Brazos River Authority

Clean Rivers Program
FY2005/2006

Stillhouse Hollow Reservoir Special Study
Segments 1216 and 1217

Special Study Final Report
September 2006

Table of Contents

List of Figures and Tables

EXECUTIVE SUMMARY

In September 2004, Brazos River Authority staff met with the Cleanwater Steering Committee to discuss water quality conditions in the Stillhouse watershed.

Purpose

In December 2003, local citizens and professionals formed the Lake Stillhouse Hollow Cleanwater Steering Committee out of concern for increased development in the Lampasas River watershed and the potential for negative impacts on the reservoir. The Brazos River Authority partnered with this stakeholder group on a Clear Rivers Program Special Study designed to provide baseline water quality data for the area and to provide data for comparison with TCEQ water quality standard criteria. In addition, biological assessments were scheduled on two tributaries that have had an increase in development and on one that has had very little development.

Findings

Potential water quality issues appear to be greatest in the Trimmier Creek tributary because of elevated *E. coli* levels and elevated suspended solids documented during the study period (See Appendix B). Data from other monitoring stations indicate supporting water quality conditions as defined by TCEQ.

Index period biological assessments on Reese Creek and South Rocky Creek, indicate that all components meet or exceed expectations for intermittent streams. The index period biological assessment conducted on Trimmier Creek indicated that limited aquatic life use was attained or exceeded by all components of the biological assessment. The benthic macroinvertebrate community rated as limited despite adequate habitat. An increased input of suspended solids from upstream land development is the likely cause as an increase in sedimentation has been documented during the study.

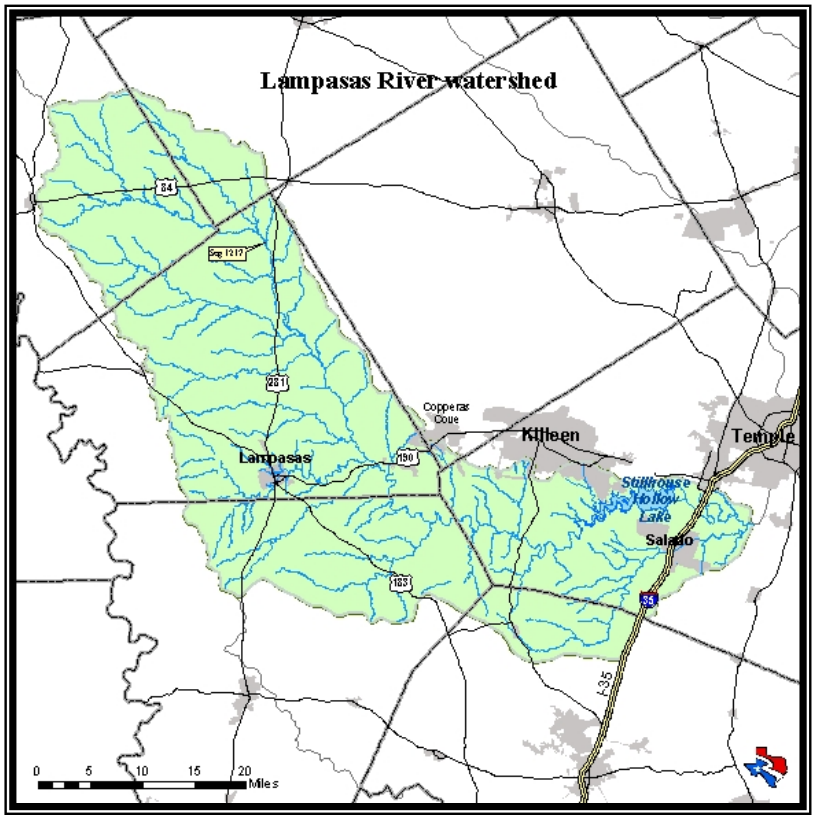
The City of Killeen has secured funding to conduct special studies within the watershed with sampling planned in these two areas. The City of Killeen plans to conduct monthly bacterial monitoring at Trimmier Creek at Chaparral Road and Lampasas River at Highway 195, with semi-annually monitoring for standard surface water quality parameters. There are additional sites throughout the watershed monitored by the City as well.

Recommendations:

- Based on water quality data collected, we recommend that the City of Killeen consider adding monthly sampling for total dissolved solids (TDS) at all locations.
- There is a USGS flow gage at Lampasas River at FM2484. Flow data is important when assessing water quality data and stream conditions. Depending on the objective(s) of the City of Killeen's studies, the City's sampling site at Lampasas River at Hwy195 may need to be changed to FM2484.

- Based on proposed sampling by the City of Killeen and best allocation of CRP resources, the BRA proposes that the Authority continue to conduct monthly sampling on the Reservoir at the two long-term routine stations – at the headwaters and the dam – and the special study reservoir site at the Trimmier Cove. Routine quarterly stream monitoring will continue at the long-term routine site Lampasas River at Highway 190 and the special study site Rocky Creek near FM 963.

INTRODUCTION



The Lake Stillhouse Hollow Cleanwater Steering Committee formed in December 2003 and has recently become a non-profit corporation. The committee is comprised of citizens and local officials committed to resource protection in the Lake Stillhouse Hollow watershed and surrounding areas. The group was formed in response to growing concern regarding development in the Stillhouse Hollow watershed and the potential impacts on the water quality of Stillhouse Hollow Reservoir. The group prepared a Source Water Protection Plan and guidelines for implementing Best Management Practices to manage threat activities occurring within the source protection area of Lake Stillhouse Hollow and the Lampasas River watershed.

Stillhouse Hollow Lake has historically experienced high water quality and the reservoir's watershed remains primarily undeveloped with agriculture as the dominant land use. A review of data conducted in 2004 indicated increasing trends in chloride and sulfate at the dam monitoring location, though the water quality assessment continued to show no water quality concerns or impairments for the reservoir.

There are three long-term monitoring sites on Lake Stillhouse Hollow and the Lampasas River upstream of the Lake. Historically, water quality analysis for these sites has indicated fully supporting conditions; however, data analysis for the Lake Stillhouse Hollow dam site indicates increasing trends in chlorides and sulfates. Additionally, routine water quality data collected by the Central Texas Water Supply Corporation indicates decreasing water quality conditions including increase in turbidity and the presence of metals. The additional sites in this area are proposed to collect baseline water quality data for the watershed. The comprehensive approach of the proposed monitoring is intended to assess water quality at primary tributary inlets to Lake Stillhouse Hollow and provide comprehensive baseline water quality data for the area.

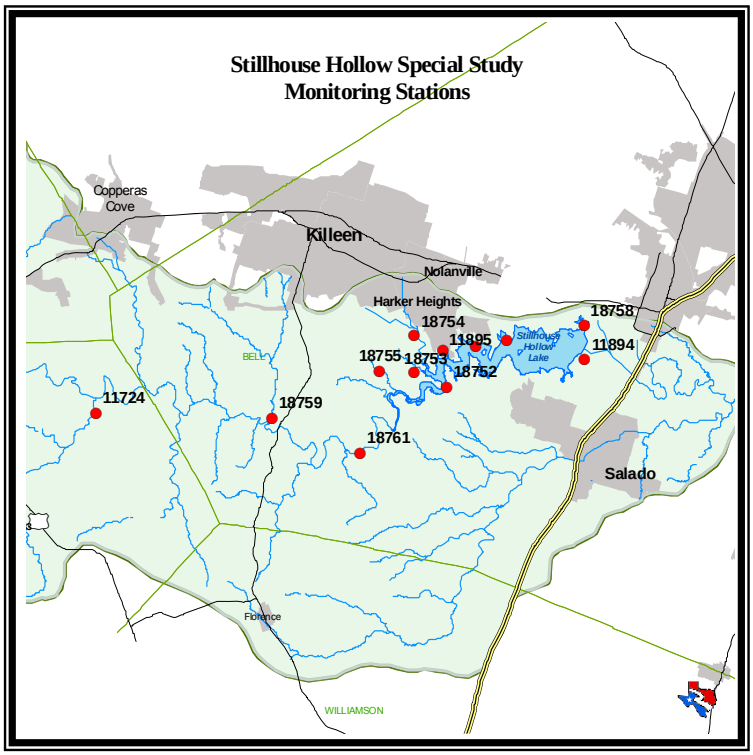
The objectives of this study were:

to characterize spatial and temporal fluctuations of water quality constituents; and

to compare concentrations of water quality constituents to TCEQ assessment criteria to determine if concentrations of water quality constituents are elevated.

Study Area

The study area encompasses much of the Lampasas River watershed from Reese Creek at FM 2670 (Station 18759) to Stillhouse Hollow Reservoir at the dam (Station 11894). The study included routine monthly monitoring of 13 stations on Stillhouse Hollow Reservoir and its tributaries. Three sites in the reservoir and Lampasas River were long-term routine monitoring stations.



WATER QUALITY STANDARDS AND CRITERIA

Table 2. indicates the current standards for segments 1216 and 1217. These standards and criteria are approved by the Environmental Protection Agency (EPA) and used by the Texas Commission on

Table 1. Surface water quality standards/criteria for segments 1216 and 1217

Parameter	Segment 1217 Standard	Segment 1216 Standard
Water Temperature	32.8 C	33.9 C
Dissolved Oxygen	5.0 mg/l	5.0 mg/l
pH	6.5 – 9.0	6.5 – 9.0
E. coli	≥394 MPN in ≥ 25% of samples and/or geometric mean ≥126 MPN/100ml	≥ 394 MPN in ≥ 25% of samples and/or geometric mean ≥126 MPN/100ml
Chloride	500 mg/l	100 mg/l
Sulfate	100 mg/l	75 mg/l
Total Dissolved Solids	1200 mg/l	500 mg/l
Nitrite + Nitrate Nitrogen*	2.76 mg/l	0.32 mg/l
Orthophosphate phosphorus*	0.5 mg/l	0.05 mg/l
Total Phosphorus*	0.8 mg/l	0.18 mg/l
Chlorophyll *a**	11.6 ug/l	21.4 ug/l

*Indicates secondary screening level

Environmental Quality (TCEQ) to assess water quality conditions in the segment. Methodologies and guidelines for data analysis and use of standards and criteria are published in the TCEQ Chapter 307 Texas Surface Water Quality Standards and the Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data.

WORK PLAN

The concerns raised by the Stillhouse Hollow Cleanwater Steering Committee as to the potential of changing water quality due to increased development, led the BRA to embark on a year long, comprehensive water quality study of the Stillhouse watershed. Sample collection began in January 2005 and concluded in August 2006. Monitoring locations were selected based on potential impacts located within an "area of primary influence" and subsequent impacts to Stillhouse Hollow Lake as identified in the Cleanwater' Source Water Protection Plan developed with the Texas Rural Water Association.

Table 2. Station location for Stillhouse Hollow Special Study

Station ID	Site Description	Monitoring
18759	Reese Creek at FM 2670	Routine
18850	Reese Creek at Maxdale Rd	Biological
18761	Lampasas River at FM 2484	Routine
11897	Lampasas River at US 190	Routine
18755	Onion Creek N of Roadrunner Lane	Routine
18754	Trimmier Creek at Chaparral	Routine/biological
11724	Rocky Creek at FM 963	Routine
18333	Rocky Creek upstream of US 183	Biological
18753	Stillhouse Hollow at Little Trimmier Creek Cove	Routine
11895	Stillhouse Hollow headwaters	Routine
18752	Stillhouse Hollow near shore on upstream side of FM 3481	Routine
18756	Stillhouse Hollow near end of Fuller Lane, W of Dana peak Park	Routine
18757	Stillhouse Hollow at cove east of Dana Peak Park	Routine
18758	Stillhouse Hollow at cove south of West Marina	Routine
11894	Stillhouse Hollow Dam	Routine

Routine Monitoring

The study included 13 routine monitoring sites on Stillhouse Reservoir and its tributaries that were monitored on a monthly basis. Water samples were collected for analyses for the standard water quality parameters. These include temperature, dissolved oxygen, pH, chloride, sulfate, total dissolved solids (TDS), total suspended solids (TSS), *E. coli*, nitrite+nitrate nitrogen, total kjeldahl nitrogen (TKN), orthophosphate phosphorus, total phosphorus, and chlorophyll *a*. Routine monitoring was conducted in accordance with the *Surface Water Quality Monitoring Procedures, Vol. 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue* (TCEQ 2003).

Biological Monitoring

Biological assessments were conducted in accordance with *Aquatic Life Monitoring* procedures for the purpose of providing baseline data on environmental conditions and to determine if the aquatic life use is being attained. The locations are selected and assessment procedures follow guidelines set forth by the *Draft Surface Water Quality Monitoring Procedures, Vol. 2: Methods for Collecting and Analyzing Biological Community and Habitat Data* (TCEQ 2005).

Biological assessments were conducted on Reese Creek and Trimmier Creek to investigate potential impacts from increased development near those creek systems. In South Rocky Creek was chosen as a suitable comparator stream as there is much less development on the creek and it is comparable to both Reese and Trimmier Creeks in size.

As part of the biological assessment, an Index of Biotic Integrity (IBI) was calculated for the fish and benthic macroinvertebrate communities. The resulting score places the biotic community into one of the four following Aquatic Life Use (ALU) categories: limited, intermediate, high, or exceptional. In addition, chemical and physical assessments are conducted that further aid in defining the ALU of the stream. Benthic macroinvertebrates were collected by kicknet and fish collections were conducted by shocking and seining methods.

Conclusions and Discussion

Datasets for sites added specifically for this study ranged between 8 and 20 and were dependent on flow. Stations 11897, 11895, and 11894 are long term routine stations that have data going back many years. See Appendix B for a summary of data.

Routine Monitoring Data Results

Results of routine monitoring for this special study indicate supporting water quality conditions as defined by TCEQ for segments 1216 and 1217, with a couple of exceptions.

Based on monthly data collected for this study, Station 18754 on Trimmier Creek was listed as a potential concern for *E. coli* (see Appendix A). The geometric mean for the station was 138 MPN/100ml; above the TCEQ standard criteria geometric mean of 126 MPN/100ml. However, the dataset for this site was strongly influenced by a sample collected during high flow conditions that were the result of a heavy rain event. Rainfall from 8th August 2005 through 10th August 2005,

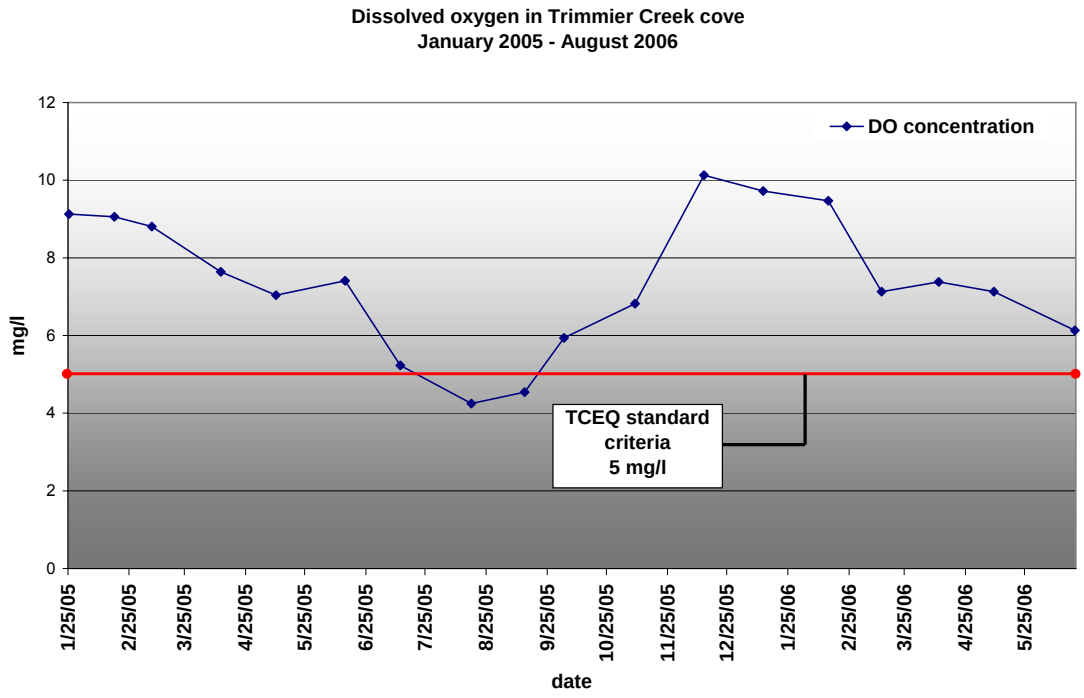
Trimmier Creek out of its banks on 10th August 2005

measured approximately 2.5 inches and resulted in localized flooding. After dilution, the *E. coli* value for this storm event was calculated to be 24,190 MPN/100ml. Storm events like the one that occurred in August of 2005 are known to cause increased concentrations of bacteria due to overland flow of water that picks up fecal wastes generated from livestock, wildlife, pets, and overstressed septic systems.

Precipitation data cited in this study was provided by the Texas A&M University Texas Weather Connection website at http://webgis.tamu.edu. Precipitation data is collected based on the latitude and longitude location of the sample location.

Moderate levels of suspended solids were also documented at station 18754 during this special study (see Appendix B). An increase in sedimentation at this station had been noted by project personnel that coincided with an increase in construction activities along the creek. The TCEQ Waco Regional Office conducted an investigation on January 13, 2006 which determined that a bridge construction site lacked proper BMPs. TCEQ sent the contractor a notice of violation letter that stated the corrective action required to prevent sediment loss from the construction site.

Figure 1



Grab samples analyzed for dissolved oxygen were evaluated against the TCEQ standard criteria of 5.0 mg/l and the TCEQ absolute minimum criteria of 3.0 mg/l. Dissolved oxygen levels indicated fully supporting conditions with monitoring station means measured between 7.0 mg/l and 11.0 mg/l. An exception to these findings was found at station 18753 (Trimmier Creek cove) where dissolved oxygen levels were measured below the 5.0 mg/l standard criteria for 11% of the sample measurements (see Figure 1). However, the mean and median DO levels were 7.39 mg/l and 7.26

mg/l, respectively at this monitoring station. Two consecutive dissolved oxygen readings fell below the 5 mg/l standard criteria is late summer 2005 in this cove.

The remaining basic water quality parameters and nutrient levels were all below standard, indicating continued high water quality conditions in the Stillhouse Hollow watershed.

Data sets for station 18755 (Onion Creek) were not evaluated because many times the creek lacked the required flow for sampling. Only 8 observations were recorded throughout the study; less than TCEQ required 10 observations needed for data analysis. From January 2005 through August 2006, station 18755 was pooled 45% of the time and dry 15% of the time.

Biological Monitoring Results

All three of the tributaries included for biological assessment are unclassified and considered to be seasonally intermittent with perennial pools. Thus, limited aquatic life use and 24-hour dissolved oxygen criteria of 3.0 mg/l (average) and 2.0 mg/l (minimum) are presumed to apply.

Biological monitoring was conducted in the Stillhouse Hollow watershed at Trimmier Creek at Chaparral Road on 20 April 2006 (station 18754), Reese Creek at Maxdale Road on 5 June 2006 (station 18850), and South Rocky Creek at upstream of US 183 on 5 April 2006 (station 18333). Biotic indices were calculated that measured the quality of the stream's biotic communities at the time of data collection.

Table 3. 2006 Stillhouse Watershed Biological Assessment Results

Study Period Location	Habitat	Benthic	Fish	DO Mean	DO Min
Trimmier – index	High	Limited	High	Exceptional	Exceptional
Reese – index	High	Intermediate	Intermediate	Exceptional	Exceptional
Rocky – index	High	High	High	Exceptional	Exceptional

Trimmier Creek assessment summary – Index period

A limited aquatic life use was attained or exceeded by all components of the index period assessment. Dissolved oxygen concentrations were consistent with an exceptional aquatic life use, while physical habitat and fish community characteristics were reflective of a high aquatic life use. Despite favorable habitat, the benthic macroinvertebrate community only scored limited, which was well below conditions observed at the reference site on South Rocky Creek. Depressed benthic macroinvertebrate integrity was attributed to suspended solids inputs from upstream land development projects, as has been documented by routine water quality monitoring and field observations over the course of the study. Since the fish community did not appear to be impacted, negative effects evidently were restricted to the benthic environment, in relation to accumulation of fine solids on the streambed.

Reese Creek assessment summary – Index period

Dissolved oxygen criteria were achieved during the index period assessment. Physical habitat attributes were consistent with a high aquatic life use, while benthic macroinvertebrate and fish community characteristics reflected attainment of an intermediate aquatic life use. Thus, all components exceeded expectations for an intermittent stream. However, disparate indications by physical habitat and biology, and the fact that biological integrity was reduced compared to the reference site on South Rocky Creek, suggest that instream stresses of some type may have been occurring at the time of the assessment. There were no obvious water quality factors which would account for reduced biological integrity, so if stresses were occurring, the cause was not apparent.

South Rocky Creek assessment summary – Index period

South Rocky Creek was determined to be a suitable comparator to both Trimmier Creek and Reese Creek, as there is little development in the watershed and the creek is physically comparable to the other tributaries. Dissolved oxygen criteria were achieved, and benthic macroinvertebrate, fish, and physical habitat characteristics reflected attainment of a high aquatic life use. Thus, all components of the assessment exceeded expectations for an intermittent stream, and reflected healthy environmental conditions with no discernible impacts.

Critical period biological assessments

Critical period assessments were not performed because of drought conditions and are scheduled for fiscal year 2007. Critical period biological assessment results will be submitted to TCEQ as an addendum to this report.

Special Study Recommendations

Routine water quality monitoring between January 2005 and August 2006 lead the BRA to conclude that water quality conditions remain good in Lake Stillhouse Hollow and its tributaries, but bear watching. Increased development in the Stillhouse watershed means that continued vigilance through monitoring is required. The City of Killeen has taken a proactive role in the area and has secured funding to monitor several locations in the area.

Based on the results of the study the Authority has the following recommendations:

- Based on water quality data collected, we recommend that the City of Killeen consider adding monthly sampling for total dissolved solids (TDS) at all locations.
- There is a USGS flow gage at Lampasas River at FM2484. Flow data is important when assessing water quality data and stream conditions. Depending on the objective(s) of the City of Killeen's studies, the City's sampling site at Lampasas River at Hwy195 may need to be changed to FM2484.
- Based on proposed sampling by the City of Killeen and best allocation of CRP resources, the BRA proposes that Authority continue to conduct monthly sampling on the Reservoir at the two long-term routine stations – at the headwaters and the dam – and the special study reservoir site at the Trimmier Cove. Routine stream monitoring will continue at the long-term routine site

Lampasas River at Highway 190 and the special study site Rocky Creek near FM 963.

The BRA believes this CRP Special Study has been successful in providing local stakeholders with valuable data that characterizes watershed conditions. In addition, the City of Killeen's success in securing funding and cooperation with the Stillhouse Hollow Cleanwater Committee will assure that issues that have been identified over the last two years will continue to be addressed by the local community. The BRA staff will continue to provide data results to the group for continued review on a quarterly basis. We encourage the committee members to contact us should new issues arise where the Clean Rivers Program can be of further assistance.

Appendix A *E. coli* data results

E. Coli	Reese Creek at FM 2670	Lampasas at FM 3484	Onion Creek	Stillhouse at Trimmier Cove	Stillhouse Headwaters	Stilhouse upstream side of FM 3481	Trimmier Creek at Chapparral	Stillhouse West of Dana Peak Park	Stillhouse East of Dana Peak Park	Stillhouse at cove south of west marina	Rocky Creek near FM 963	Stillhouse Hollow Dam
Collectdate												
13-Jun-2002												
10-Jul-2002					1							
28-Aug-2002					0.5							5.2
22-Oct-2002					22.6							0.5
27-Feb-2003					68							
14-Apr-2003					0.5							1
16-Jul-2003					1							1
19-Nov-2003					5							0.5
13-Jan-2004					1							1
14-Apr-2004					34							2
13-Jul-2004												0.5
20-Oct-2004					0.5							0.5
25-Jan-2005	38	46	142	3	3	2	29	1	0.5	1		
17-Feb-2005	78	67	47	19	3	3	107	0.5	0.5	2		10
8-Mar-2005	78	411	126	649	114	67	144	47	6	1		0.5
12-Apr-2005	31	26	133	3	2	3	2420	5	0.5	0.5		0.5
10-May-2005	75	118	75	15	3	3	249	2	1	2		3
14-Jun-2005	285	18					42					0.5
12-Jul-2005	435	80		0.5	0.5	0.5	23	0.5	0.5	3		
17-Aug-2005	13504	19863	17329	12	2	2	24196	1	0.5	0.5		
13-Sep-2005	30	309		0.5	0.5	1	84	0.5	0.5	1		0.5
3-Oct-2005	88	42		2	1	0.5	16	0.5	0.5	0.5		0.5
8-Nov-2005	86	65		1	0.5	0.5	229	1	2	1		1
13-Dec-2005	57	58		5	0.5	0.5	98	0.5	0.5	1		0.5
12-Jan-2006	74	150		4	0.5	0.5	48	0.5	0.5	11		0.5
14-Feb-2006	14	63		6	1	0.5	69	0.5	0.5	1	21	0.5
13-Mar-2006	30	54		6	1	2	60	1	0.5	2	201	0.5
11-Apr-2006	81	28	19	11	1	4	58	0.5	4	3	20	1
9-May-2006	649	866	44	24	8	34	244	4	0.5	5	361	0.5
19-Jun-2006	130	10		10	0.5	1	366	0.5	0.5	0.5	20	0.5
17-Jul-2006	86	42		2	2	0.5	237	0.5	0.5	1	52	2
8-Aug-2006				0.5	0.5	1		0.5	0.5	0.5		0.5

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