

West Fork San Jacinto River, Segment
1004

Stewarts Creek, Segment 1004E

Crystal Creek, Segment 1004D

Preliminary Data Review & Monitoring Plan

James Miertschin, PhD, PE

James Miertschin & Associates

Environmental Engineering

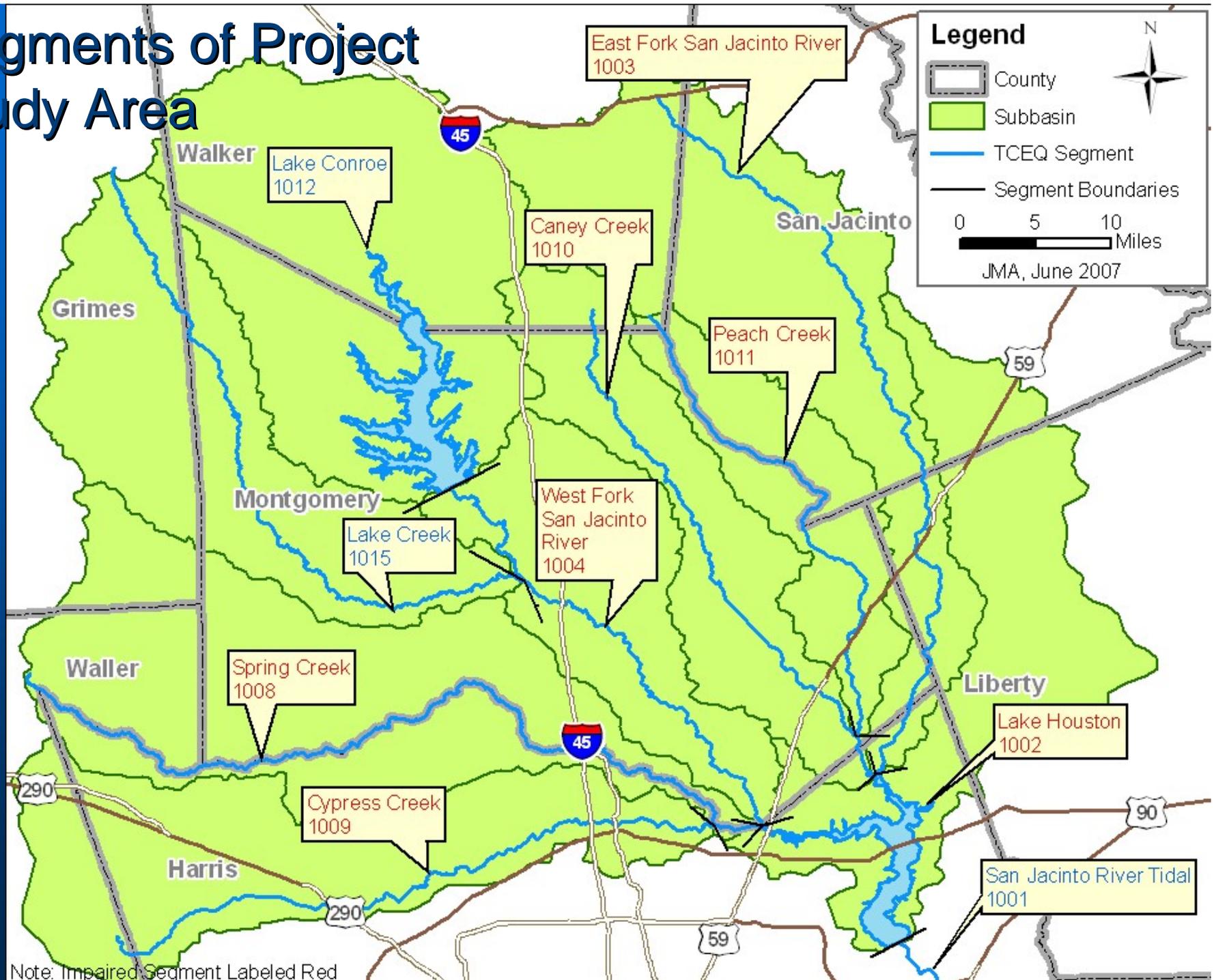




Introduction

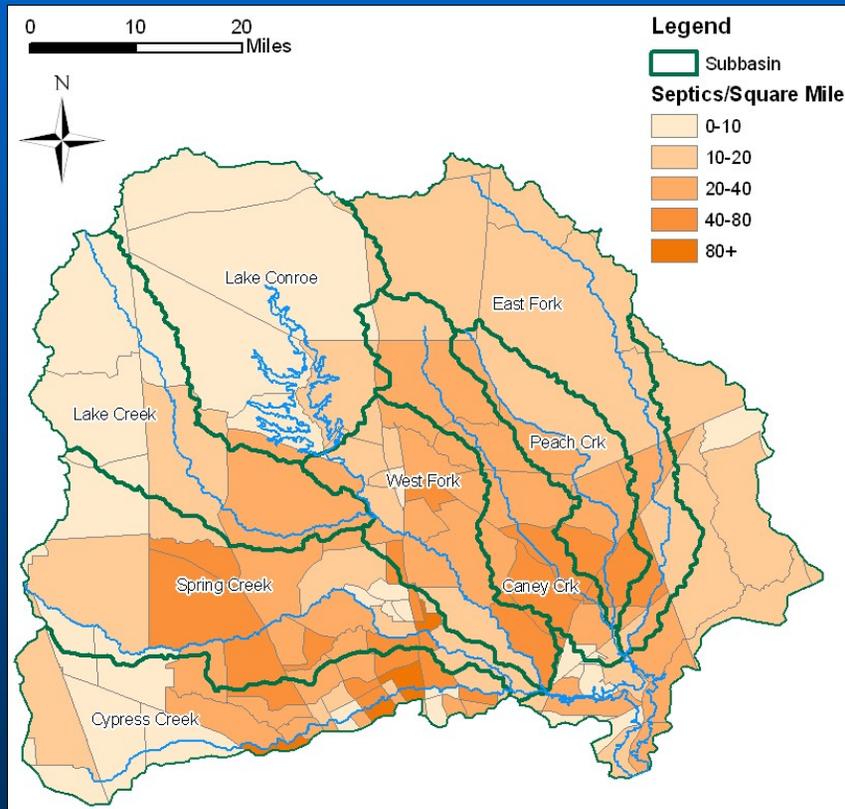
- Several stream segments of San Jacinto River Basin above Lake Houston identified as impaired
- TCEQ divides segments into assessment units (AU) to refine spatial resolution
- Stream segment is considered impaired when geometric mean of *E. coli* exceeds criterion of 126 org/100mL

Segments of Project Study Area

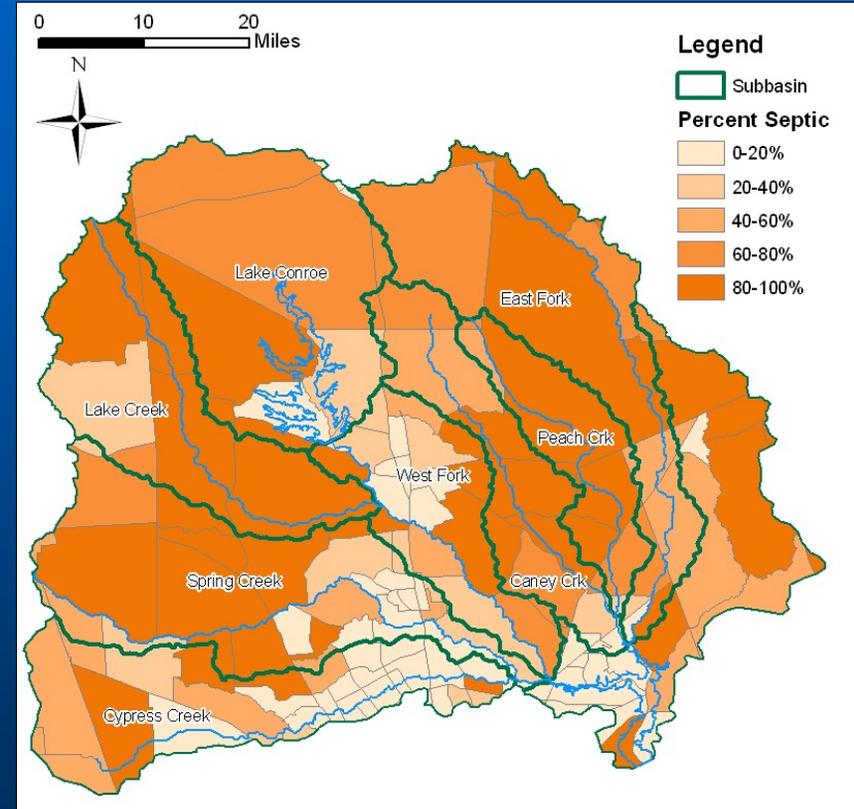


Note: Impaired Segment Labeled Red

Septic Systems



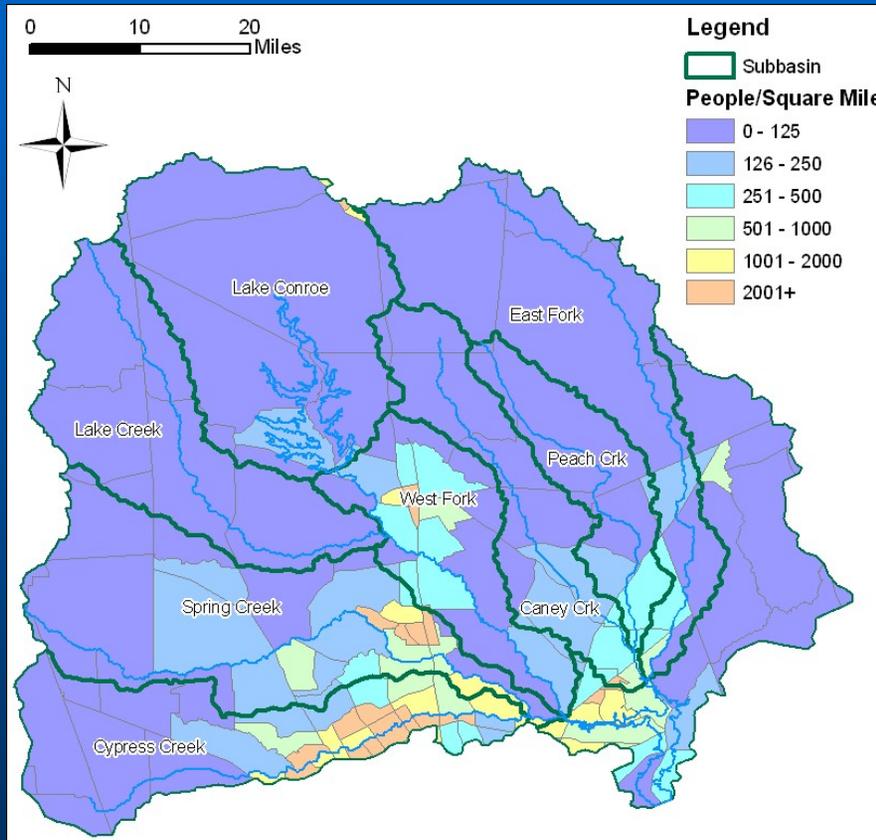
Septic System Density (1990)



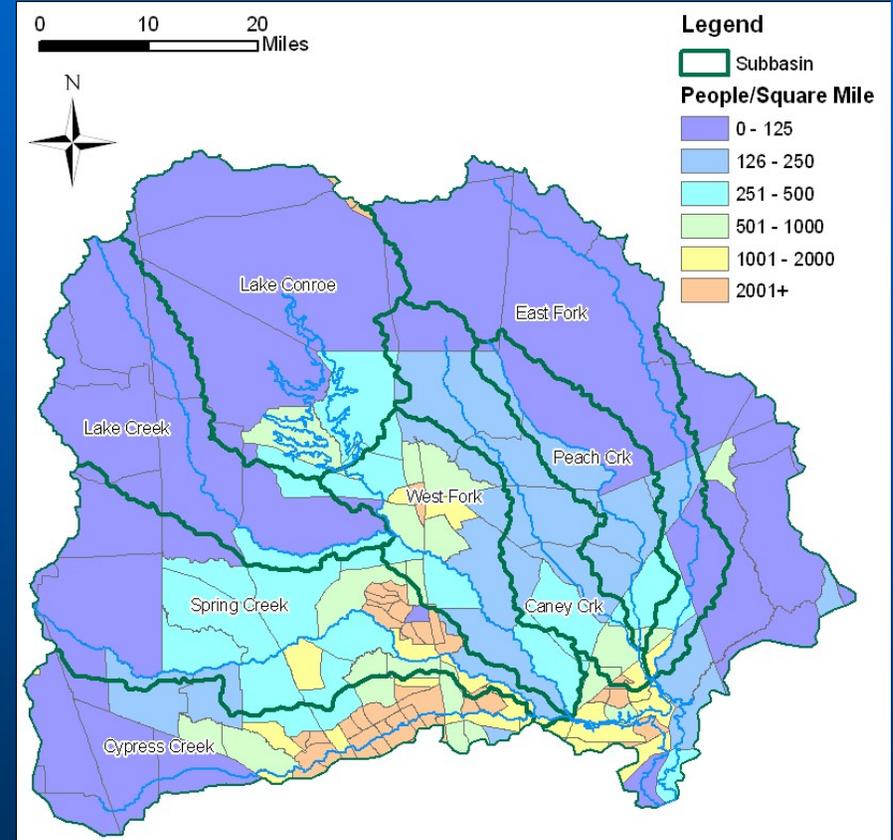
Percentage of Households Served by Septic Systems (1990)



Population Density



Project Area Population Density (1990)



Project Area Population Density (2005)

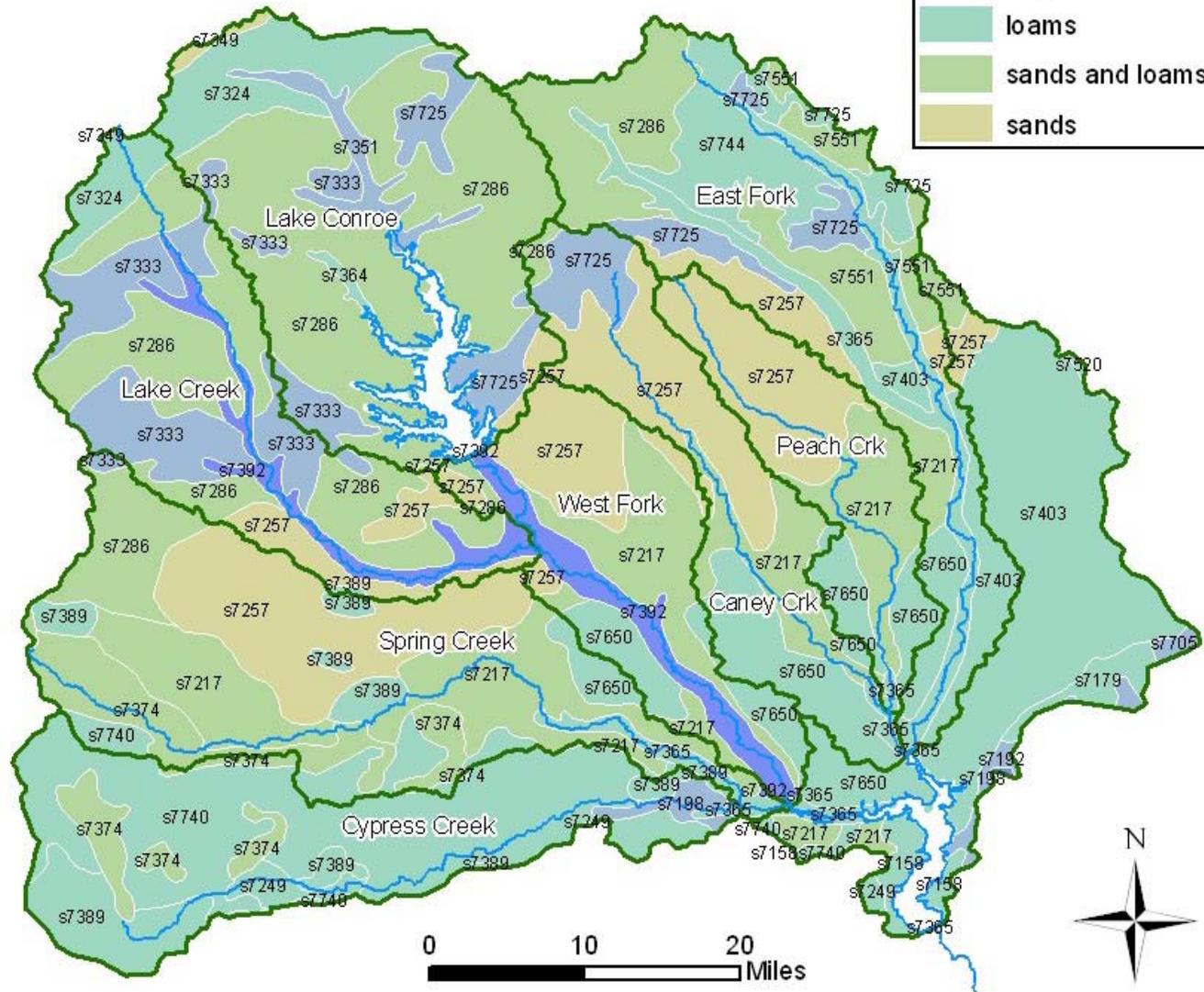
Key	Soil Association
s7158	Ozan-Atasco-Aldine
s7179	Brackett-Bolar-Aledo
s7192	Lake charles-Beaumont
s7198	Morey-Mocarey-Bernard
s7217	Splendora-Segno-Landman-Boy
s7249	Gessner-Clodine-Addicks
s7257	Conroe
s7286	Huntsburg-Fetzer-Depcor-Boy-Annona
s7324	Greenvine-Falba-Burlewash-Arol
s7333	Latium-Frelsburg-Crockett-Carbengle-Brenham-Bosque-Bleiberville
s7349	Tonkavar-Shiro-Gomery-Elmina
s7351	Nahatche-Kaufman-Gowker
s7364	Nahatche-Hatcliff
s7365	Pluck-Kian-Hatcliff
s7374	Wockley-Segno-Monaville-Hockley
s7389	Katy-Clodine-Aris
s7392	Tinn-Kaufman-Gladewater

Key	Soil Association
s7398	Sealy-Kenney-Chazos
s7403	Waller-Sorter-Kirbyville
s7520	Waller-Otanya-Kirbyville-Dallardsville
s7551	Pinetucky-Doucette
s7650	Waller-Sorter
s7705	Woodville-Vamont
s7725	Woodville-Wiergate-Burkeville
s7740	Wockley-Hockley-Gessner
s7744	Woodville-Pinetucky

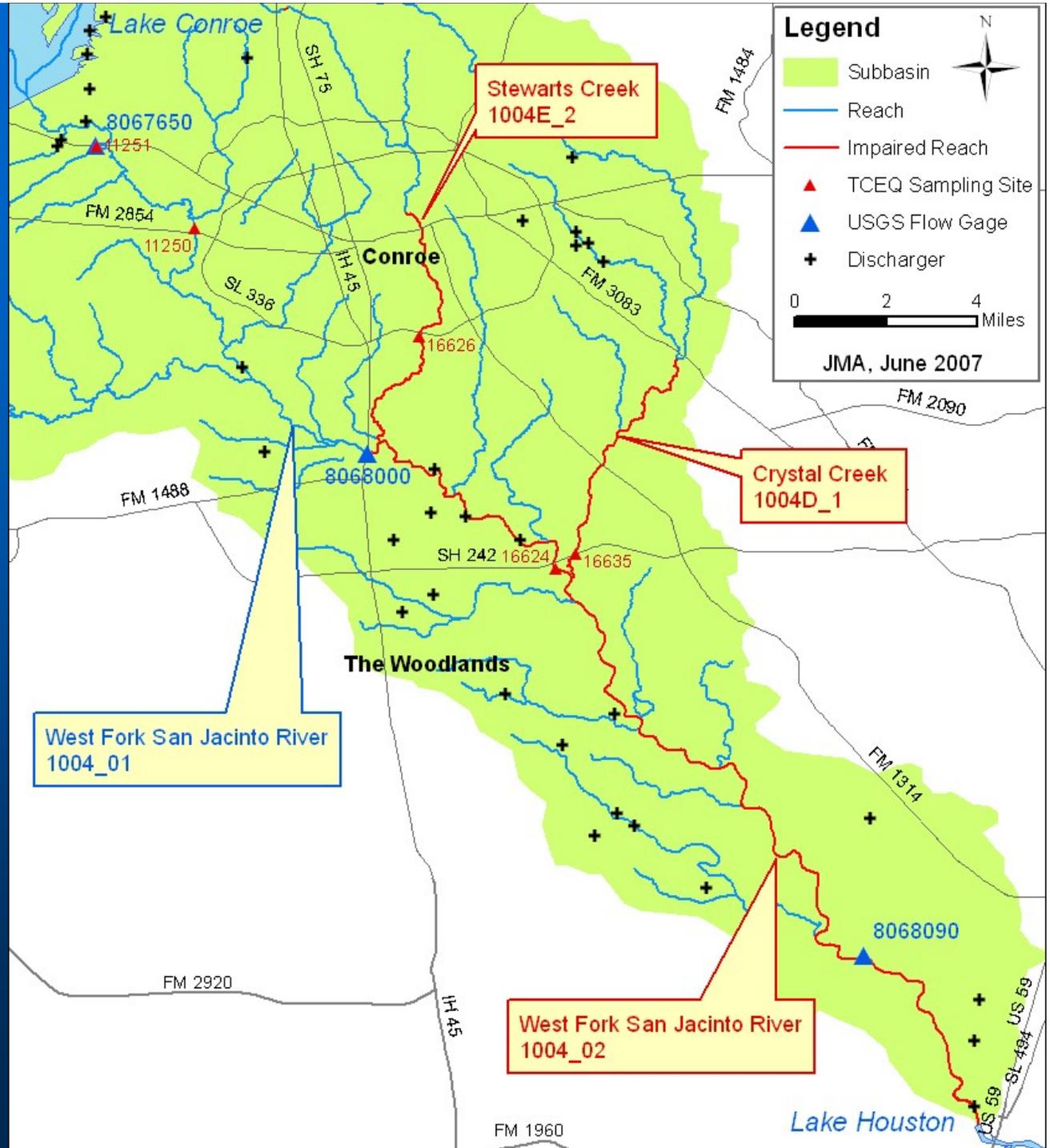
Legend

-  Segment
-  Subbasin
-  clays
-  clays and loams
-  loams
-  sands and loams
-  sands

Soil Associations



West Fork Study Area





West Fork Assessment Units and Results

Assessment Unit	Segment Name	Assessment Unit Description	# Samples	# Exceed	Geo. Mean	Impaired
1004_01	West Fork San Jacinto River	Lake Conroe Dam to IH45	39	6	60	No
1004_02	West Fork San Jacinto River	IH 45 to the Spring Creek confluence	38	10	167	Yes
1004D_01	Crystal Creek	Confluence with West Fork San Jacinto River upstream to confluence of the East and West Forks of Crystal Creek	86	19	136	Yes
1004E_02	Stewarts Creek	From Airport Rd to confluence with West Fork San Jacinto River	88	33	225	Yes

West Fork Sampling Sites



TCEQ #	TCEQ Description	USGS #
11251	WEST FORK SAN JACINTO RIVER IMMEDIATELY DOWNSTREAM OF SH 105 NW OF CONROE	08067650
11250	WEST FORK SAN JACINTO RIVER 70 METERS UPSTREAM OF FM 2854 WEST OF CONROE	
16626	STEWARTS CREEK 175 METERS DOWNSTREAM OF SH LOOP 336 SOUTHEAST OF CONROE	
16624	WEST FORK SAN JACINTO RIVER 267 METERS DOWNSTREAM OF SH 242/LAZY RIVER ROAD	
16635	CRYSTAL CREEK AT SH 242 SOUTHEAST OF CONROE	

West Fork *E. coli* Data Summary



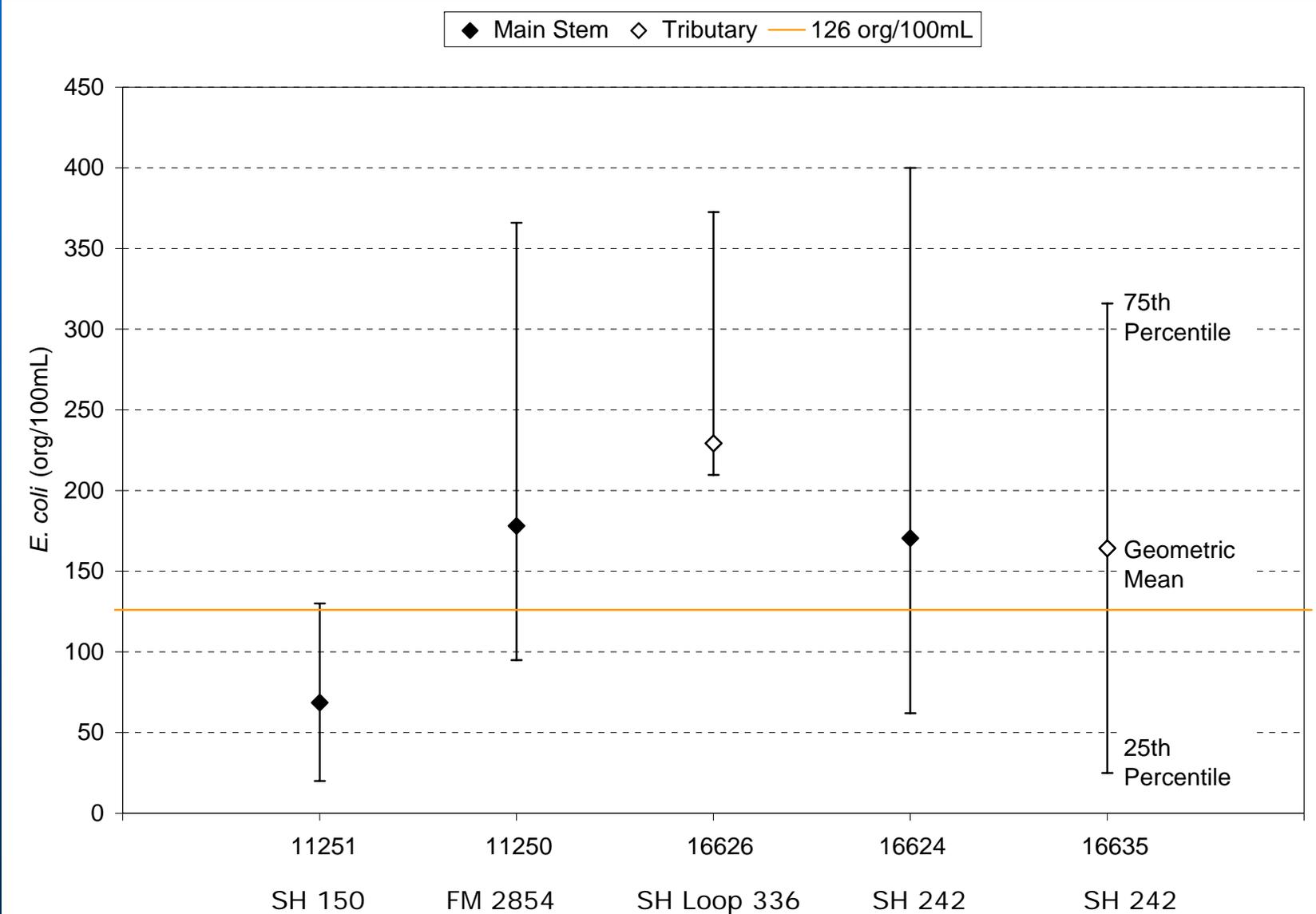
Station	11251	11250	16626	16624	16635
Location	SH 105	FM 2854	SH Loop 336	SH 242	SH 242
Reach	W Fork	W Fork	Stewarts	W Fork	Crystal
Begin Date	Jun-00	Oct-04	Jun-00	Jun-00	Jun-00
End Date	Apr-05	Jul-06	Apr-05	Apr-05	Apr-05
Count	41	8	91	41	89
75th Percentile	130	366	373	400	316
Geometric mean	69	178	229	170	164
25th Percentile	20	95	210	62	25

Spatial and Temporal Analysis

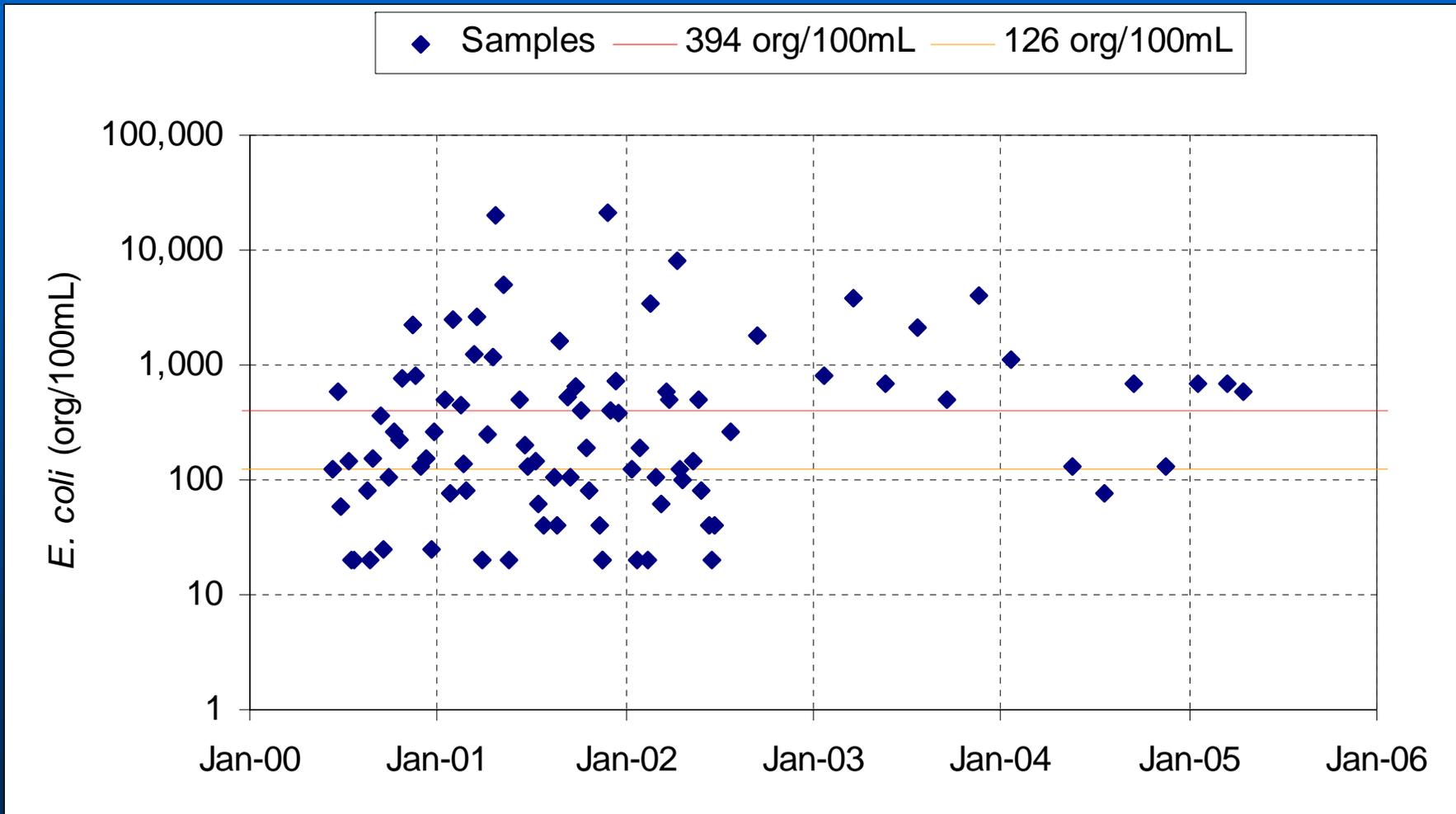
- Spatial analysis can be helpful when attempting to locate sources of bacteria
- Temporal analysis can be useful for determining changes in sources over time



West Fork Spatial Analysis

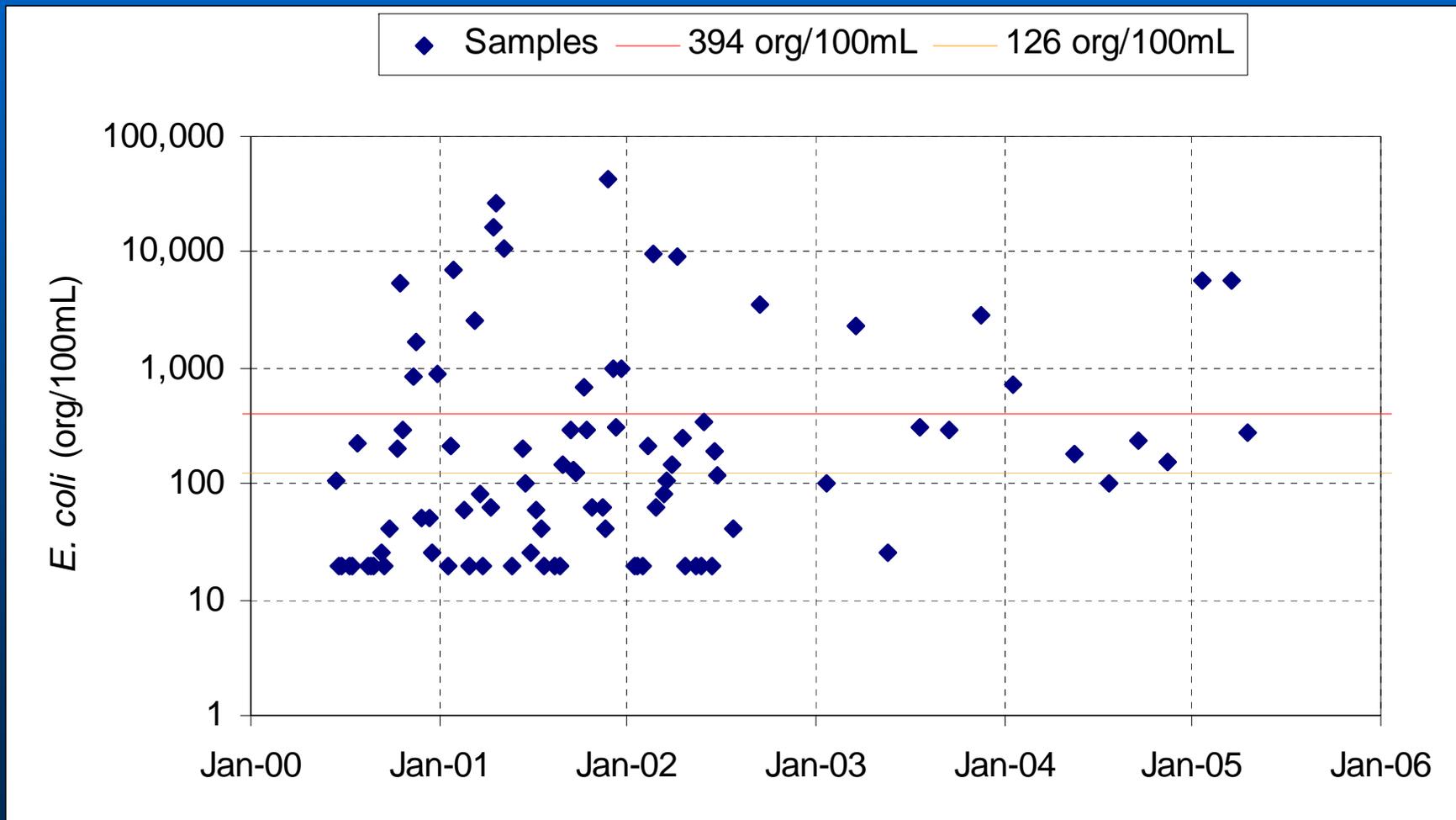


Temporal Analysis: West Fork at SH 242 (#16624)





Temporal Analysis: Crystal Creek (#16635)





Flow Duration Curves

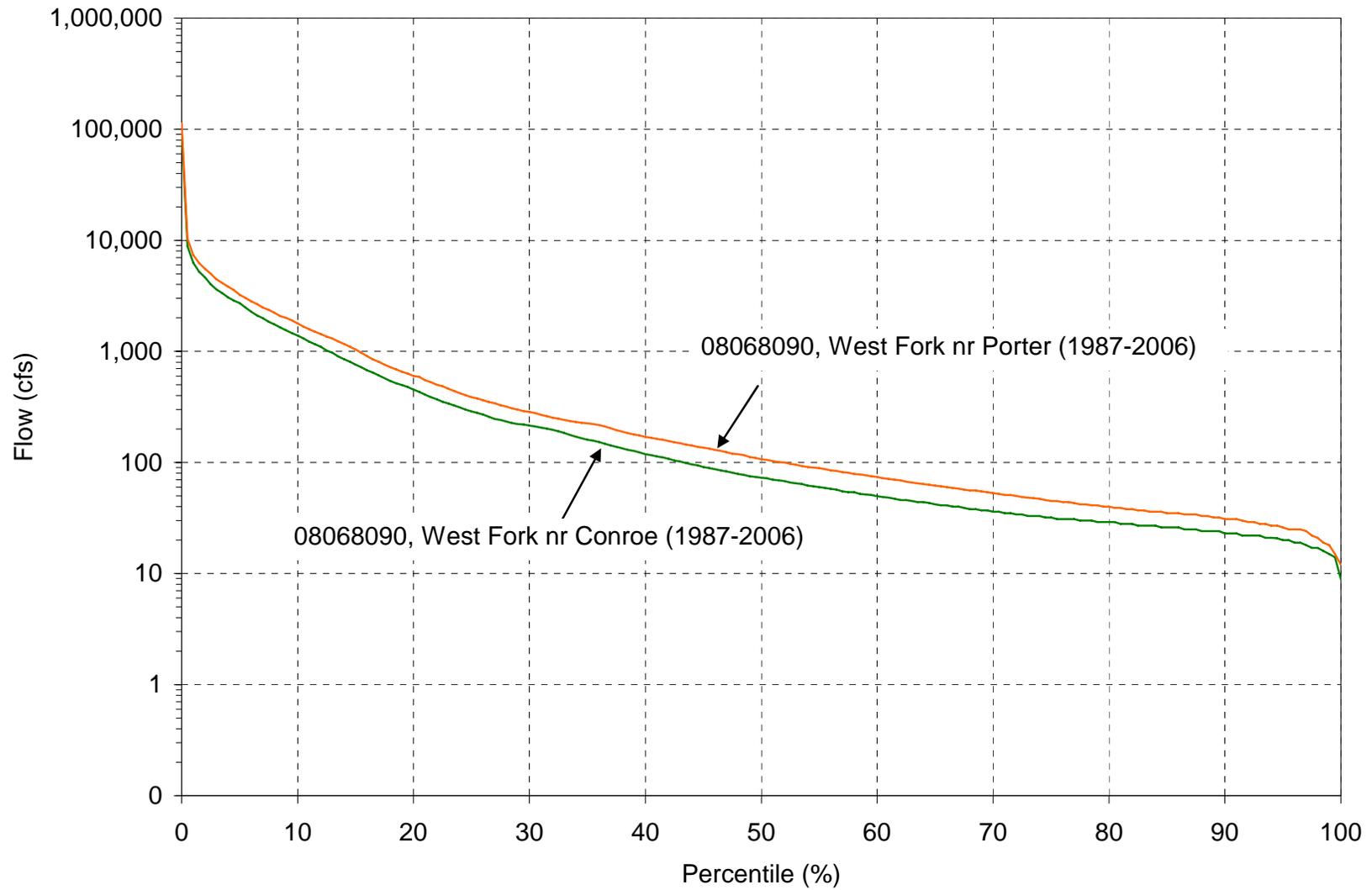
- A flow duration curve (FDC) is a graph of daily average streamflow versus the percent of days that the average streamflow value is exceeded
- FDCs are typically developed using daily flow data collected at USGS gaging stations
- Since most sampling sites do not have a corresponding USGS gage, flow records were synthesized using nearby gages and drainage area adjustment factors



West Fork USGS Flow Gages

Station	Stream	Location	Available FDC data
08067650	West Fork San Jacinto River	below Lk Conroe near Conroe, TX	N/A
08068000	West Fork San Jacinto River	near Conroe, TX	1987-2006
08068090	West Fork San Jacinto River	above Lk Houston near Porter, TX	1987-2006

West Fork Flow Duration Curve

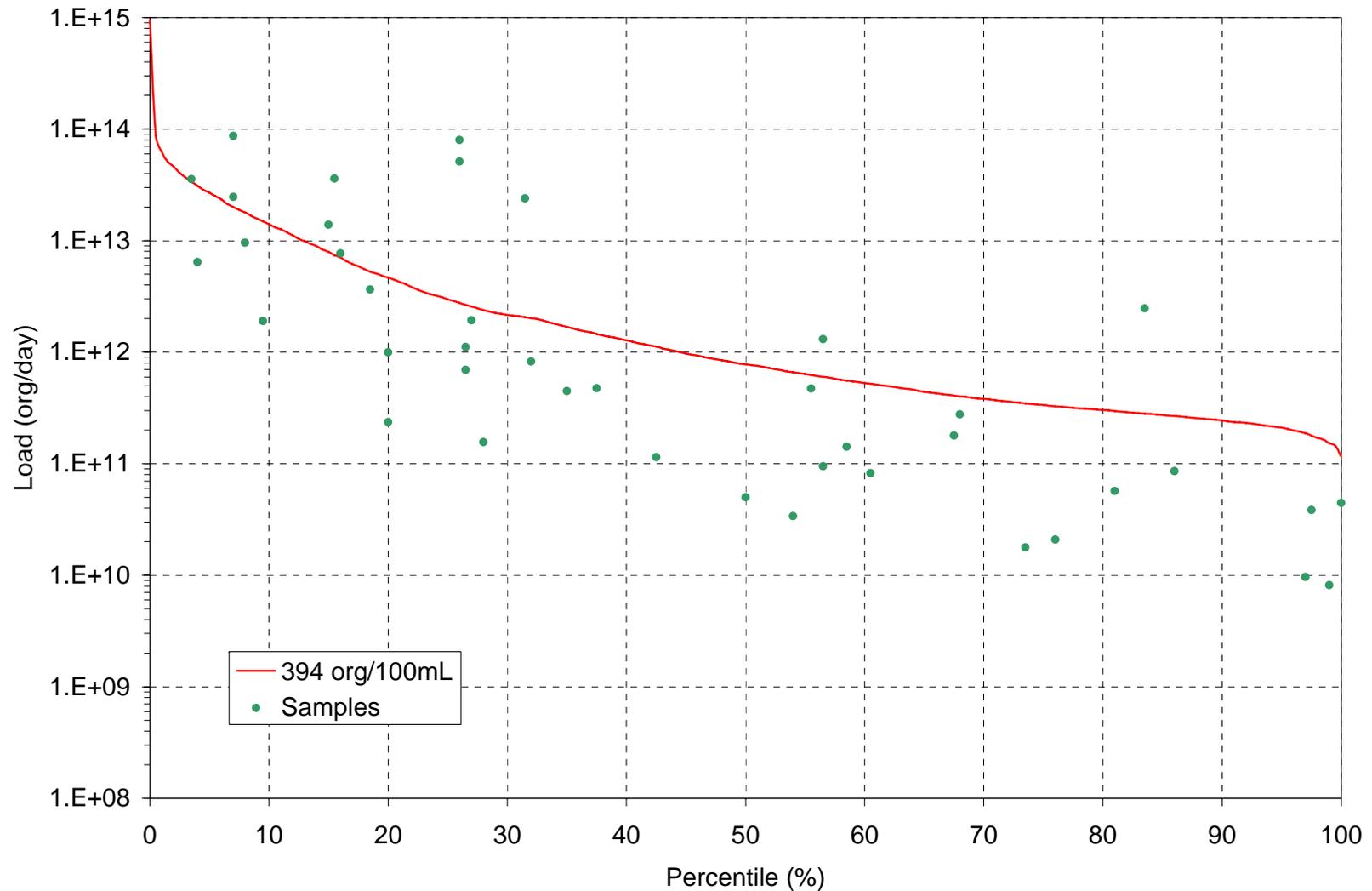




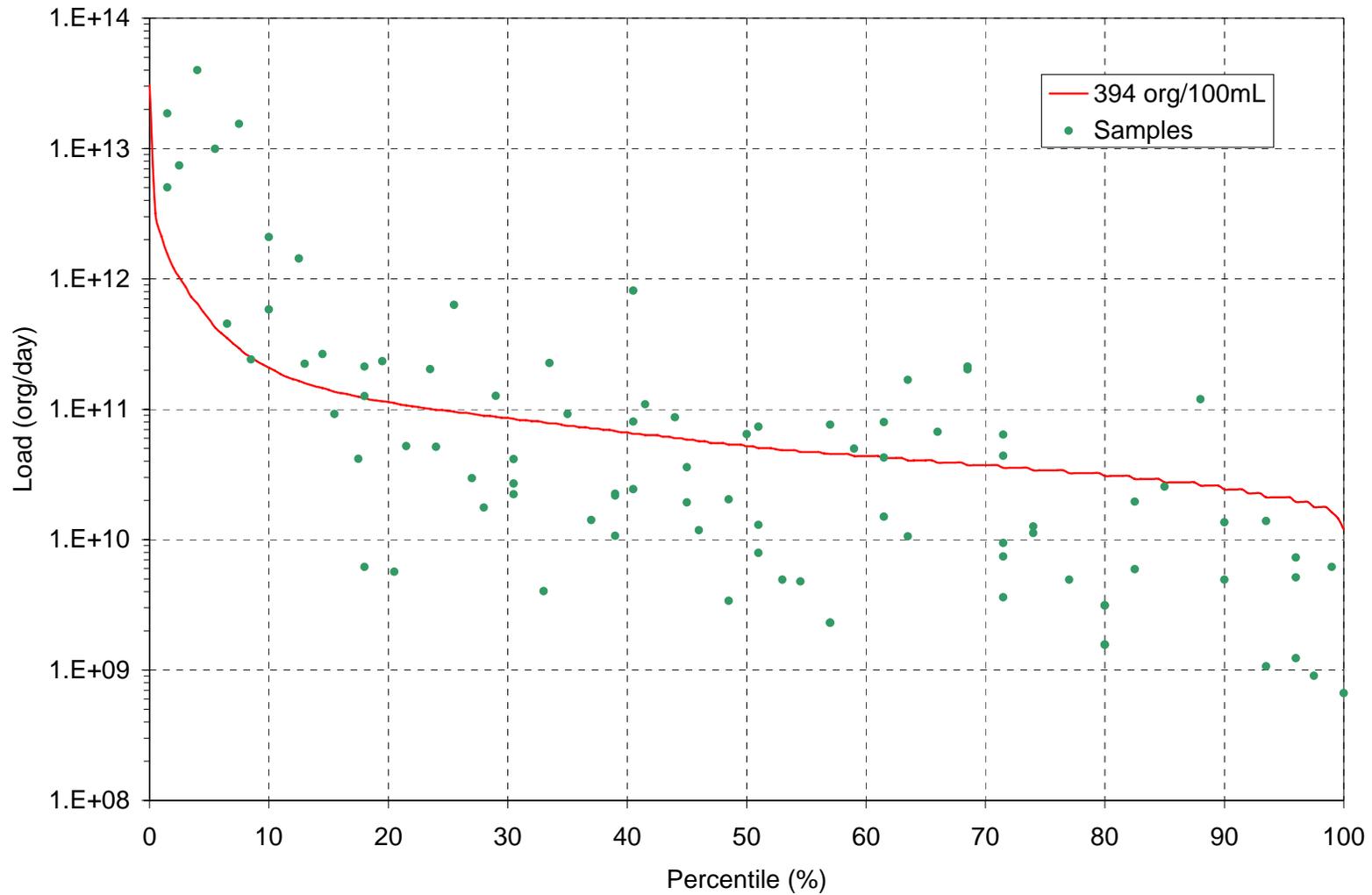
Load Duration Curves

- Load duration curves are presented from upstream to downstream
- Bacterial loads are the product of each grab sample bacteria concentration and the corresponding mean daily streamflow rate.
- The greatest exceedances typically occur under high flow conditions

LDC for West Fork at SH 242 (#16624)

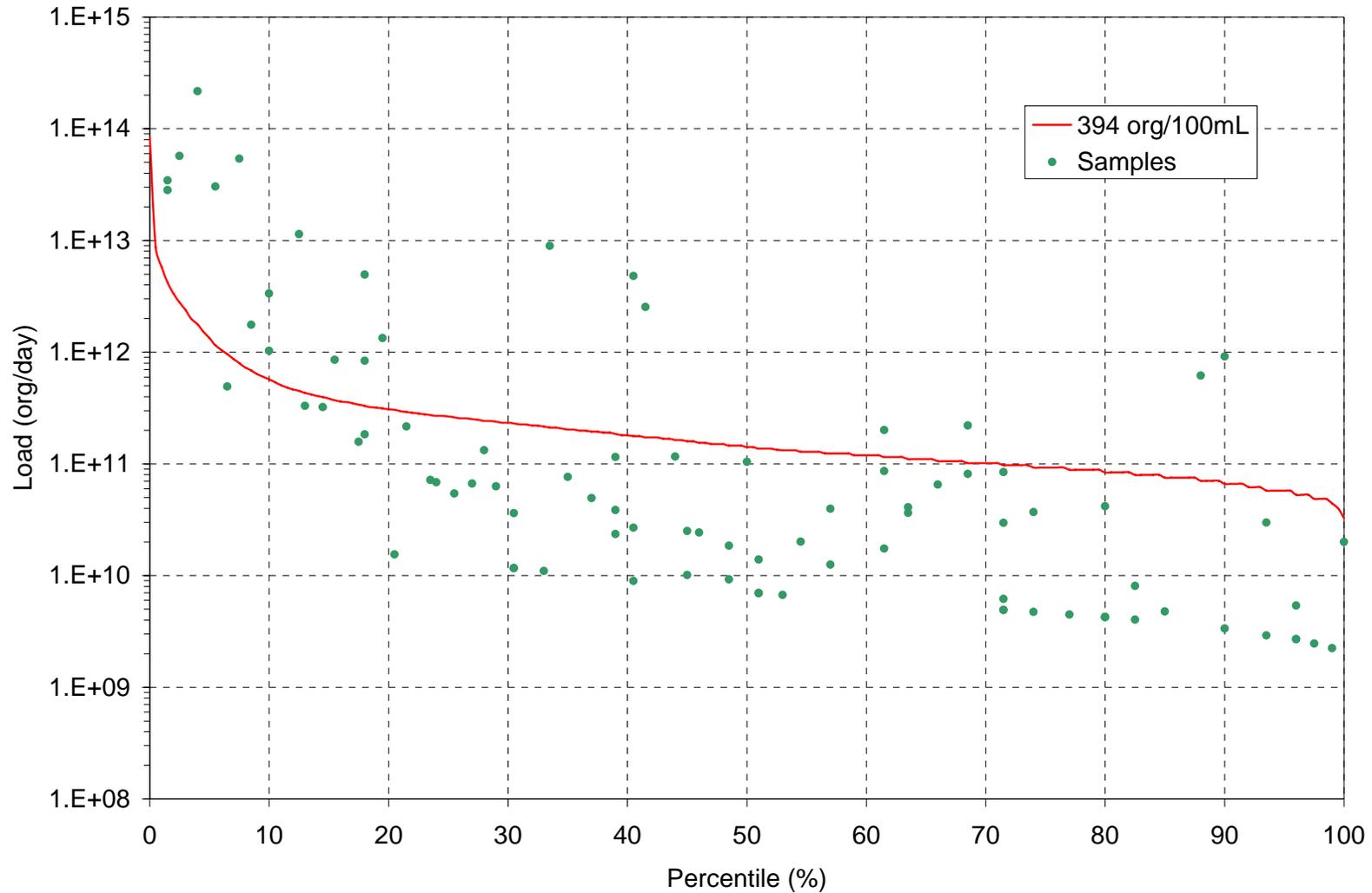


LDC for Stewarts Creek (#16626)





LDC for Crystal Creek (#16635)





Potential Sources

- Two primary source categories:
 - Wasteloads (WL) - any source flowing into a waterway and covered by a permit
 - wastewater treatment plants
 - discharges of runoff from municipal areas covered under stormwater permits (MS4s)
 - Loads (L) - remaining diffuse sources of pollutants that are not covered by permit
 - runoff from rural or urban areas outside of permitting jurisdictions



Runoff Sources

- Natural areas typically produce the smallest runoff source loads because they tend to produce the least runoff volume and tend to have the lowest density of fecal sources
- Rural areas may also have smaller source loads due to lower runoff volumes and less impervious cover
- Urban areas may produce larger bacteria loads because of high impervious cover, which can increase the frequency and intensity of runoff events
- Monitoring plan will seek to characterize sources

Wastewater Treatment Facilities



- Potential to contribute significant bacteria loads if complete disinfection is not achieved
- Loads may be most noticeable under low flow conditions, during which some streams may be effluent dominated
- Also possible for treatment plants to contribute significant loads under wet weather conditions
- Increased loading due to stormwater inflow and infiltration may result in poorer plant performance

West Fork



Wastewater Treatment Facility Summary

- 31 permitted facilities
- Total current flow 11 MGD (18 cfs)
- Total Permitted flow 23 MGD (36 cfs)
- WWTP flows account for 100% of the stream flow at the 99th percentile regime (low flow), 17% of the flow at the 50th percentile (median flow)



Monitoring Plan



Monitoring Objectives

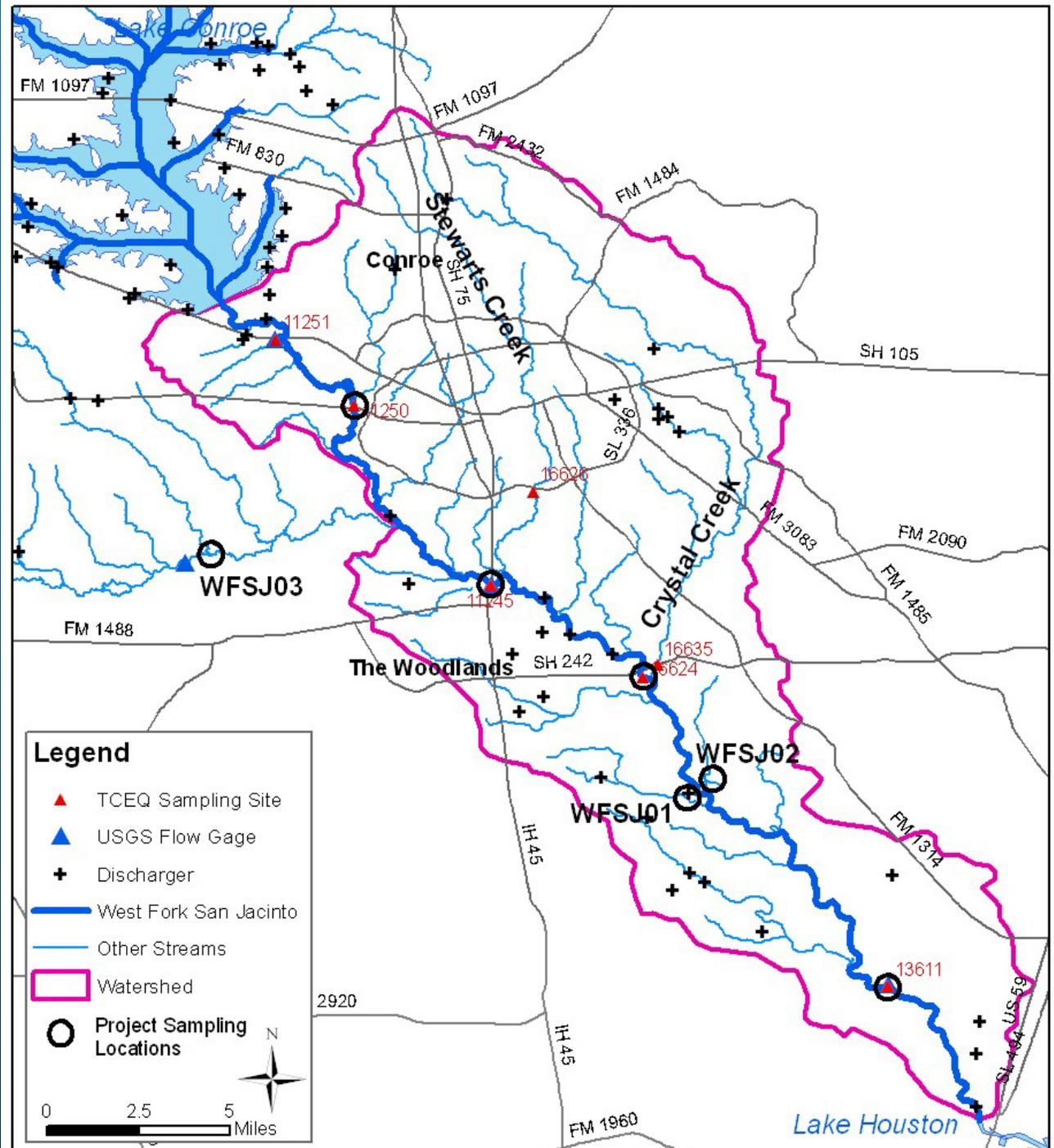
- Provide:
 - better definition of the water quality conditions on the study segments with respect to bacterial indicators,
 - definition of source areas or loading points that contribute to conditions in the segment,
 - data sufficient for estimation of loadings and support of allocation activities.



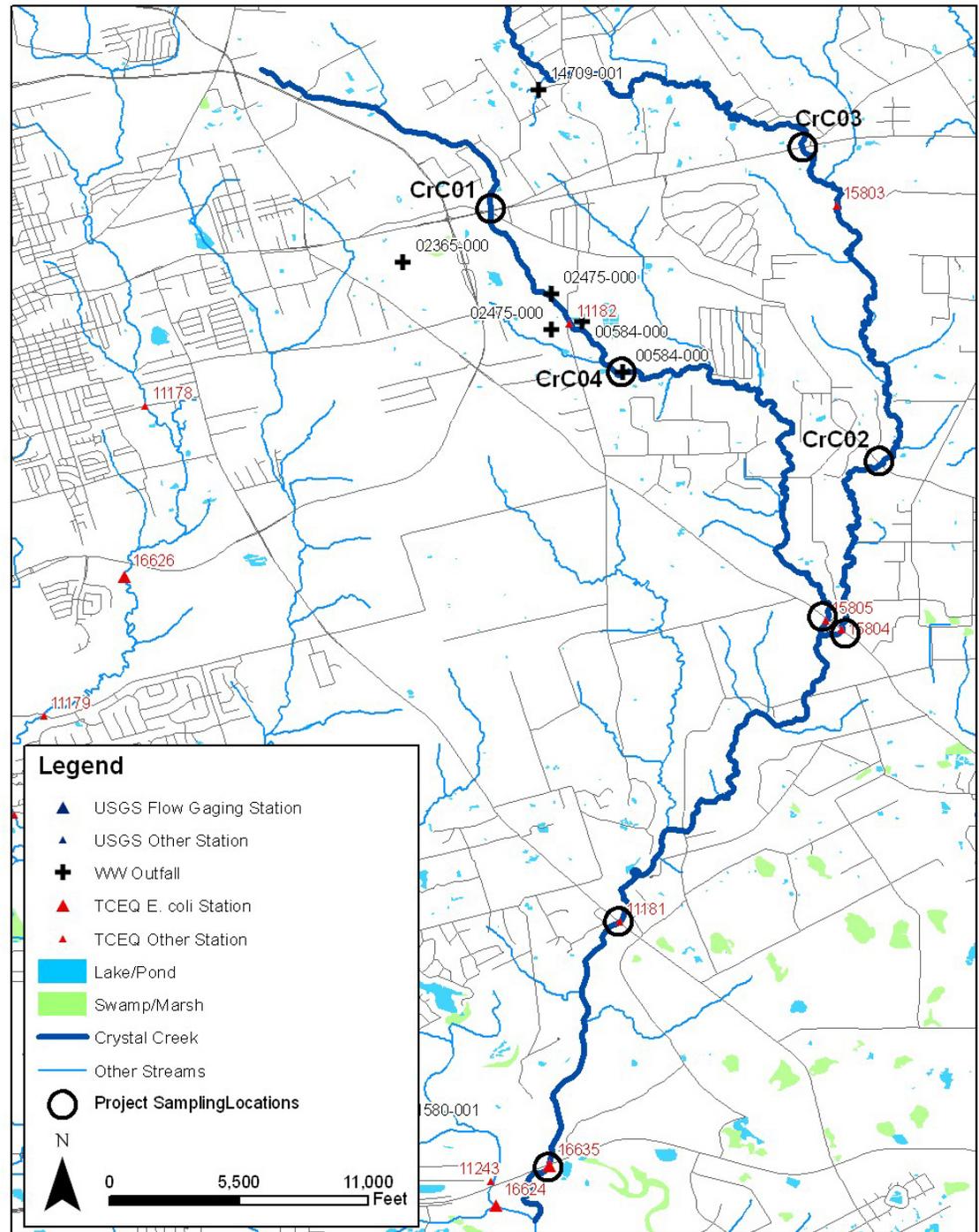
Synoptic Sampling Surveys

- Samples to be collected under baseflow conditions
- Ascertain source areas, longitudinal trends, extent of impairment
- Routine monitoring stations and additional sites
- Two synoptic sampling surveys on each study segment
- General schedule for these events November 2007 to July 2008
- Sampling commences after Quality Assurance Project Plan (QAPP) is approved by TCEQ

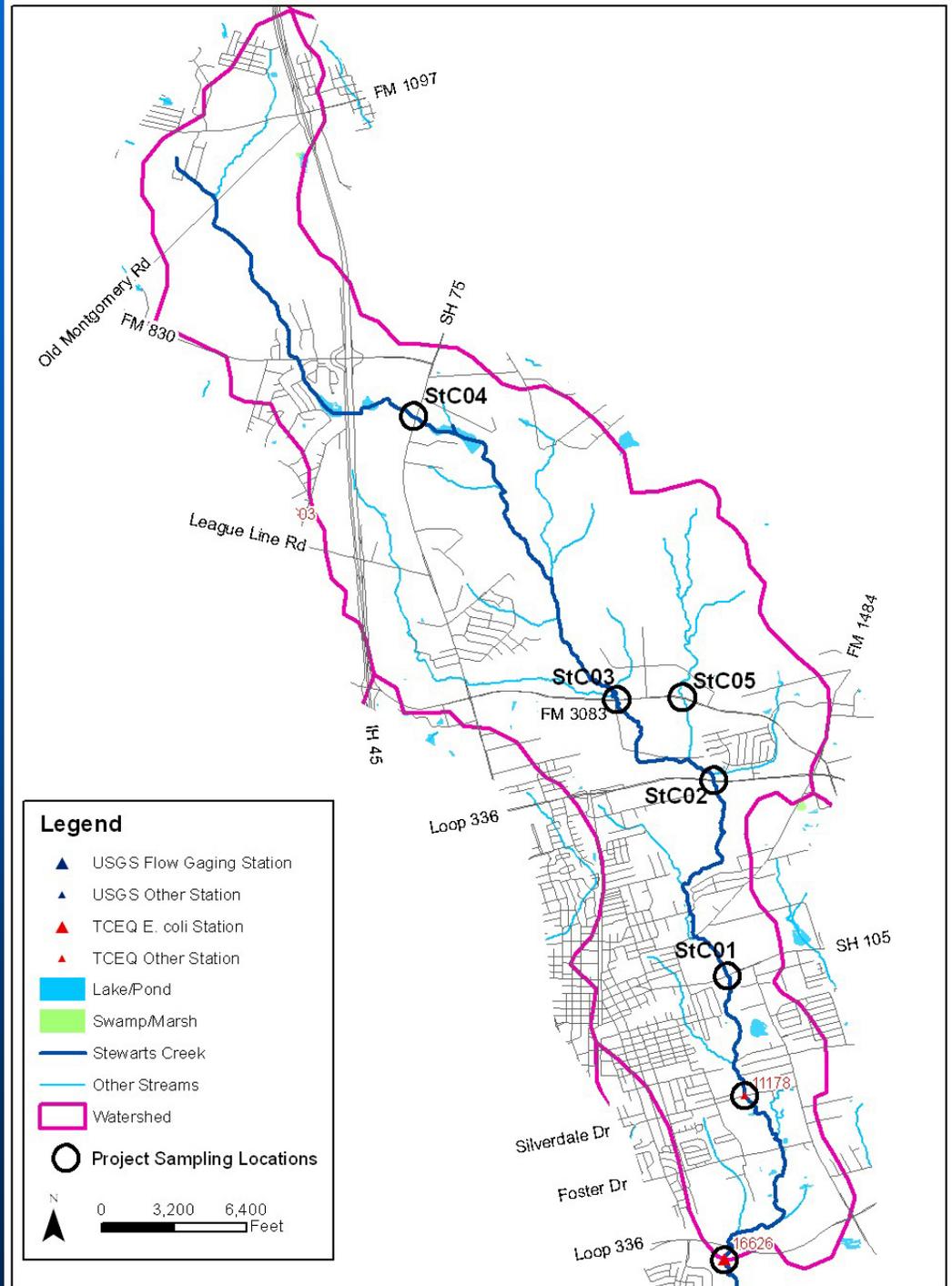
Sampling Stations for West Fork San Jacinto River, Segment 1004



Sampling Stations for Crystal Creek, Segment 1004D



Sampling Stations for Stewarts Creek, Segment 1004E



Spatially-Intensive Source Studies



- Upper East Fork San Jacinto River, Segment 1003; Stewarts Creek, Segment 1004E; Willow Creek Segment, 1008H; and Spring Gully, Segment 1009 D
- Evaluate specific source locations in detail
- Baseflow Conditions
- Selected segments: urban, rural
- Numerous sampling points, eg, 1000-ft intervals
- Sample pipes, outfalls, tributaries
- Test for bacteria, optical brighteners
- Extrapolate to similar areas in study area

Sediment Source Studies



- Upper East Fork San Jacinto River, Segment 1003; Stewarts Creek, Segment 1004E; Willow Creek Segment, 1008H; and Spring Gully, Segment 1009 D
- Evaluate sediment as potential bacteria source
- Baseflow conditions
- Sediment sampling at varying distance from stream bed



Resuspension Study

- Willow Creek Segment, 1008H; and Spring Gully, Segment 1009D
- Evaluate resuspension of bed sediments as bacteria source
- Baseflow Conditions
- Track bacteria in water column over 1-2 days



Kinetics Study

- One location at each of the following: Willow Creek Segment, 1008H; and Spring Gully, Segment 1009D
- Evaluate regrowth of bacteria from point sources
- Baseflow Conditions
- In situ bacteria kinetic rates

Wet Weather WWTP Sampling Study



- Willow Creek Segment, 1008H
- Estimate WWTP loads under wet weather conditions
- Sample 10-30 WWTPs at outfall pipes
- Sample receiving stream at downstream monitoring station
- Estimate total event loading of bacteria from point sources
- Estimate proportion of total stream loading derived from point sources



Microbial Source Tracking

- Spring Gully, Segment 1009D
- Conduct sampling and testing for qPCR
- Test for human presence/absence
- Test raw wastewater samples
- Rapid turn-around of results may guide additional testing
- One baseline survey
- Repeat if warranted

TCEQ Website for Project Information



<http://www.tceq.state.tx.us/implementation/water/tmdl/82-lakehouston.html>