Action Plan Items Related to EII Site Scores - Fiscal Year 2008

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Abstract

The Environmental Integrity Index (EII) was used to identify creek reaches with at least a 13% decrease in environmental health in using data collected in 2008 compared to initial conditions sampled from 1999 (phase 3 watersheds). City of Austin programs with the potential to reverse the recent degradation in five problem areas (aquatic life, habitat, nutrients plus bacteria, nutrients alone, and litter) through structural and non-structural BMPs were identified. Primary and secondary problem reach lists are provided for the programs. Comparison of EII scores to reaches affected by Austin Clean Water Program (ACWP) wastewater infrastructure improvements was conducted and identified positive responses in selected water quality indicators from ACWP

Introduction

As a measure to address developing environmental problems, the Watershed Protection Department (WPD) has initiated a process to identify watersheds with declining environmental health and recommend solutions to stop or reverse the observed degradation. Determination of degrading creeks conditions is based on Environmental Integrity Index (EII) scores, and is assessed for phase 3 EII reaches sampled in 2008 versus initial sampling events completed in 1999. This analysis is an update of previous work (COA 2007), as specified in the Water Resource Evaluation (WRE) Section business plan and complements (but does not replace) the water quality problem scores calculated for use in the departmental master plan (COA 2009).

The Austin Clean Water Program (ACWP, http://www.ci.austin.tx.us/acwp/) was created in November 2001 to improve sanitary sewer overflows in compliance with an US Environmental Protection Agency administrative order. Approximately 100 wastewater infrastructure projects were completed thru 2009. The ACWP efforts have drastically reduced sanitary sewer overflows, from more than 12 million gallons in FY2002 to less than 610,000 gallons in FY2007. Though not a specific objective in the design of the EII sampling regime, EII scores were evaluated in reaches affected by ACWP projects to determine what impact these projects would have on instream water quality. While immediate construction impacts could temporarily decrease EII scores, it is hypothesized that wastewater line relocation and retrofits should improve water quality.

The Development of Action Plans from Changes in EII Scores

In an effort to tie Department action plans to sites and watersheds which are exhibiting declines in environmental integrity as measured by the EII, the WRE section has proposed an annual plan:

- Identify creek reaches with decreasing health using the Environmental Integrity Index (EII) and documentation of the selection process.
- Isolate probable causes by comparing sub-index scores and raw data components.
- Identify opportunities for reversing/mitigating the decrease or partnering with other ongoing efforts to address specific causes of degradation.
- Develop plans for program, regulation, or CIP project to take advantage of opportunities within the watershed(s) of concern.

EII scores have been calculated for the 50 sampled watersheds. The initial EII sampling was conducted during 1996-1999. Following rounds have been completed every three years, although sampling frequency has been increased to every other year beginning in 2009. Parameter values/scores from the initial EII samples were compared to those from the most recent sampling events completed in 2008 for the phase 3 watersheds. Only major changes, defined as a decline of > 12.5 points out of a possible 100 and equivalent to a change in EII category, were identified. City of Austin (COA) programs have been designated the responsibility to evaluate the recent degradation and recommend appropriate actions for remediation. The 5 problem areas which are most amenable to change are listed in Table 1. For each problem area, the primary reaches with major declines in all of the listed parameters/scores are identified for referral to the specified program. Secondary problem reaches with major declines in one or more parameters/scores but without major declines in all parameters/scores are also identified.

Table 1. Problem Areas with Recent Declines in EII Parameters/Scores

Problem Area	Parameters/EII components Involved in Determination of Degradation	COA Program to Evaluate and Recommend Solution
Decline in aquatic life scores	Diatom and benthic macroinvertebrate scores	WRE Surface Water Team
Declines in physical integrity and non-contact recreation EII sub-indices	Physical Integrity and Non-Contact Recreation EII sub-indices	Master Plan Committee
Nutrient levels and bacteria increased indicating potential sewer line problems	Nitrate, ammonia, orthophosphorus, and e-coli	Austin Water Utility
Nutrient levels increased but bacteria levels did not indicating potential fertilizer problems	Nitrate, ammonia, orthophosphorus	ERM Community Education Section
Non-contact recreation litter scores decreased	Litter score	Keep Austin Beautiful

Initial year data for multiple sites within the same EII reach were averaged to yield a reach score if a matching site was not sampled within the reach. All phase 3 watershed reaches sampled in 2008 were previously sampled in 1999. EII reaches citywide were affected by the on-going drought of 2008.

Primary degradation sites with designated evaluation programs

A. EII sites with major (>12.5 points) decreases in both benthic macroinvertebrate and diatom scores for evaluation by the WRE surface water team (excluding sites dry in 2008).

Table 2. EII sites with major decreases in both benthic macroinvertebrate (bug) and diatom scores.

There were no primary problem sites for aquatic life in 2008. All sites flowing in 2008 yielded improved biological scores except upper Gilleland Creek (GIL6) and the mouth of Rinard (RIN1).

B. EII Sites with major decreases in both physical integrity and non-contact recreation scores for recommendation to the WPD masterplan committee.

Table 3. EII sites with major decreases in both physical integrity (PI) and non-contact recreation (NCR) scores

EII Reach	COA Site #	Site Name	Change in NCR Score	Change in PI Score
CMF1	1048	Common Ford in Common Ford Park	-33	-12
CRN1	1222	Cuernavaca Creek @ River Hills Rd	-19	-23

Changes at CMF1 were unexpected, as the site is within a City of Austin preserve, and are most likely a function of the on-going severe drought of 2008. Changes at Cuernavaca Creek most likely due to recent construction of low water crossing upstream of site.

C. EII Sites where nutrient component scores decreased and bacteria scores decreased for recommendation to the AWU.

Table 4. EII sites where nutrient scores decreased and bacteria scores decreased.

EII Reach	COA Site #	Site Name	ΔBacT	ΔNH3	ΔNO3	ΔOP
CMF1	1048	Common Ford in Common Fork Park	-38	-29	-40	-30

D. EII sites where both NO_3 and orthophosporus scores decreased without substantial decrease in bacteria (potential fertilizer application problems) for evaluation by the ERM education group.

Table 5. EII sites where both NO_3 and orthophosphorus scores decreased without substantial decrease in bacteria scores.

EII Reach	COA Site #	Site Name	ΔBacT	ΔNO3	ΔOP
PAN1	1223	Panther Hollow Creek @ Big View Road	-2	-51	-77
BRW1	1224	Bear Creek (West) @ Fritz Hughes Park Road	5	-14	-31

E. EII sites with major decreases in non-contact recreation litter scores for KAB.

Table 6. EII sites that have degrading (by more than one EII category) non-contact recreation litter scores

EII Reach	COA Site #	Site Name	Change in Litter
RIN2	1219	Rinard Creek at FM1327 and Bradshaw Rd	-45
HRS1	1201	Harris Branch Creek at Boyce Ln	-35
DRE2	1211	Dry Creek at Pearce Rd	-25
NFD1	1217	North Fork Dry Creek at FM812	-25

Secondary Problem Sites

AA. EII sites with major decreases in either benthic macroinvertebrate or diatom scores

Table 7. EII sites with major decreases in either benthic macroinvertebrate (bug) or diatom scores

Decreases at GIL6 < 12 points. Diatom Subindex scores improved at RIN1.

EII Reach	COA Site #	Site Name	Change in Bug Score
RIN1	233	Rinard Creek @ Bradshaw Road	-26

BB. EII Sites with major decreases in either physical integrity or non-contact recreation scores for recommendation to the masterplan committee.

Table 8. EII sites with major decreases in either physical integrity (PI) or non-contact recreation (NCR) scores

EII Reach	COA Site #	Site Name	Change in NCR	Change in PI
BRW1	1224	Bear Creek (West) @ Fritz Hughes Park Road	-26	-4
DKR1	1974	Decker Creek @ Gilbert Rd	-10	-21
DRE1	1210	Dry Creek @ Wolf Lane	-14	7
GIL1	886	Gilleland Creek @ FM 969	12	-14
GIL3	1191	Gilleland Creek @ West Parsons St	4	-15
NFD1	1217	North Fork Dry Creek @ FM812	-15	-8
PAN1	1223	Panther Hollow Creek @ Big View Road	-41	-3
RDR1	316	Deer @ Running Deer Trail (AST)	-7	-27
RIN2	1219	Rinard Creek @ FM1327 and Bradshaw Road	0	-17
TRK1	1221	Turkey Creek @ City Park Road	-28	-4

CC. EII sites with a major decrease in at least one nutrient component (NO_3, NH_3, orthophosphorus) and in the water quality bacteria score for recommendation to the AWU.

Table 9 EII sites with a major decrease in at least one nutrient component (NO_3, NH_3, orthophosphorus) and in the water quality bacteria score.

EII Reach	COA Site #	Site Name	ΔBacT	ΔNH3	ΔNO3	ΔOP
RDR1	316	Deer @ Running Deer Trail (AST)	-35	46	2	-28
CRN1	1222	Cuernavaca Creek @ River Hills Road	-46	25	-6	-25
TRK1	1221	Turkey Creek at City Park Rd	-14	25	4	-25
NFD1	1217	North Fork Dry at FM812	-32	37	27	-17

DD. EII sites with a major decrease in either orthophosphorus or NO_3 component scores without a major decrease in bacteria scores as a list of sites with potential fertilizer application problems.

Table 10. EII sites with a major decrease in nutrient scores with a major decrease in bacteria scores as potential fertilizer application problems.

EII Reach	COA Site #	Site Name	ΔBacT	ΔNO3	ΔOP
ELM2	1204	Elm Creek @ FM 973	27	-69	-8
DRE2	1211	Dry Creek @ Pearce Road	2	-45	23
DRE1	1210	Dry Creek @ Wolf Lane	23	-43	6
DKR3	1196	Decker Creek @ Lindell Lane	14	-17	17

Evaluation of ACWP Impacts on EII Scores

Measured ammonia values, a human waste product in high concentrations in untreated wastewater, and the EII water quality subindex score were used to evaluate the impact of ACWP projects on instream water quality. Ammonia can be toxic to fish, and can be converted to a form usable by algae potentially resulting in excessive algae blooms in creeks. EII water quality scores integrate nutrients, suspended solids and bacteria measurements into a single multi-metric value. Ammonia measurements and EII water quality scores were compared before and after ACWP projects for 17 reaches were a comparison was spatially and temporally relevant. It should be noted the time period before and after comparisons, the magnitude (e.g., linear feet of line) of the individual ACWP and the distance upstream was variable for the assessed reaches.

The majority of sites downstream of ACWP projects with available data yielded an improvement in ammonia concentrations (figure 1). The average improvement was larger than the average decrease for the minority of sites that did not show an improvement. A non-parametric paired Wilcoxon signed-rank test (Gilbert 1987) yields a statistically significant (α=0.03) improvement in ammonia concentrations for all sites combined.

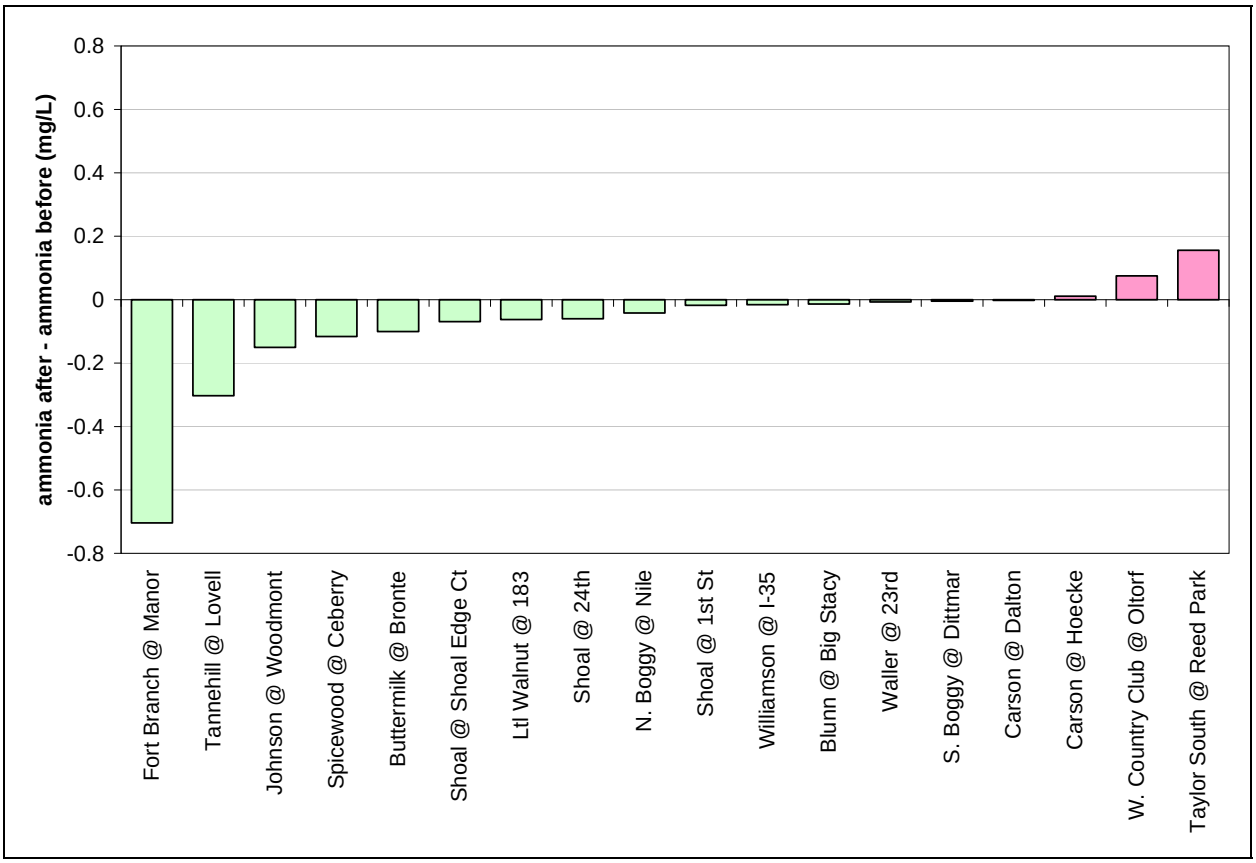

Figure 1. Change in ammonia (mg/L as N) after ACWP projects. Negative values indicate improvement (decrease) in ammonia after ACWP projects.

EII water quality scores yield a similar pattern of general improvement following ACWP projects (figure 2). The majority of sites yielded improved scores, and the average increase was greater than the average decrease. A non-parametric paired Wilcoxon signed-rank test (Gilbert 1987) yields a statistically significant ($\alpha<0.01$) improvement in water quality scores for all sites combined.

Temporal trend analysis should be utilized in the future, when sufficient post-construction data are available, to evaluate the on-going impacts of the ACWP efforts on water quality. If successful, the ACWP project should enable WPD staff to more effectively identify smaller sources of wastewater contamination in Austin's creeks.

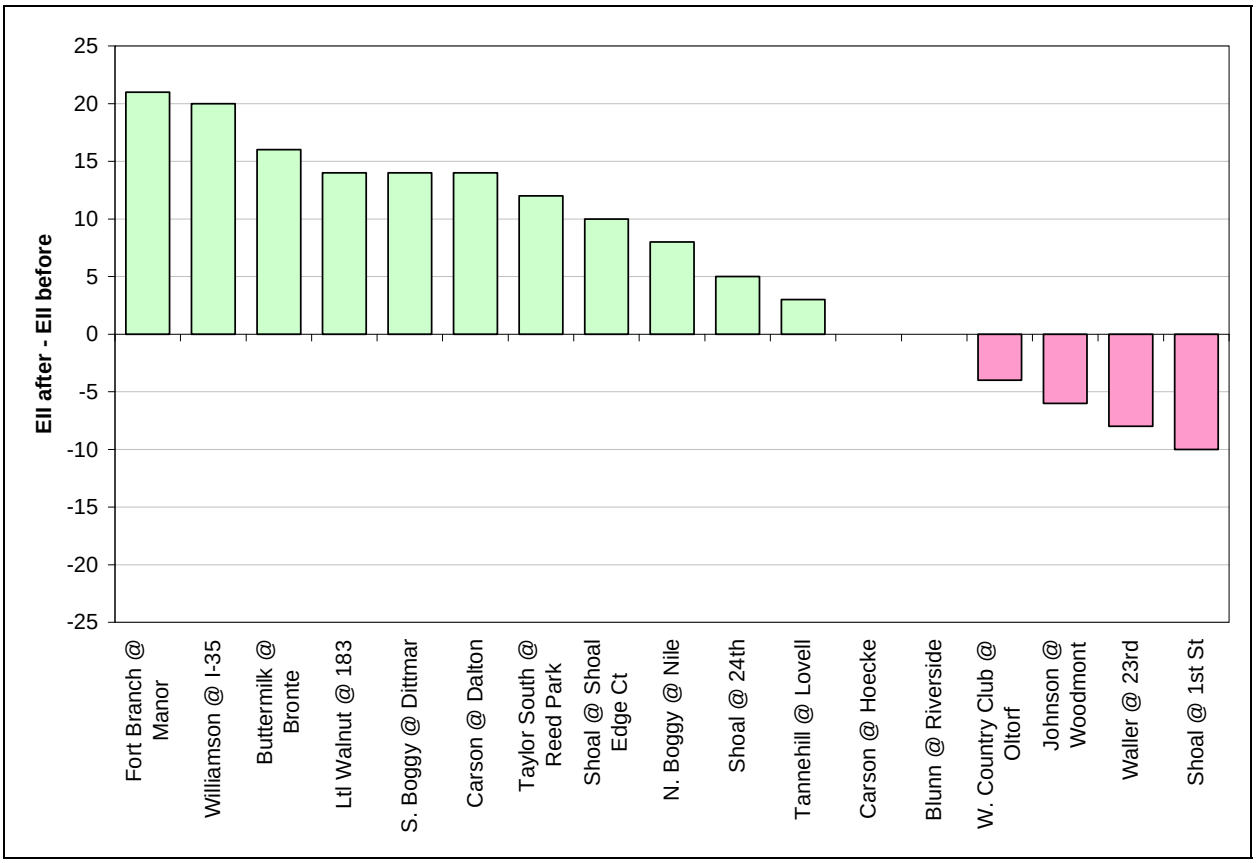

Figure 2. Change in EII water quality scores (0-100, worst to best) after ACWP projects. Positive values indicate improvement in water quality after ACWP projects.

Conclusions

EII data were used to identify degrading sites in Austin creeks for recommendation to designated programs for remediation. Although potential solutions have been identified for each group (Table 11), solution options must be continually evaluated and developed. Solution implementation must be documented, so that as additional EII data becomes available the effectiveness of solutions can be evaluated effectively.

The ACWP program, nearing completion in 2009, appears to have made positive improvements in water quality based on an analysis of a limited number of affected EII reaches. Both measured ammonia values and EII water quality scores yielded statistically significant improvements after ACWP projects.

Table 11. Potential solution options to identified degradation problems.

Problem	COA Program	Potential Solution
Aquatic Life Impairments	Surface Water Evaluation	Direct short-term monitoring to identify impairment source
Physical Integrity Decline	Stream Restoration Program	CIP structural BMP in problem area
Sewer Leaks	Austin Water Utility	Remove sewer line from creek or retrofit line (e.g., add liner)
Fertilizer Application	Community Education Program – Grow Green	Targeted public education campaign
Litter	Keep Austin Beautiful	Volunteer creek clean-up efforts

References

City of Austin (COA). 2007. Action Plan Items Related to EII Site Scores - Fiscal Year 2006. City of Austin Watershed Protection and Development Review Department, Environmental Resource Management Division, Water Resource Evaluation Section. SR-07-03.

City of Austin (COA). 2009. WPDRD Master Plan Water Quality Problem Score Method Revision. City of Austin Watershed Protection and Development Review Department, Environmental Resource Management Division, Water Resource Evaluation Section. SR-08-09.

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, New York.