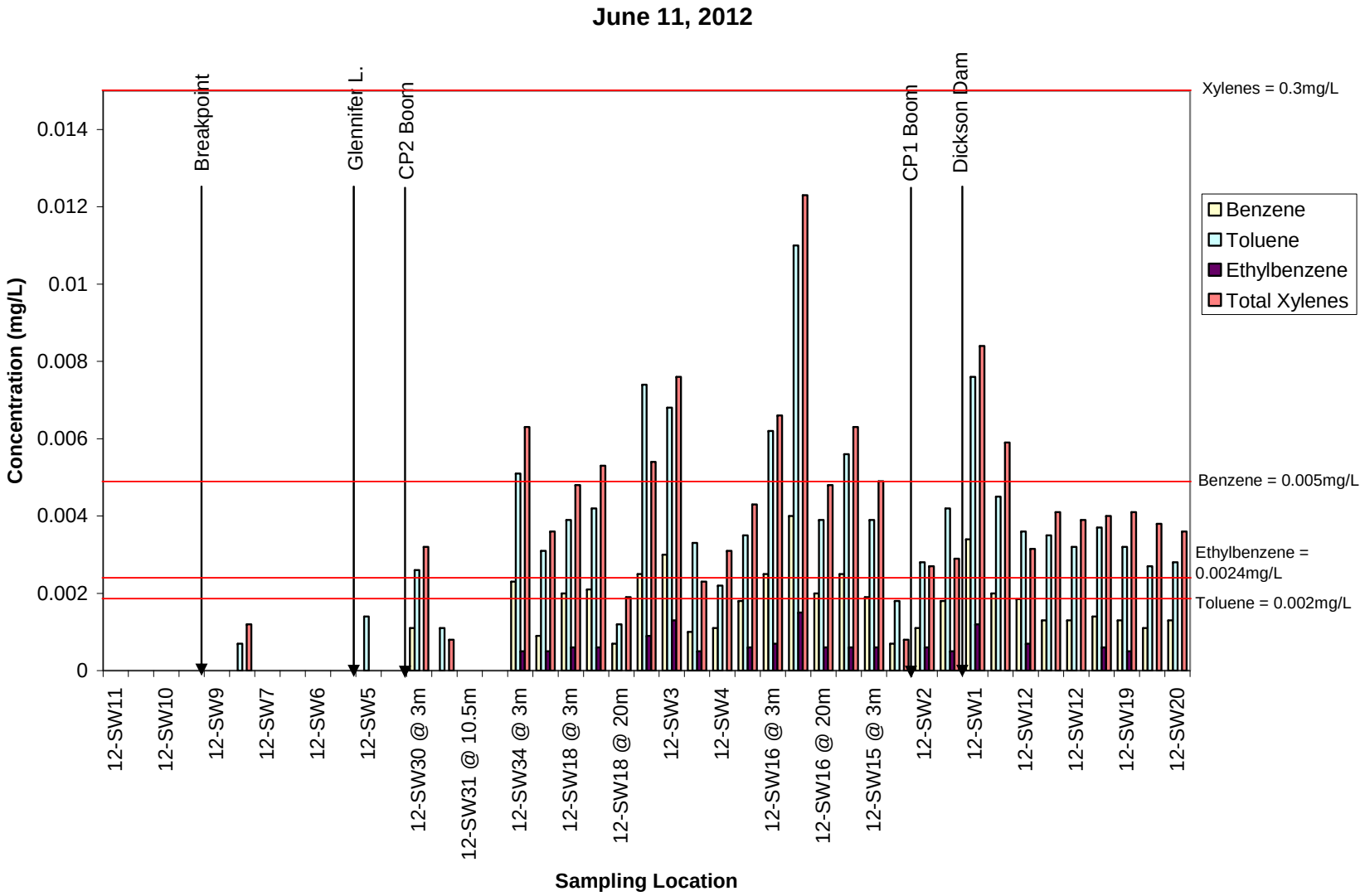
Petroleum Hydrocarbons (Benzene, Toluene, Ethylbenzene and Total Xylenes)

June 8, 2012

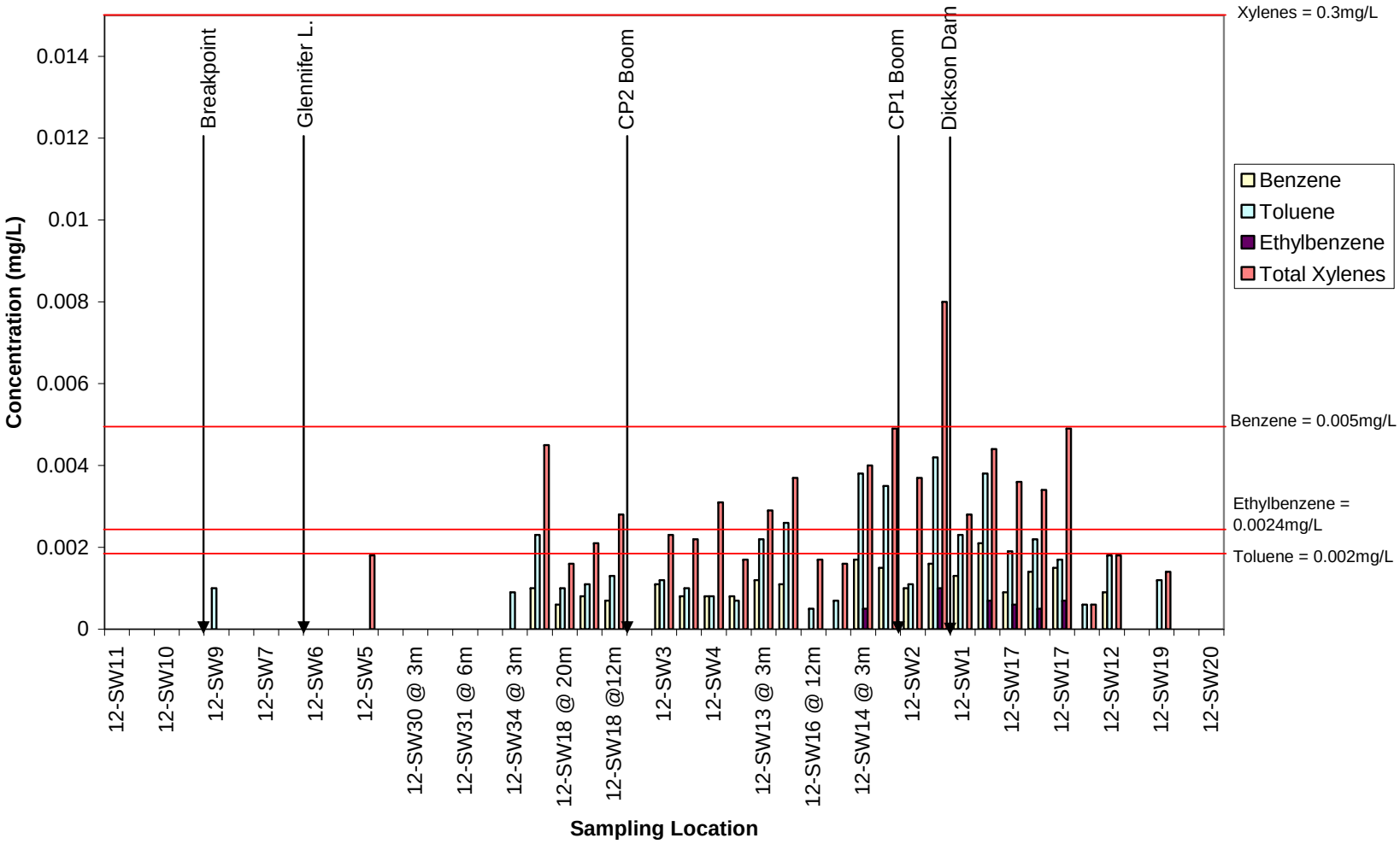

0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Concentration (mg/L)
Xylenes CCME Ag Use guideline = 0.3mg/L
Benzene DW guideline = 0.005mg/L
Ethylbenzene DW guideline = 0.0024mg/L
Toluene CCME PAL guideline = 0.002mg/L
Benzene
Toluene
Ethylbenzene
Total Xylenes
Breakpoint
Glennifer L.
CP2 Boom
CP1 Boom
Dickson Dam
12-SW11
12-SW10
12-SW9
12-SW8
12-SW7
12-SW6
12-SW5
12-SW3
12-SW4
ESRD4 @ 0m
ESRD4 @ 10m
ESRD4 @ 20m
ESRD4 @ 25m
ESRD5 @ 0m
12-SW2
12-SW2
12-SW1
12-SW1
Sampling Location


June 9, 2012
Breakpoint
Glennifer L
CP2 Boom
CP1 Boom
Dickson Dam
Xylenes = 0.3mg/L
Benzene = 0.005mg/L
Ethylbenzene = 0.0024mg/L
Toluene = 0.002mg/L
Benzene
Toluene
Ethylbenzene
Total Xylenes
Concentration (mg/L)
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
12-SW11
12-SW11
ESRD1
12-SW10
12-SW10
12-SW9
12-SW9
12-SW7
12-SW7
ESRD2
12-SW6
12-SW6
12-SW5
12-SW5
12-SW3
12-SW3
12-SW4
12-SW4
12-SW13 @ 0.5m
ESRD4 @ 0m
ESRD4 @ 13m
ESRD4 @ 20m
12-SW2
12-SW2 @ 0.3m
12-SW1
12-SW1 @ 0.3m
ESRD6
ESRD7
Sampling Location

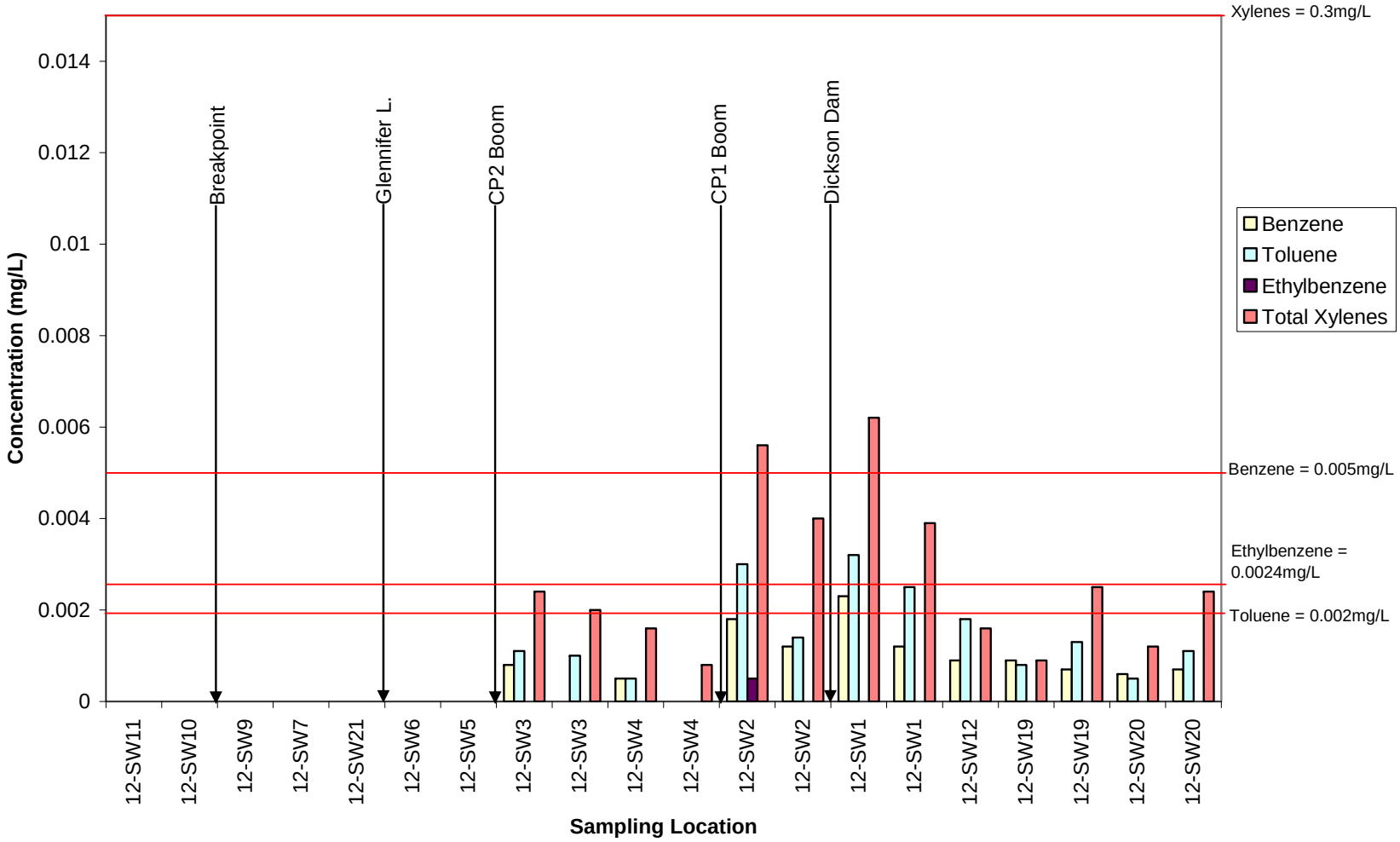

June 10, 2012
Breakpoint
Glennifer L.
CP2 Boom
CP1 Boom
Dickson Dam
Xylenes = 0.3mg/L
Benzene = 0.005mg/L
Ethylbenzene = 0.0024mg/L
Toluene = 0.002mg/L
Benzene
Toluene
Ethylbenzene
Total Xylenes
Concentration (mg/L)
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
12-SW11
12-SW11
12-SW10
12-SW9
12-SW9
12-SW9
12-SW7
12-SW7
12-SW6
12-SW6
12-SW5
12-SW5
12-SW3
12-SW3
12-SW4
12-SW4
12-SW16 @ 3m
12-SW14 @ 3m
12-SW15 @ 3m
12-SW15 @ 20m
12-SW15 @ 12m
12-SW2
12-SW2
12-SW1
12-SW1
12-SW17
12-SW12
12-SW12
12-SW19
12-SW20
Sampling Location

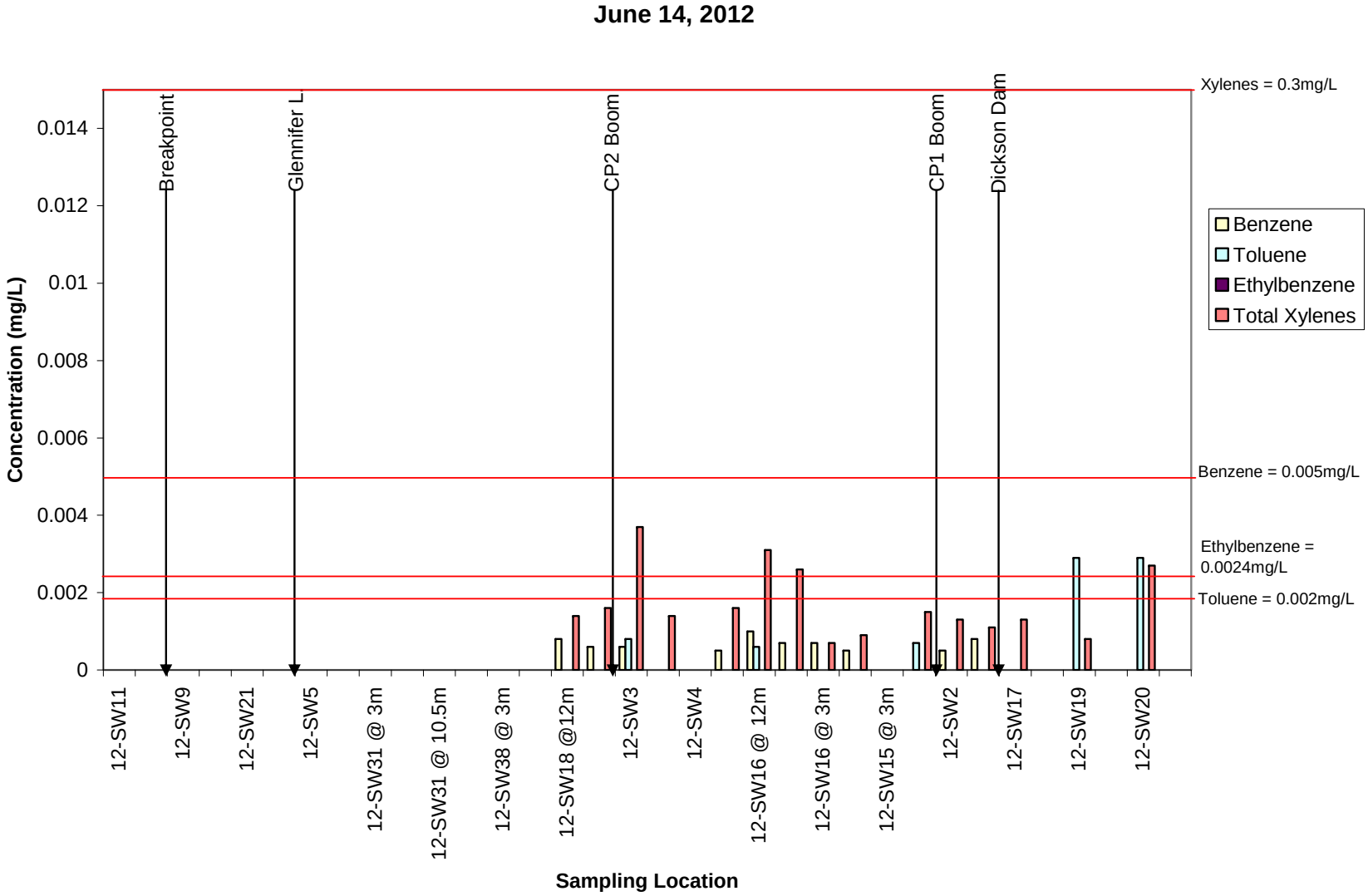

June 11, 2012
Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Breakpoint
Glennifer L.
CP2 Boom
CP1 Boom
Dickson Dam
Xylenes = 0.3mg/L
Benzene = 0.005mg/L
Ethylbenzene = 0.0024mg/L
Toluene = 0.002mg/L
Benzene
Toluene
Ethylbenzene
Total Xylenes
12-SW11
12-SW10
12-SW9
12-SW7
12-SW6
12-SW5
12-SW30 @ 3m
12-SW31 @ 10.5m
12-SW34 @ 3m
12-SW18 @ 3m
12-SW18 @ 20m
12-SW3
12-SW4
12-SW16 @ 3m
12-SW16 @ 20m
12-SW15 @ 3m
12-SW2
12-SW1
12-SW12
12-SW12
12-SW19
12-SW20
Sampling Location

June 12, 2012

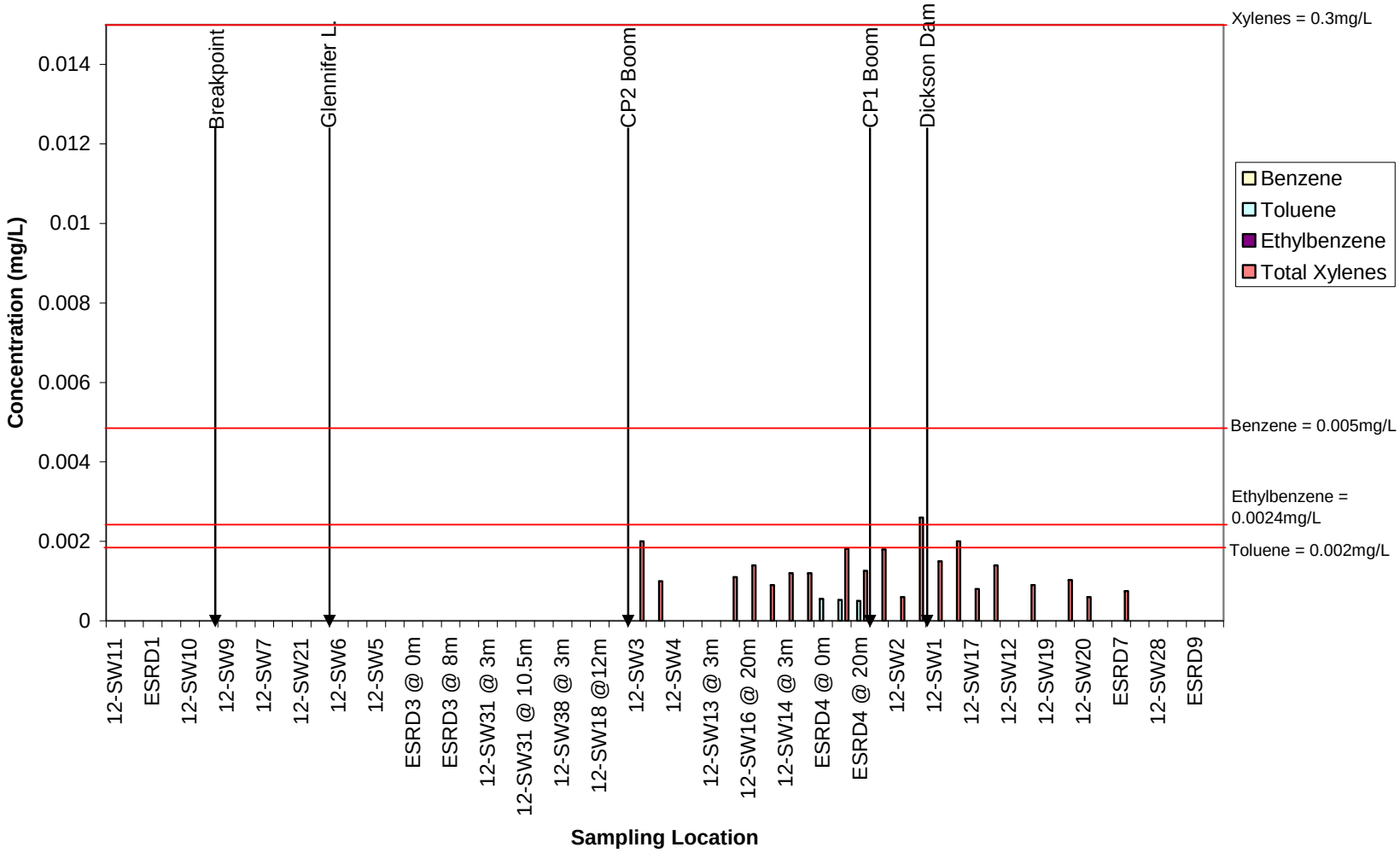

Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Breakpoint
Glennifer L.
CP2 Boom
CP1 Boom
Dickson Dam
Xylenes = 0.3mg/L
Benzene = 0.005mg/L
Ethylbenzene = 0.0024mg/L
Toluene = 0.002mg/L
Benzene
Toluene
Ethylbenzene
Total Xylenes
12-SW11
12-SW10
12-SW9
12-SW7
12-SW6
12-SW5
12-SW30 @ 3m
12-SW31 @ 6m
12-SW34 @ 3m
12-SW18 @ 20m
12-SW18 @12m
12-SW3
12-SW4
12-SW13 @ 3m
12-SW16 @ 12m
12-SW14 @ 3m
12-SW2
12-SW1
12-SW17
12-SW17
12-SW12
12-SW19
12-SW20
Sampling Location

June 13, 2012

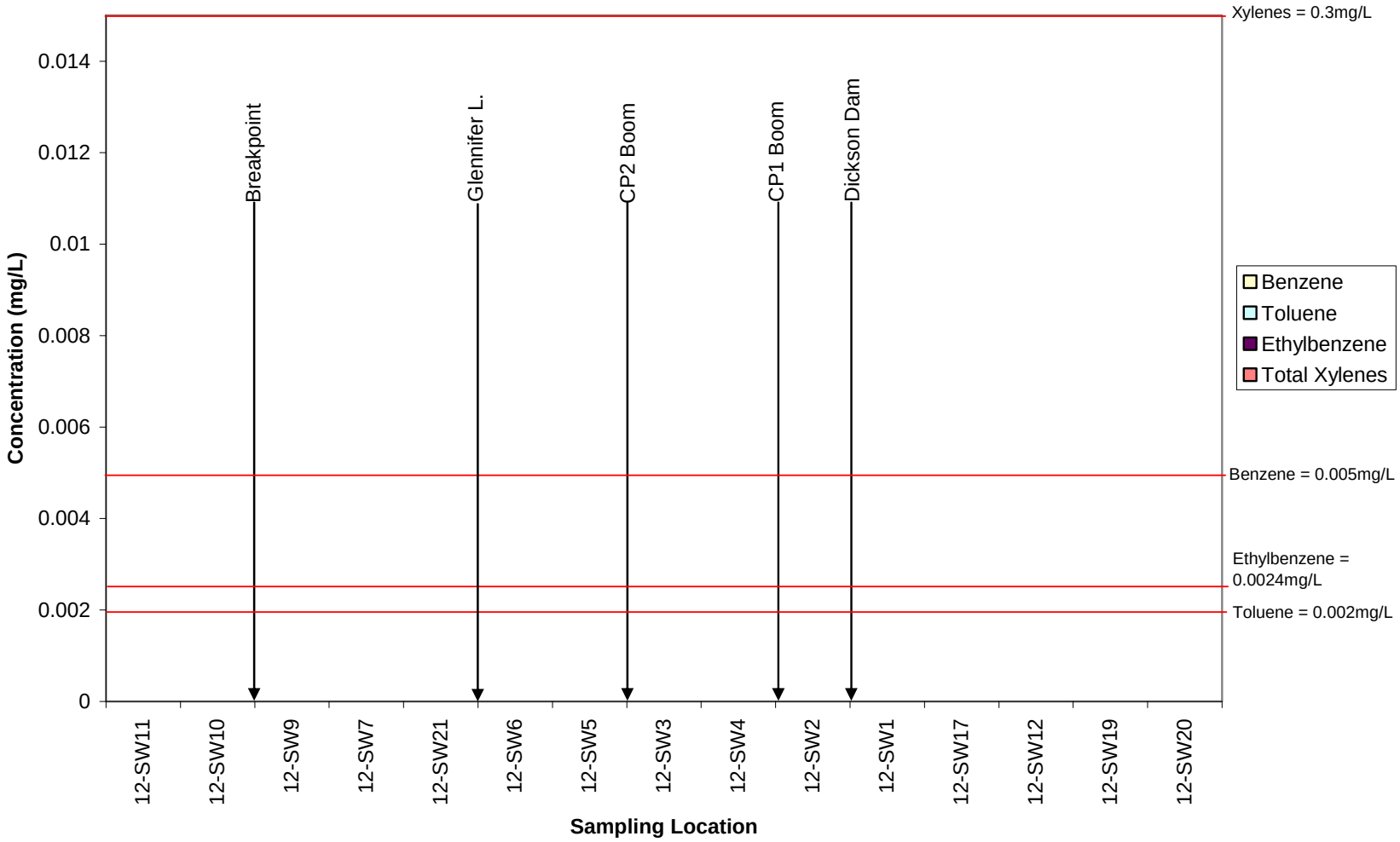

Xylenes = 0.3mg/L
Benzene = 0.005mg/L
Ethylbenzene = 0.0024mg/L
Toluene = 0.002mg/L
Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Breakpoint
Glennifer L.
CP2 Boom
CP1 Boom
Dickson Dam
Benzene
Toluene
Ethylbenzene
Total Xylenes
12-SW11
12-SW10
12-SW9
12-SW7
12-SW21
12-SW6
12-SW5
12-SW3
12-SW3
12-SW4
12-SW4
12-SW2
12-SW2
12-SW1
12-SW1
12-SW12
12-SW19
12-SW19
12-SW20
12-SW20
Sampling Location


June 14, 2012
Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Breakpoint
Glennifer L
CP2 Boom
CP1 Boom
Dickson Dam
Xylenes = 0.3mg/L
Benzene = 0.005mg/L
Ethylbenzene = 0.0024mg/L
Toluene = 0.002mg/L
Benzene
Toluene
Ethylbenzene
Total Xylenes
12-SW11
12-SW9
12-SW21
12-SW5
12-SW31 @ 3m
12-SW31 @ 10.5m
12-SW38 @ 3m
12-SW18 @12m
12-SW3
12-SW4
12-SW16 @ 12m
12-SW16 @ 3m
12-SW15 @ 3m
12-SW2
12-SW17
12-SW19
12-SW20
Sampling Location

June 15, 2012

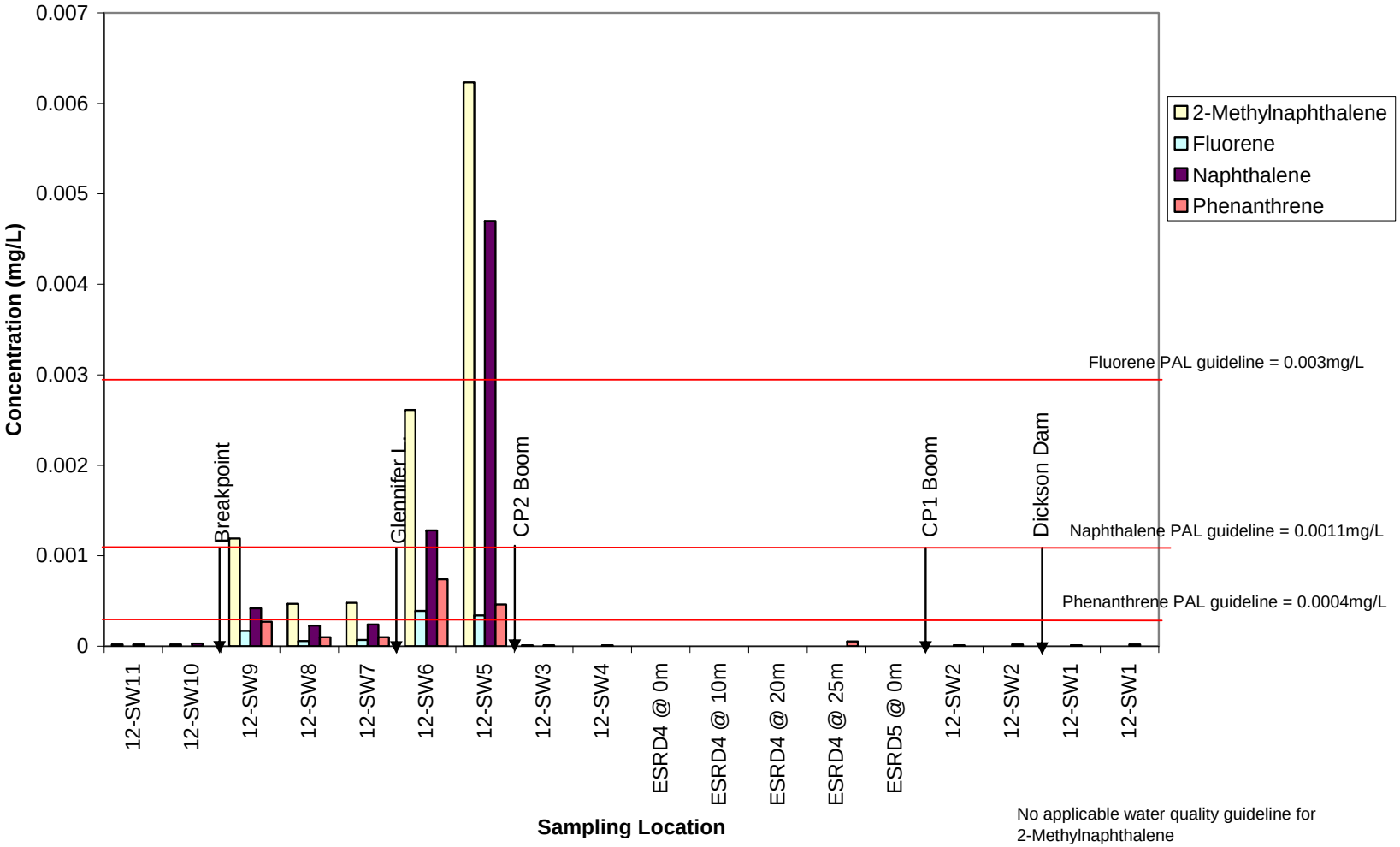

Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Breakpoint
Glennifer L.
CP2 Boom
CP1 Boom
Dickson Dam
Xylenes = 0.3mg/L
Benzene = 0.005mg/L
Ethylbenzene = 0.0024mg/L
Toluene = 0.002mg/L
Benzene
Toluene
Ethylbenzene
Total Xylenes
12-SW11
ESRD1
12-SW10
12-SW9
12-SW7
12-SW21
12-SW6
12-SW5
ESRD3 @ 0m
ESRD3 @ 8m
12-SW31 @ 3m
12-SW31 @ 10.5m
12-SW38 @ 3m
12-SW18 @12m
12-SW3
12-SW4
12-SW13 @ 3m
12-SW16 @ 20m
12-SW14 @ 3m
ESRD4 @ 0m
ESRD4 @ 20m
12-SW2
12-SW1
12-SW17
12-SW12
12-SW19
12-SW20
ESRD7
12-SW28
ESRD9
Sampling Location

June 16, 2012

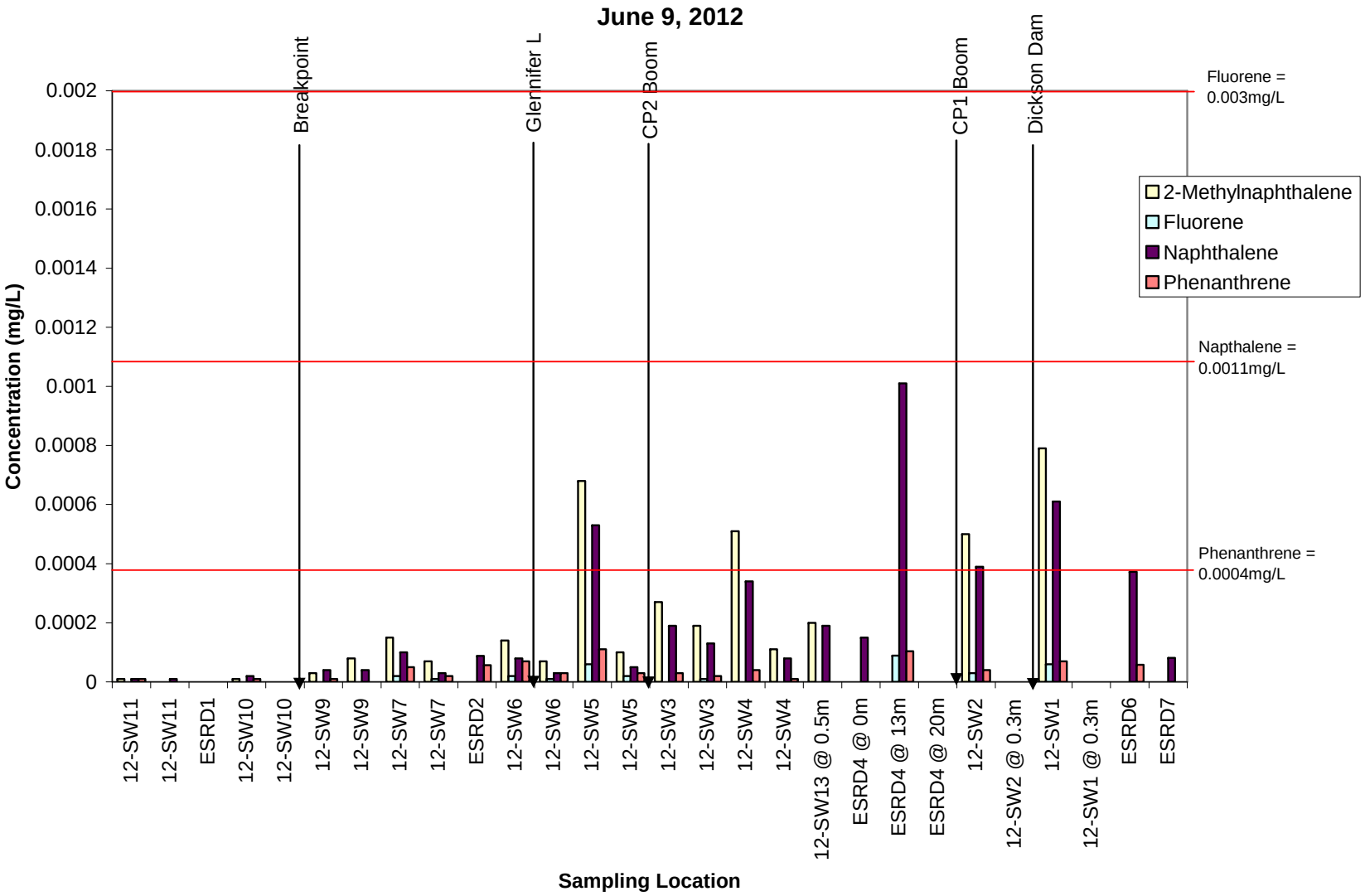

Xylenes = 0.3mg/L
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Concentration (mg/L)
Breakpoint
Glennifer L.
CP2 Boom
CP1 Boom
Dickson Dam
Benzene
Toluene
Ethylbenzene
Total Xylenes
Benzene = 0.005mg/L
Ethylbenzene = 0.0024mg/L
Toluene = 0.002mg/L
12-SW11
12-SW10
12-SW9
12-SW7
12-SW21
12-SW6
12-SW5
12-SW3
12-SW4
12-SW2
12-SW1
12-SW17
12-SW12
12-SW19
12-SW20
Sampling Location

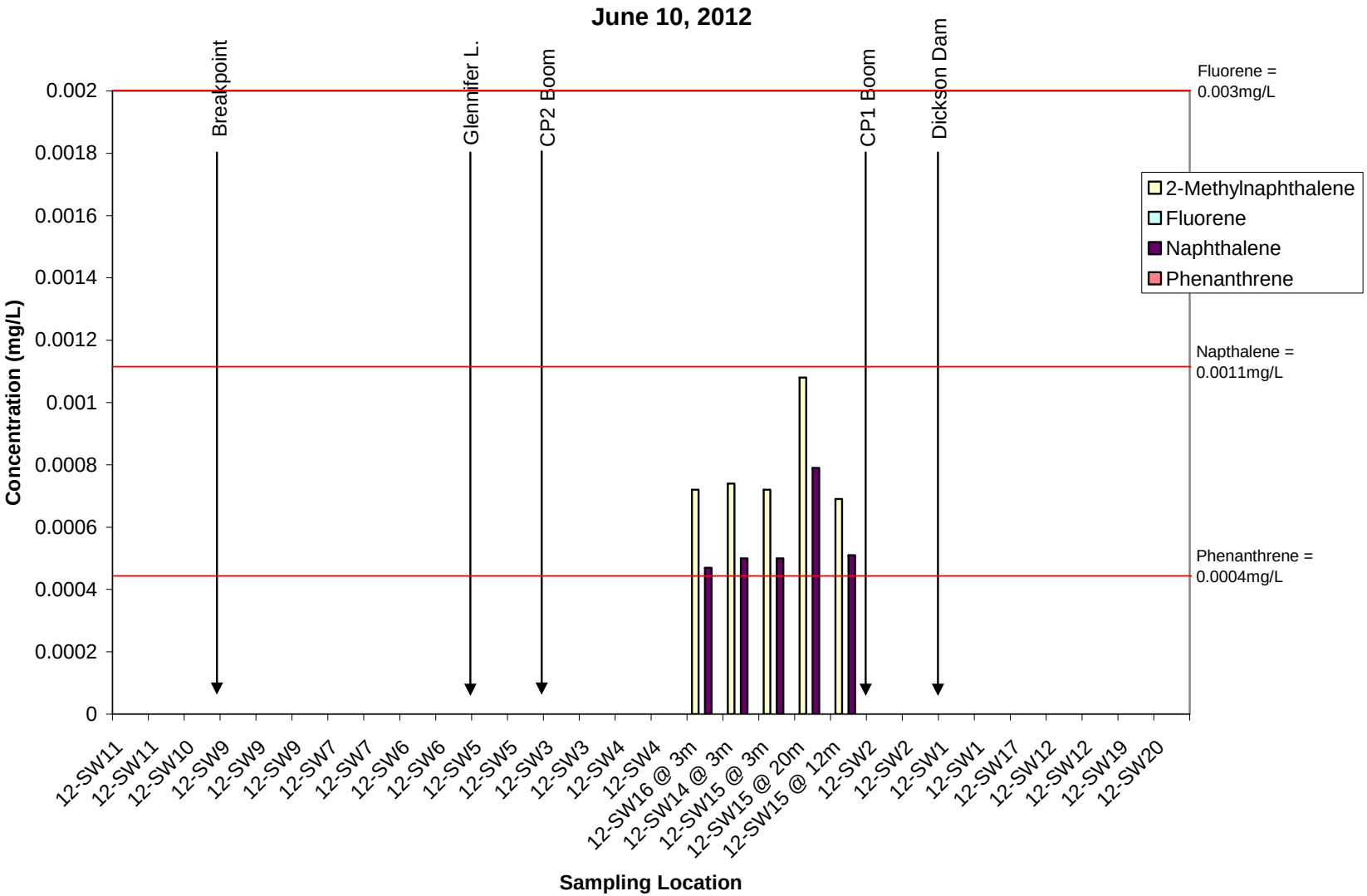
Polycyclic Aromatic Hydrocarbons (2-methynaphthalene, Naphthalene, Fluorene and Phenanthrene)

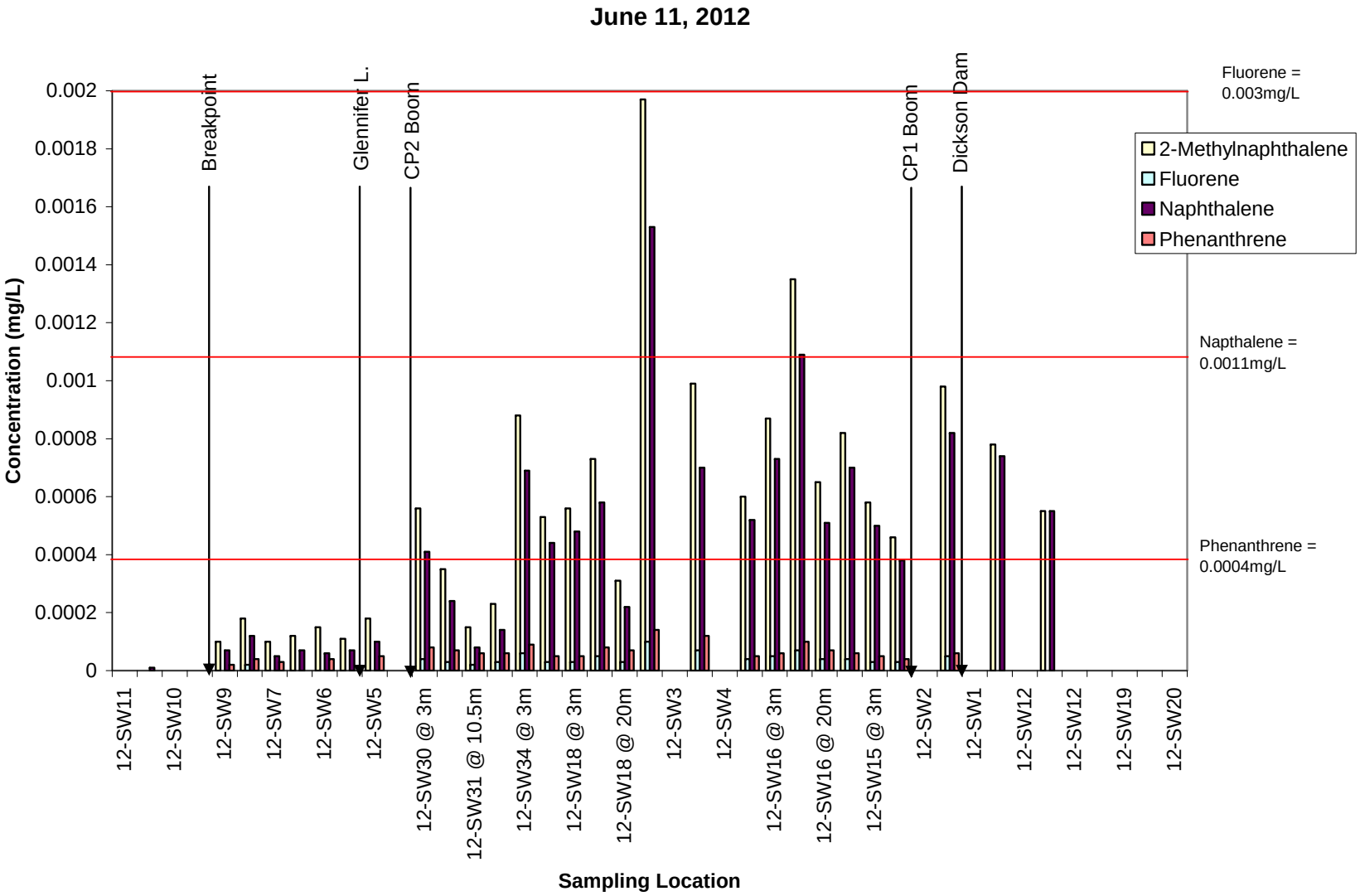
June 8, 2012



No applicable water quality guideline for 2-Methylnaphthalene


June 9, 2012
Breakpoint
Glennifer L
CP2 Boom
CP1 Boom
Dickson Dam
Fluorene = 0.003mg/L
Napthalene = 0.0011mg/L
Phenanthrene = 0.0004mg/L
2-Methylnaphthalene
Fluorene
Naphthalene
Phenanthrene
Concentration (mg/L)
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
12-SW11
12-SW11
ESRD1
12-SW10
12-SW10
12-SW9
12-SW9
12-SW7
12-SW7
ESRD2
12-SW6
12-SW6
12-SW5
12-SW5
12-SW3
12-SW3
12-SW4
12-SW4
12-SW13 @ 0.5m
ESRD4 @ 0m
ESRD4 @ 13m
ESRD4 @ 20m
12-SW2
12-SW2 @ 0.3m
12-SW1
12-SW1 @ 0.3m
ESRD6
ESRD7
Sampling Location


June 10, 2012
Breakpoint
Glennifer L.
CP2 Boom
CP1 Boom
Dickson Dam
Fluorene = 0.003mg/L
Napthalene = 0.0011mg/L
Phenanthrene = 0.0004mg/L
2-Methylnaphthalene
Fluorene
Naphthalene
Phenanthrene
Concentration (mg/L)
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
12-SW11
12-SW11
12-SW10
12-SW9
12-SW9
12-SW9
12-SW7
12-SW7
12-SW6
12-SW6
12-SW5
12-SW5
12-SW3
12-SW3
12-SW4
12-SW4
12-SW16 @ 3m
12-SW14 @ 3m
12-SW15 @ 3m
12-SW15 @ 20m
12-SW15 @ 12m
12-SW2
12-SW2
12-SW1
12-SW1
12-SW17
12-SW12
12-SW12
12-SW19
12-SW20
Sampling Location


June 11, 2012
Concentration (mg/L)
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Breakpoint
Glennifer L.
CP2 Boom
CP1 Boom
Dickson Dam
Fluorene = 0.003mg/L
Napthalene = 0.0011mg/L
Phenanthrene = 0.0004mg/L
2-Methylnaphthalene
Fluorene
Naphthalene
Phenanthrene
12-SW11
12-SW10
12-SW9
12-SW7
12-SW6
12-SW5
12-SW30 @ 3m
12-SW31 @ 10.5m
12-SW34 @ 3m
12-SW18 @ 3m
12-SW18 @ 20m
12-SW3
12-SW4
12-SW16 @ 3m
12-SW16 @ 20m
12-SW15 @ 3m
12-SW2
12-SW1
12-SW12
12-SW12
12-SW19
12-SW20
Sampling Location

June 15, 2012

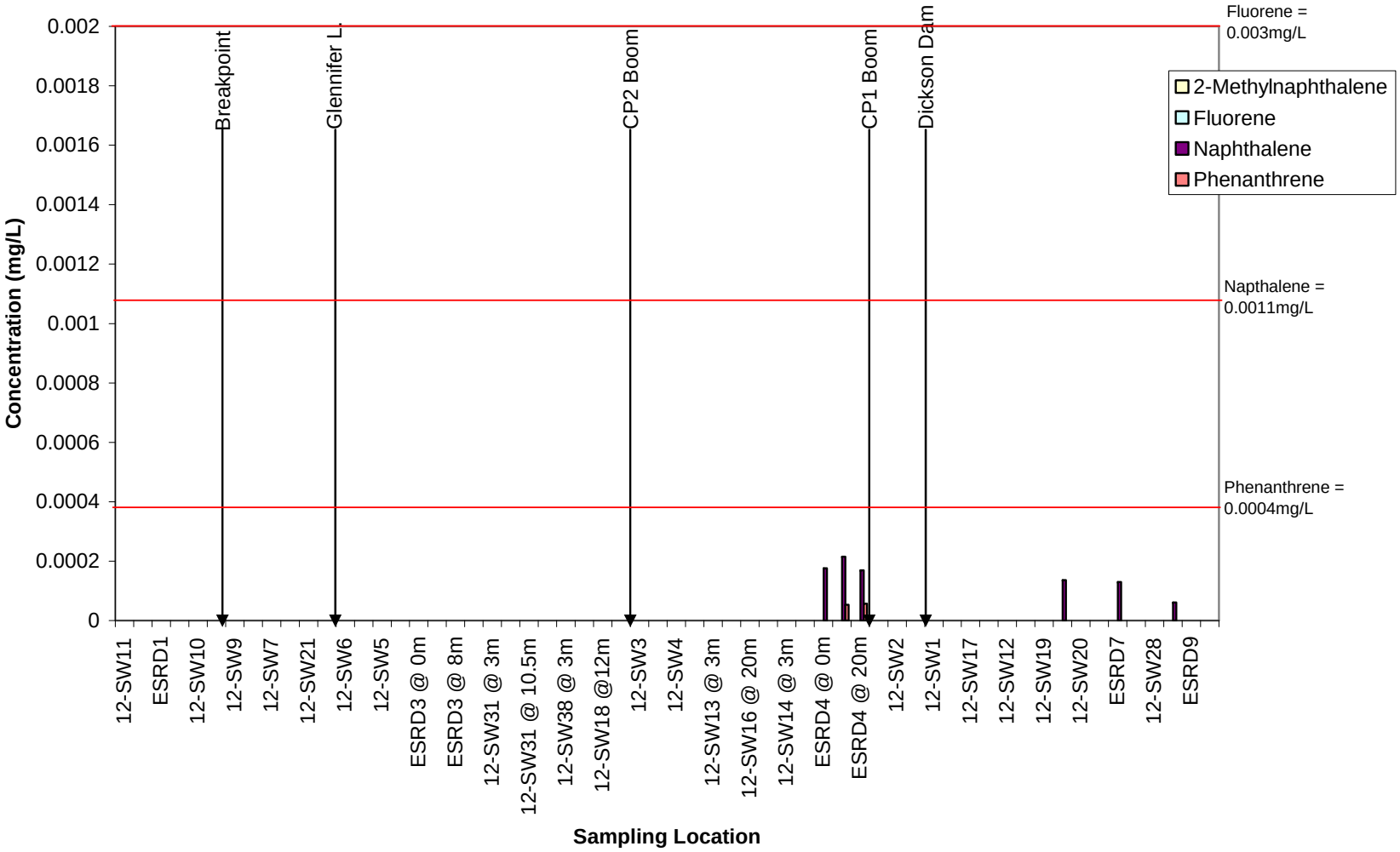
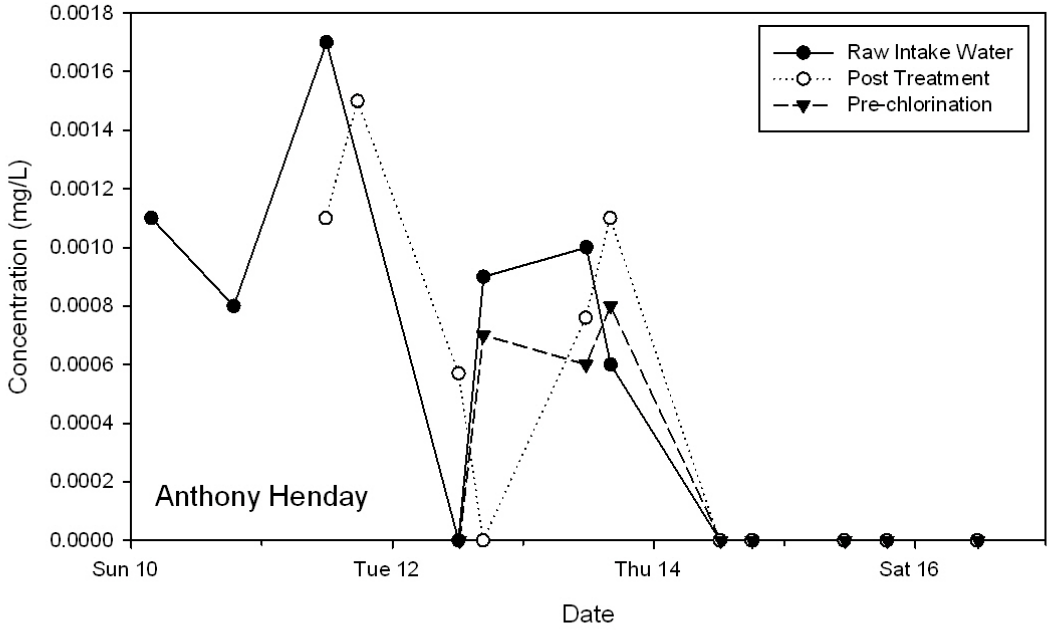

Concentration (mg/L)
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Breakpoint
Glennifer L.
CP2 Boom
CP1 Boom
Dickson Dam
Fluorene = 0.003mg/L
Napthalene = 0.0011mg/L
Phenanthrene = 0.0004mg/L
2-Methylnaphthalene
Fluorene
Naphthalene
Phenanthrene
12-SW11
ESRD1
12-SW10
12-SW9
12-SW7
12-SW21
12-SW6
12-SW5
ESRD3 @ 0m
ESRD3 @ 8m
12-SW31 @ 3m
12-SW31 @ 10.5m
12-SW38 @ 3m
12-SW18 @12m
12-SW3
12-SW4
12-SW13 @ 3m
12-SW16 @ 20m
12-SW14 @ 3m
ESRD4 @ 0m
ESRD4 @ 20m
12-SW2
12-SW1
12-SW17
12-SW12
12-SW19
12-SW20
ESRD7
12-SW28
ESRD9
Sampling Location

Figure 15
Anthony Henday and Red Deer Drinking
Water Treatment Plant Water Chemistry - Benzene



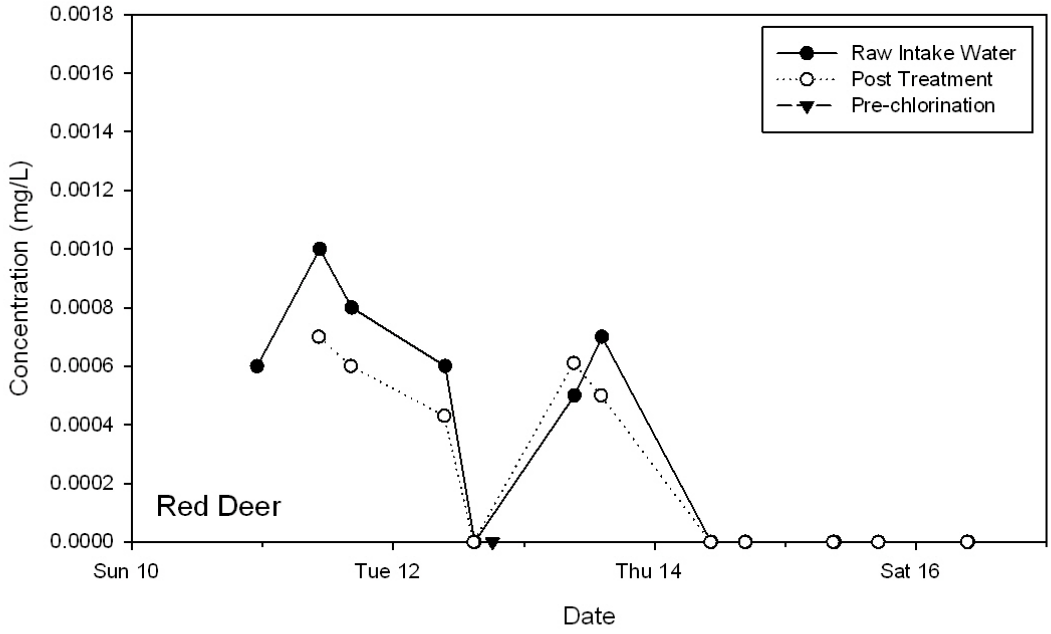
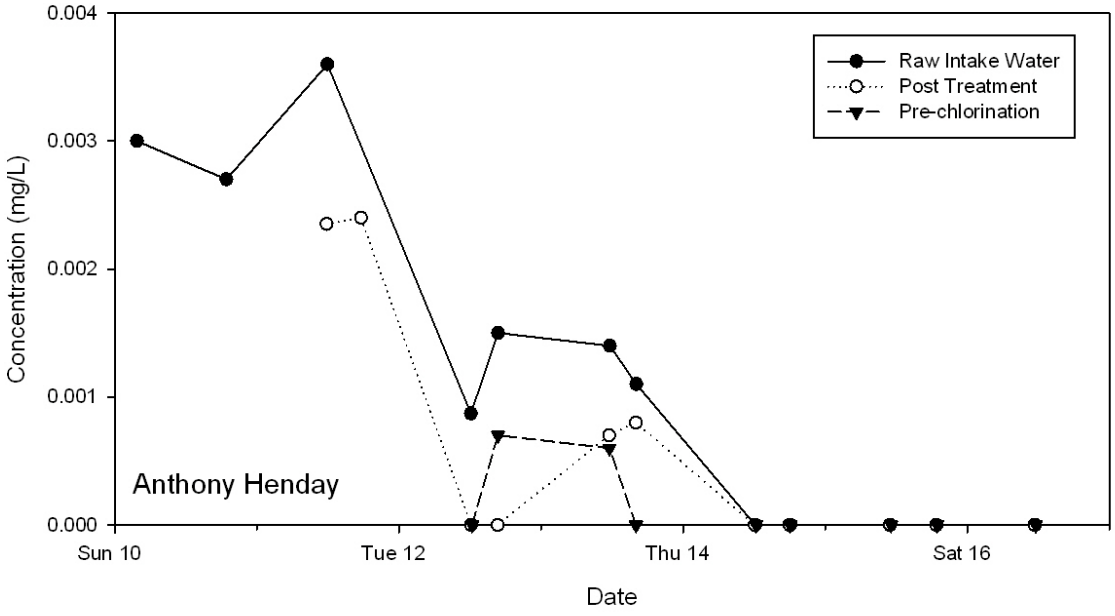


Figure 16
Anthony Henday and Red Deer Drinking
Water Treatment Plant Water Chemistry - Toluene



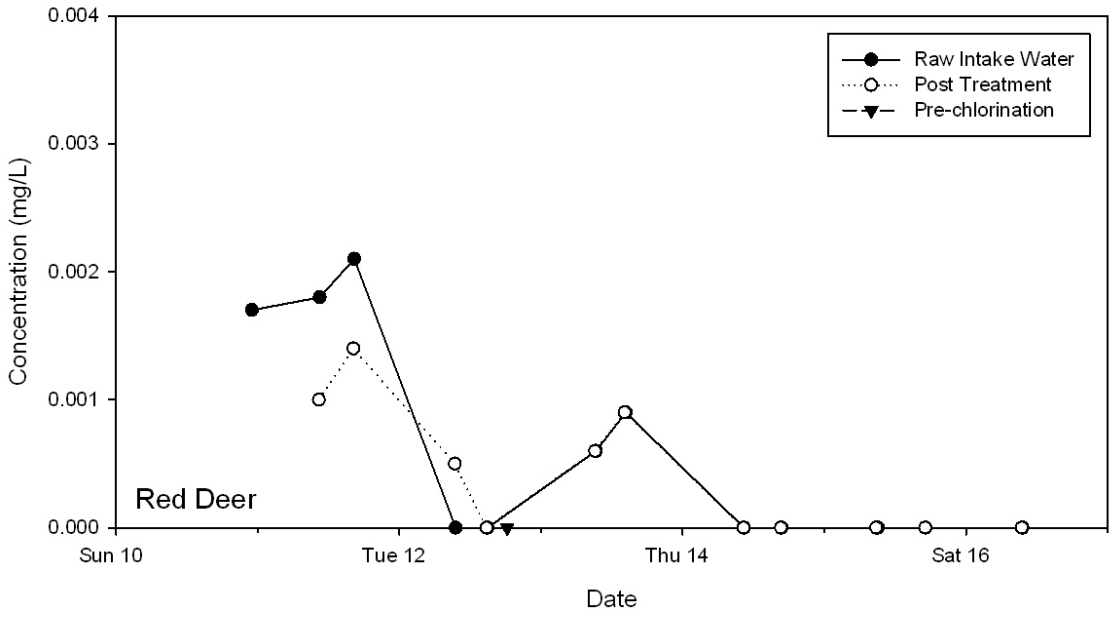
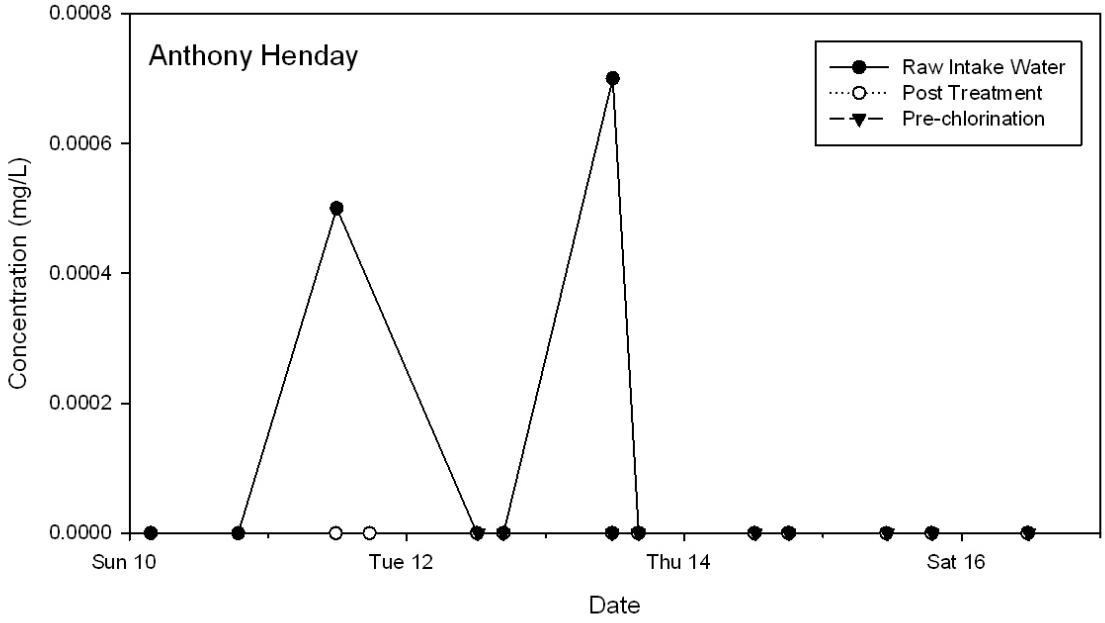


Figure 17
Anthony Henday and Red Deer Drinking
Water Treatment Plant Water Chemistry - Ethylbenzene



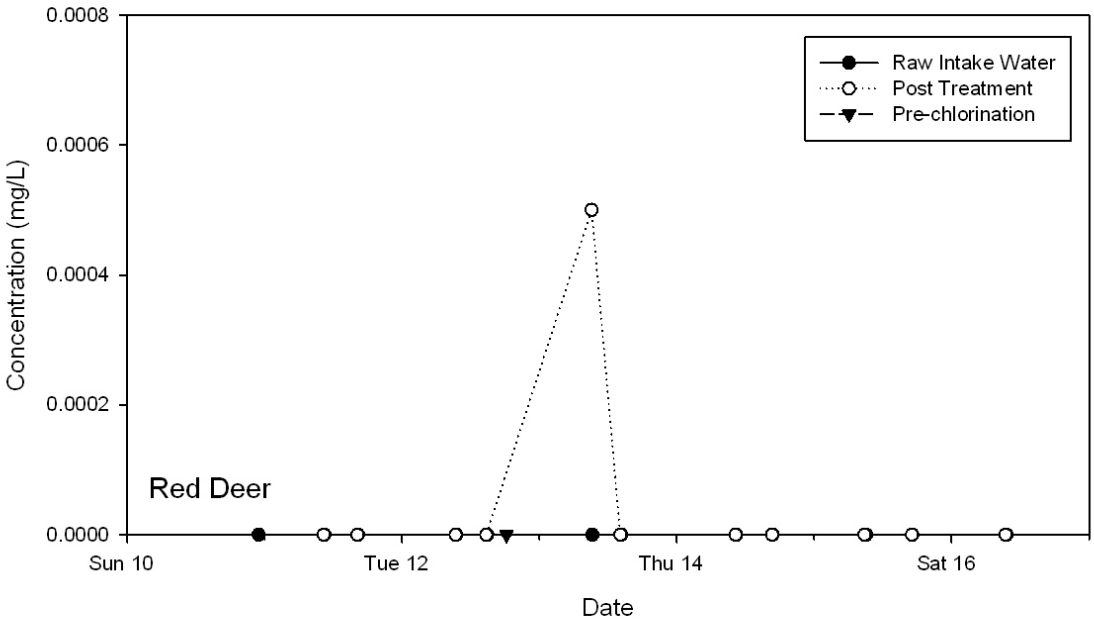


Figure 18
Anthony Henday and Red Deer Drinking
Water Treatment Plant Water Chemistry - Xylenes