Appendix 7H

Overland Flow and Surface Water Scoring

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Overland Flow and Surface Water Scoring

SURFACE WATER SCORING AND RANKING

Introduction

There are a large number of river and stream crossings along the Longhorn pipeline. These include five major river crossings as well as crossings of secondary or above streams (at least one branch above the crossing), and numerous crossings of primary streams (no branches above the crossing). In addition, there are a large number of spots in the line, which depending on slope and soil characteristics, represent points where overland flow of gasoline or oil will move perpendicular to the line.

There are a number of potential impacts from a leak at a river or stream crossing. These may include:

- Downstream transport of gasoline or crude oil, and gasoline or crude oil constituents such as benzene, toluene, xylene, and if present in fuels, MTBE;
- Contamination of the river bed soils; and
- Contamination of downstream aquifers which are regenerated from in-stream recharge features or through alluvium.

DATA SOURCES

The following information was collected on each surface water body crossed by the Longhorn Pipeline System:

- River/stream name at each crossing;
- Calculation of basin area draining to river/stream above each crossing point;
- Slope of river/stream in vicinity of crossing point;
- Longest distance from crossing to origination of watercourse;
- Slope of basin from selected origination point to crossing point;
- Flow data for specific rivers and creeks (where available);
- Modeling parameters for two crossings (Onion Creek, Colorado River);
- Downstream water rights for each secondary or above river or stream; and
- Maximum leak volume(s) for each point in pipeline.

Much of this information was collected from the United States Geological Society (USGS) maps or similar data sources. For example, calculation of the basin area was performed

by manually delineating the basin for each river or stream. Other data were drawn from outside data sources, such as flow data and downstream water rights. Finally, leak volumes were calculated by GIS from pipeline diameter, proximity to valves, and topography along line.

In addition, for each 100 meters along the System, from Houston to El Paso, an overland flow trace was calculated using Digital Line Graph surface models from USGS. For each 100 meters, it was possible to digitally construct an overland flow trace which would show the pathway of a theoretical volume of spilled gasoline or crude oil away from the line to the most likely surface water body.

Once this overland flow trace was modeled, the likelihood for a spill to reach the surface water body could be ranked. The following information was generated for each overland flow trace:

- The distance from the theoretical release point along the System to the nearest surface water body;
- The slope from the theoretical release point to the nearest surface water body; and
- The land use cover between the release point and the nearest surface water body.

Distance, slope, and cover will all effect the ability of a release to travel overland to a surface water body where it would be transported by water in the stream.

OBJECTIVES

Because of the System's large number of crossings, and even larger number of points along the pipeline with potential to impact surface waters due to overland flow from the pipeline to a stream, it was necessary to handle the surface water impacts as one large data set, that included both crossings and overland flow points. By combining these data sets, it was possible to rank each of the 2,516 segment of the line for potential to impact surface waters.

METHODOLOGY

The methodology for evaluating surface hydrology involved two separate phases; evaluation of leaks to rivers and streams, and evaluation of leaks to overland flow points.

Leaks to Rivers and Streams

The critical output from the evaluation of rivers and streams was to determine how far a certain concentration of select constituents might travel along the watercourse under different leak and flow scenarios. Scores were assigned to each stream crossed by the pipeline, based on ability of the stream to transport a spill (on a scale of 1 – 6), potential for isolation of a spill for cleanup (on a scale of 1 – 6), and combined value of downstream uses of the water, and distance to identified downstream use (on a scale of 1 – 10).

The transport and isolation scores are described in Chapter 4 of the Longhorn EA. Assignment of value/distance scores are described in Chapter 7 of the Longhorn EA.

Downstream uses that were identified included public drinking water rights, in-stream recreation, and recreational uses associated with parks, state natural areas, and preserves.

Modeling was performed on one stream crossing, and two river crossings, at a range of hydrological conditions and leak scenarios. The models indicated that under certain flow conditions, travel of gasoline plumes containing benzene or MTBE at concentrations in excess of drinking water standards, could travel far downstream, although volatilization will decrease the concentrations of these constituents, particularly the volatile organic benzene. Within streams or rivers, the plumes containing benzene/MTBE concentrations is expected to pass by any point in the stream within about a 1-day time period. On the other hand, plumes of contamination reaching a lake, particularly plumes containing high concentrations of the less-volatile, highly water soluble compound MTBE may render the water in the lake non-potable for an extended period of time.

The overall sensitivity of a stream or river was calculated by summing the three scores described above – transport characteristics, ability to isolate, and distance/value of downstream water uses. The maximum combined score was 22, the minimum 3. Sensitivity and hypersensitivity for each stream and river crossed by the pipeline was then determined based on these factors.

Overland Flows

Three factors were used to determine the overland flows and intermittent streams during non-flow conditions of gasoline or crude oil. First is the slope of the land, which will determine how much impetus there is for the spill to move. Second is the distance to a surface water body. Third is the porosity of the soil, which will determine how quickly the spill is absorbed by the soils, retarding overland flows. For this exercise, soil porosity was evaluated as a function of land use cover. Other factors that would influence transport location but not included were ground conditions, weather conditions, specific spill volume, and duration of spill.

Based on these three parameters considered, a score between 1 and 5 was assigned to each flow trace modeled. A score of 5 represented those flow traces most likely to reach surface water, including segments of the line actually including surface water crossings.

In order to rank these overland flow segments along with the surface water crossings along the System, the 1 – 5 overland flow score was translated into a 0.2 to 1.0 flow factor. This factor was then multiplied by the score for the surface water body that would be affected if a release reached a stream. Thus, a combined score of 22 represented a release at a point ranked as highly likely to result in contamination of a very sensitive surface water body.

SCORING RESULTS

Determination of Sensitive/Hypersensitive

Once a sensitivity/risk factor was calculated for each segment of the pipeline, a distribution curve was set up to evaluate sensitivity scores with miles of pipeline. The sensitivity score for each segment was plotted against the miles of pipeline having a lower sensitivity score than any given segment. Points along the curve were chosen and qualitative observations of the

data were made. Points were selected to differentiate sensitive and hypersensitive scoring thresholds along the distribution curve, based on inflection points in the curve. Verification of the data points excluded by the thresholds was done by spot checking the points against topographic maps.

Sensitivity for drinking water impacts for overland flow segments was set at a score of 15.2. Drinking water hypersensitivity was assigned to overland flow segments having a score of 18 or higher. Proof checking of pipeline segments not rated sensitive or hypersensitive did not indicate any where major surface water quality concerns were apparent.

Sensitivity for recreational impacts for overland flow segments set at a score of 15. No overland flow segments were rated as hypersensitive for recreational areas.

Segments Scored as Sensitive/Hypersensitive

The following number of segments and distances represent the areas rated as sensitive for drinking water or recreational water use, including segments including crossings:

- Drinking water sensitive – 93 segments, 15.19 miles;
- Recreational sensitive - 73 segments, 11.49 miles;
- Drinking water hypersensitive – 6.18 miles; and
- Recreational hypersensitive – 7.51 miles.

The segments scored as sensitive or hypersensitive as well as scorings, are included in Tables 7H-1 through 7H-4.

CONCLUSIONS

The results of the impact analysis focused on potential damages to in-stream uses and to water rights for rivers and streams. After concentrations of concern were defined, modeling results are extrapolated to the entire population of 2nd degree above rivers and streams, and downstream concentrations are projected. The types of water rights and in-stream water uses that are impacted downstream will be catalogued.

The secondary impact of potential downstream contamination of ground water resources (due to surface features or adsorption into the river alluvium) was also addressed quantitatively. It is not possible to do a complete and precise assessment of the amount of contamination possible for these aquifers. However, it will be possible to identify which resources may be impacted, the conditions under which those impacts may take place (i.e., high flow in river versus low flow), and the mitigation measures be available for preventing those impacts.

Table 7H-1. Drinking Water Sensitive Segments Along Longhorn Pipeline

Begin Mile	End Mile	Stream Name	Stream Number	Stream Crossing Milepoint	Segment Length	Segment Overland Flow Code	Segment Drains to Stream Number:	Dw Sens	Rec Sens	DW Sens x Overland Flow	Rec Sens x Overland Flow
163.48	163.67	Marble Creek	101	163.50	0.19	*	101	16	18	16	18
163.67	163.86	Unk 102	102	163.56	0.19	*	101	16	18	16	18
163.92	164.04	Onion Creek	103	163.98	0.12	*	103	20	22	20	22
164.10	164.17				0.06	4	103	20	22	16	17.6
164.91	164.97				0.06	4	103	20	22	16	17.6
179.51	179.89	Long Branch	108	179.63	0.37	*	108	16	18	16	18
180.20	180.26				0.06	5	108	16	18	16	18
180.88	181.01	Barton Creek	109	180.92	0.12	*	109	18	20	18	20
182.12	182.19				0.06	5	109	18	20	18	20
182.43	182.50				0.06	5	109	18	20	18	20
184.73	184.86				0.12	5	110	18	14	18	14
185.42	185.79	Fitzhugh Creek	110	185.76	0.37	*	110	18	14	18	14
185.79	185.85				0.06	5	110	18	14	18	14
187.53	187.65				0.12	5	110	18	14	18	14
189.46	189.58				0.12	5	111	16	16	16	16
190.08	190.20				0.12	5	111	16	16	16	16
190.26	190.39	Unk 111	111	190.34	0.12	*	111	16	16	16	16
191.38	191.44				0.06	5	111	16	16	16	16
192.19	192.25				0.06	4	112	19	19	15.2	15.2
192.63	192.94				0.31	4	112	19	19	15.2	15.2
192.94	193.00				0.06	5	112	19	19	19	19
193.00	193.25	Flat Creek	112	193.21	0.25	*	112	19	19	19	13
193.25	193.31				0.06	5	112	19	19	19	19
193.31	193.43				0.12	4	112	19	19	15.2	15.2
193.68	194.18				0.50	4	112	19	19	15.2	15.2
196.10	196.29	Unk 113	113	196.15	0.19	*	113	17	17	17	17
197.29	197.53				0.25	5	114	17	17	17	17
198.16	198.28	Unk 114	114	198.23	0.12	*	114	17	17	17	17
198.59	198.78	Pedernales River	115	198.73	0.19	*	115	22	22	22	22
198.78	198.84	Unk 116	116	198.80	0.06	*	115	22	22	22	22
198.84	198.96				0.12	4	115	22	22	17.6	17.6
199.34	199.46	Unk 117	117	199.37	0.12	*	117	17	17	17	17
201.26	201.39				0.12	5	118	17	17	17	17
201.88	202.13	Unk 118	118	201.94	0.25	*	118	17	17	17	17
202.26	202.57	Cottonwood Creek	119	202.49	0.31	*	119	18	18	18	18
202.57	202.63				0.06	5	119	18	18	18	18
203.13	203.31	Cottonwood Creek	120	203.19	0.19	*	120	17	17	17	17
203.31	203.44	Cottonwood Creek	121	203.37	0.12	*	121	17	17	17	17
204.93	205.05	Unk 122	122	205.02	0.12	*	122	17	17	17	17
205.05	205.18				0.12	5	122	17	17	17	17
205.98	206.05	Harden Russell	123	206.03	0.06	*	123	16	16	16	16
206.23	206.36				0.12	5	123	16	16	16	16
207.91	208.04	Buffalo Creek	124	207.98	0.12	*	124	17	17	17	17
209.22	209.34				0.12	5	125	16	16	16	16
209.84	209.96	Hickory Creek	125	209.91	0.12	*	125	16	16	16	16
211.45	211.64	Spring Branch	126	211.61	0.19	*	126	15	15	15	15
212.82	212.88				0.06	5	127	16	16	16	16
213.19	213.25				0.06	5	127	16	16	16	16
213.25	213.44	White Oak Creek	127	213.26	0.19	*	127	16	16	16	16
228.66	229.29				0.62	4	135	20	16	16	12.8
229.29	229.35	Crabapple Creek	135	229.33	0.06	*	135	20	16	20	16
229.35	229.66				0.31	4	135	20	16	16	12.8
230.34	230.40				0.06	5	136	17	13	17	13
230.72	230.90	Unk 136	136	230.75	0.19	*	136	17	13	17	13
240.22	240.35	Unk 141	141	240.31	0.12	*	141	17	11	17	11
247.74	247.93				0.19	5	147	16	11	16	11
247.99	248.11	Cedar Hollow	147	248.01	0.12	*	147	16	11	16	11
248.11	248.30	Cedar Hollow	148	248.23	0.19	*	148	16	11	16	11

Table 7H-1. (Continued)

Begin Mile	End Mile	Stream Name	Stream Number	Stream Crossing Milepoint	Segment Length	Segment Overland Flow Code	Segment Drains to Stream Number:	Dw Sens	Rec Sens	DW Sens x Overland Flow	Rec Sens x Overland Flow
248.30	248.55	Squaw Creek	150	248.49	0.25	*	150	18	13	18	13
248.80	248.86				0.06	5	150	18	13	18	13
248.98	249.11	Threadgill Creek	151	249.99	0.12	*	150	18	13	18	13
249.73	250.10	Spring Branch	152	250.04	0.37	*	151	18	13	18	13
250.10	250.16				0.06	5	152	15	10	15	10
250.16	250.29	Spring Branch	153	250.24	0.12	*	153	15	10	15	10
250.29	250.47	Spring Branch	154	250.34	0.19	*	154	15	10	15	10
254.82	255.07	Panther Creek	156	254.87	0.25	*	156	15	11	15	11
255.51	255.57				0.06	5	157	15	11	15	11
255.94	256.00	Panther Creek	157	255.98	0.06	*	157	15	11	15	11
257.81	258.06	Rocky Creek	158	257.89	0.25	*	158	15	11	15	11
259.92	260.11	Schep Creek	160	260.04	0.19	*	160	15	11	15	11
260.11	260.17				0.06	5	160	15	11	15	11
262.09	262.16				0.06	4	161	20	18	16	14.4
263.46	263.59				0.12	4	161	20	18	16	14.4
263.65	263.96	James River	161	263.89	0.31	*	161	20	18	20	18
263.96	264.02				0.06	5	161	20	18	20	18
264.02	264.08				0.06	4	161	20	18	16	14.4
264.08	264.33				0.25	5	161	20	18	20	18
264.33	264.89				0.56	4	161	20	18	16	14.4
264.89	265.01				0.12	5	162	15	11	15	11
265.82	266.13	Mill Creek	162	265.99	0.31	*	162	15	11	15	11
266.69	266.82	Unk 163	163	266.71	0.12	*	163	15	11	15	11
267.00	267.19				0.19	5	163	15	11	15	11
267.75	267.87	Mill Creek	164	267.86	0.12	*	164	16	12	16	12
267.87	267.94				0.06	5	164	16	12	16	12
269.49	269.55				0.06	5	164	16	12	16	12
271.23	271.41	Little Rocky Creek	165	271.30	0.19	*	165	15	11	15	11
271.66	271.79				0.12	5	165	15	11	15	11
275.76	275.95	Unk 167	167	275.83	0.19	*	167	15	11	15	11
276.37	276.77	Llano River	168	276.57	0.40	*	168	20	18	20	18
315.91	316.03				0.12	5	185	15	11	15	11
324.05	324.42	Middle Valley	192	324.20	0.37	*	192	15	11	15	11
334.11	334.30	Antelope Draw	197	334.27	0.19	*	197	15	11	15	11
334.30	334.36				0.06	5	197	15	11	15	11

* Signifies river crossing

Table 7H-2. Drinking Water Hypersensitive Segments Along Longhorn Pipeline

Begin Mile	End Mile	Stream Name	Stream Number	Stream Crossing Milepoint	Segment length	Segment Overland Flow Code	Segment Drains to Stream Number:	DW Sens	Rec Sens	DW Sens x Overland Flow	Rec Sens x Overland Flow
163.48	163.67	Marble Creek	101	163.50	0.19	*	101	16	18	16	18
163.67	163.86	Unk 102	102	163.56	0.19	*	101	16	18	16	18
163.92	164.04	Onion Creek	103	163.98	0.12	*	103	20	22	20	22
179.51	179.89	Long Branch	108	179.63	0.37	*	108	16	18	16	18
180.88	181.01	Barton Creek	109	180.92	0.12	*	109	18	20	18	20
185.42	185.79	Fitzhugh Creek	110	185.76	0.37	*	110	18	14	18	14
190.26	190.39	Unk 111	111	190.34	0.12	*	111	16	16	16	16
193.00	193.25	Flat Creek	112	193.21	0.25	*	112	19	19	19	13
196.10	196.29	Unk 113	113	196.15	0.19	*	113	17	17	17	17
198.16	198.28	Unk 114	114	198.23	0.12	*	114	17	17	17	17
198.59	198.78	Pedernales River	115	198.73	0.19	*	115	22	22	22	22
198.78	198.84	Unk 116	116	198.80	0.06	*	115	22	22	22	22
199.34	199.46	Unk 117	117	199.37	0.12	*	117	17	17	17	17
201.88	202.13	Unk 118	118	201.94	0.25	*	118	17	17	17	17
202.26	202.57	Cottonwood Creek	119	202.49	0.31	*	119	18	18	18	18
203.13	203.31	Cottonwood Creek	120	203.19	0.19	*	120	17	17	17	17
203.31	203.44	Cottonwood Creek	121	203.37	0.12	*	121	17	17	17	17
204.93	205.05	Unk 122	122	205.02	0.12	*	122	17	17	17	17
205.98	206.05	Harden Russell	123	206.03	0.06	*	123	16	16	16	16
207.91	208.04	Buffalo Creek	124	207.98	0.12	*	124	17	17	17	17
209.84	209.96	Hickory Creek	125	209.91	0.12	*	125	16	16	16	16
213.25	213.44	White Oak Creek	127	213.26	0.19	*	127	16	16	16	16
229.29	229.35	Crabapple Creek	135	229.33	0.06	*	135	20	16	20	16
230.72	230.90	Unk 136	136	230.75	0.19	*	136	17	13	17	13
240.22	240.35	Unk 141	141	240.31	0.12	*	141	17	11	17	11
247.99	248.11	Cedar Hollow	147	248.01	0.12	*	147	16	11	16	11
248.11	248.30	Cedar Hollow	148	248.23	0.19	*	148	16	11	16	11
248.30	248.55	Squaw Creek	150	248.49	0.25	*	150	18	13	18	13
248.98	249.11	Threadgill Creek	151	249.99	0.12	*	150	18	13	18	13
249.73	250.10	Spring Branch	152	250.04	0.37	*	151	18	13	18	13
263.65	263.96	James River	161	263.89	0.31	*	161	20	18	20	18
267.75	267.87	Mill Creek	164	267.86	0.12	*	164	16	12	16	12
276.37	276.77	Llano River	168	276.57	0.40	*	168	20	18	20	18

* Signifies river crossing

Table 7H-3. Recreational Waters Sensitive Segments Along Longhorn Pipeline

Begin Mile	End Mile	Stream Name	Stream Number	Stream Crossing Milepoint	Segment length	Segment Overland Flow Code	Segment Drains to Stream Number:	DW Sens	Rec Sens	DW Sens x Overland Flow	Rec Sens x Overland Flow
63.81	64.00	Clear Creek	44	63.91	0.19	*		13	16	13	16
64.00	64.06	Brazos River	45	64.00	0.06	*		13	16	13	16
127.88	128.00	Hunt Creek	83	127.92	0.12	*		8	17	8	17
131.30	131.54	Alum Creek	86	131.46	0.25	*		11	14	11	14
134.40	134.53	Colorado River	89	134.44	0.12	*		13	22	13	22
134.53	134.59	Unk 90	90	134.51	0.06	*		9	18	9	18
163.48	163.67	Marble Creek	101	163.50	0.19	*		16	18	16	18
163.67	163.86	Unk 102	102	163.56	0.19	*		16	18	16	18
163.92	164.04	Onion Creek	103	163.98	0.12	*		20	22	20	22
164.10	164.17				0.06	4	103	20	22	16	17.6
164.91	164.97				0.06	4	103	20	22	16	17.6
167.34	167.52				0.19	5	104	14	16	14	16
168.08	168.27				0.19	5	104	14	16	14	16
168.39	168.89	Boggy Creek 104, 105, 106	104	168.55	0.50	*		10	16	10	16
168.89	168.95	Boggy Creek	105	168.79	0.06	*		10	16	10	16
168.95	169.26	Boggy Creek	106	168.82	0.31	*		10	16	10	16
174.61	174.67	Slaughter Creek	107	174.65	0.06	*		14	16	14	16
174.67	174.73				0.06	5	107	14	16	14	16
179.51	179.89	Long Branch	108	179.63	0.37	*		16	18	16	18
180.20	180.26				0.06	5	108	16	18	16	18
180.82	180.88				0.06	4	109	18	20	14.4	16
180.88	181.01	Barton Creek	109	180.92	0.12	*		18	20	18	20
181.94	182.12				0.19	4	109	18	20	14.4	16
182.12	182.19				0.06	5	109	18	20	18	20
182.19	182.25				0.06	4	109	18	20	14.4	16
182.37	182.43				0.06	4	109	18	20	14.4	16
182.43	182.50				0.06	5	109	18	20	18	20
182.62	182.68				0.06	4	109	18	20	14.4	16
185.42	185.79	Fitzhugh Creek	110	185.76	0.37	*		18	14	18	14
189.46	189.58				0.12	5	111	16	16	16	16
190.08	190.20				0.12	5	111	16	16	16	16
190.26	190.39	Unk 111	111	190.34	0.12	*	1	16	16	16	16
191.38	191.44				0.06	5	111	16	16	16	16
192.19	192.25				0.06	4	112	19	19	15.2	15.2
192.63	192.94				0.31	4	112	19	19	15.2	15.2
192.94	193.00				0.06	5	112	19	19	19	19
193.25	193.31				0.06	5	112	19	19	19	19
193.31	193.43				0.12	4	112	19	19	15.2	15.2
193.68	194.18				0.50	4	112	19	19	15.2	15.2
196.10	196.29	Unk 113	113	196.15	0.19	*		17	17	17	17
197.29	197.53				0.25	5	114	17	17	17	17
198.16	198.28	Unk 114	114	198.23	0.12	*		17	17	17	17
198.59	198.78	Pedernales River	115	198.73	0.19	*		22	22	22	22
198.78	198.84	Unk 116	116	198.80	0.06	*		22	22	22	22
198.84	198.96				0.12	4	115	22	22	17.6	17.6
199.34	199.46	Unk 117	117	199.37	0.12	*		17	17	17	17
201.26	201.39				0.12	5	118	17	17	17	17
201.88	202.13	Unk 118	118	201.94	0.25	*		17	17	17	17
202.26	202.57	Cottonwood Creek	119	202.49	0.31	5	119	18	18	18	18
202.57	202.63				0.06	5	119	18	18	18	18
203.13	203.31	Cottonwood Creek	120	203.19	0.19	*		17	17	17	17
203.31	203.44	Cottonwood Creek	121	203.37	0.12	*		17	17	17	17
204.93	205.05	Unk 122	122	205.02	0.12	*		17	17	17	17
205.05	205.18				0.12	5	122	17	17	17	17
205.98	206.05	Harden Russell	123	206.03	0.06	*		16	16	16	16
206.23	206.36				0.12	5	123	16	16	16	16
207.91	208.04	Buffalo Creek	124	207.98	0.12	*		17	17	17	17

Table 7H-3. (Continued)

Begin Mile	End Mile	Stream Name	Stream Number	Stream Crossing Milepoint	Segment length	Segment Overland Flow Code	Segment Drains to Stream Number:	DW Sens	Rec Sens	DW Sens x Overland Flow	Rec Sens x Overland Flow
209.22	209.34				0.12	5	125	16	16	16	16
209.84	209.96	Hickory Creek	125	209.91	0.12	*		16	16	16	16
211.45	211.64	Spring Branch	126	211.61	0.19	*		15	15	15	15
212.82	212.88				0.06	5	127	16	16	16	16
213.19	213.25				0.06	5	127	16	16	16	16
213.25	213.44	White Oak Creek	127	213.26	0.19	*		16	16	16	16
229.29	229.35	Crabapple Creek	135	229.33	0.06	*		20	16	20	16
233.08	233.32	Unk 137	137	233.19	0.25	*		14	14	14	14
234.75	234.88	Sandy Creek (1)	138	234.85	0.12	*		12	14	12	14
236.56	236.74	Sandy Creek (2)	139	236.72	0.19	*		12	14	12	14
263.65	263.96	James River	161	263.89	0.31	*		20	18	20	18
263.96	264.02				0.06	5	161	20	18	20	18
264.08	264.33				0.25	5	161	20	18	20	18
276.37	276.77	Llano River	168	276.57	0.40	*		20	18	20	18
525.31	525.49	Pecos River	250	525.44	0.19	*		12	15	12	15
526.48	526.88	Unk 251	251	526.68	0.40	*		12	15	12	15

* Signifies river crossing

Table 7H-4. Recreational Waters Hypersensitive Segments Along Longhorn Pipeline

Begin Mile	End Mile	Stream Name	Stream Number	Stream Crossing Milepoint	Segment length	DW Sens	Rec Sens	DW Sens x Overland Flow	Rec Sens x Overland Flow
63.81	64.00	Clear Creek	44	63.91	0.19	13	16	13	16
64.00	64.06	Brazos River	45	64.00	0.06	13	16	13	16
127.88	128.00	Hunt Creek	83	127.92	0.12	8	17	8	17
131.30	131.54	Alum Creek	86	131.46	0.25	11	14	11	14
134.40	134.53	Colorado River	89	134.44	0.12	13	22	13	22
134.53	134.59	Unk 90	90	134.51	0.06	9	18	9	18
163.48	163.67	Marble Creek	101	163.50	0.19	16	18	16	18
163.67	163.86	Unk 102	102	163.56	0.19	16	18	16	18
163.92	164.04	Onion Creek	103	163.98	0.12	20	22	20	22
168.39	168.89	Boggy Creek 104, 105, 106	104	168.55	0.50	10	16	10	16
168.89	168.95	Boggy Creek	105	168.79	0.06	10	16	10	16
168.95	169.26	Boggy Creek	106	168.82	0.31	10	16	10	16
174.61	174.67	Slaughter Creek	107	174.65	0.06	14	16	14	16
179.51	179.89	Long Branch	108	179.63	0.37	16	18	16	18
180.88	181.01	Barton Creek	109	180.92	0.12	18	20	18	20
185.42	185.79	Fitzhugh Creek	110	185.76	0.37	18	14	18	14
190.26	190.39	Unk 111	111	190.34	0.12	16	16	16	16
196.10	196.29	Unk 113	113	196.15	0.19	17	17	17	17
198.16	198.28	Unk 114	114	198.23	0.12	17	17	17	17
198.59	198.78	Pedernales River	115	198.73	0.19	22	22	22	22
198.78	198.84	Unk 116	116	198.80	0.06	22	22	22	22
199.34	199.46	Unk 117	117	199.37	0.12	17	17	17	17
201.88	202.13	Unk 118	118	201.94	0.25	17	17	17	17
202.26	202.57	Cottonwood Creek	119	202.49	0.31	18	18	18	18
203.13	203.31	Cottonwood Creek	120	203.19	0.19	17	17	17	17
203.31	203.44	Cottonwood Creek	121	203.37	0.12	17	17	17	17
204.93	205.05	Unk 122	122	205.02	0.12	17	17	17	17
205.98	206.05	Harden Russell	123	206.03	0.06	16	16	16	16
207.91	208.04	Buffalo Creek	124	207.98	0.12	17	17	17	17
209.84	209.96	Hickory Creek	125	209.91	0.12	16	16	16	16
211.45	211.64	Spring Branch	126	211.61	0.19	15	15	15	15
213.25	213.44	White Oak Creek	127	213.26	0.19	16	16	16	16
229.29	229.35	Crabapple Creek	135	229.33	0.06	20	16	20	16
233.08	233.32	Unk 137	137	233.19	0.25	14	14	14	14
234.75	234.88	Sandy Creek (1)	138	234.85	0.12	12	14	12	14
236.56	236.74	Sandy Creek (2)	139	236.72	0.19	12	14	12	14
263.65	263.96	James River	161	263.89	0.31	20	18	20	18
276.37	276.77	Llano River	168	276.57	0.40	20	18	20	18
525.31	525.49	Pecos River	250	525.44	0.19	12	15	12	15
526.48	526.88	Unk 251	251	526.68	0.40	12	15	12	15