



# Watershed Protection Development Review

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## Linking BMPs to Receiving Water Impact Mitigation in Austin, TX

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### Abstract

*Changes to receiving water bodies following Best Management Practices project (BMP) implementation were evaluated using the Environmental Integrity Index (EII). Data from five wet ponds and one channel restoration project were used. Changes in the six EII sub-indices (water quality, sediment quality, contact recreation, non-contact recreation, habitat quality and aquatic life support) were generally positive except for habitat quality, which declined initially but tended to recover. Water quality through wet pond sites improved by an average of 7%, and the channel erosion site improved water by 18%. Additional data collection is needed to strengthen conclusions.*

### Introduction

When multiple Best Management Practice projects (BMPs) for solving water quality, flooding and erosion problems in Austin waterways are proposed, a method is needed to determine which BMP, or combination of BMPs, produces the most improvement in the waterway for the least cost to the community.

The Environmental Integrity Index (EII) provides a comprehensive measurement of the environmental health of Austin's watersheds. This index includes six sub-indices: water quality, sediment quality, contact recreation, non-contact recreation, habitat quality, and aquatic life support. EII scores are used with flood and erosion indices in the City of Austin (COA) master-planning process to determine which waterways will be targeted for improvement.

In addition EII scores being used to identify sections of Austin area creeks with need for improvement, they are also being used to select which proposed BMPs would yield the most benefit from expenditure of capital improvement project funds. To use EII scores in this way, it is necessary to determine if a consistent pattern of change in EII scores follows BMP implementation. That pattern could form the basis of a model to predict change in environmental quality resulting from future BMPs. An assessment of changes in EII scores due to recently implemented BMPs is included in this report.

### Assessment of Changes in EII Scores due to existing BMPs

An assessment of the impacts of BMPs on EII site scores is required as a preliminary step in predictive model development. Eight recently completed, BMPs (see Table 1), selected by Water Quality Management staff for this investigation, are the major COA Watershed Protection Department BMPs completed either just before or during the period of EII sampling (1996-present). These BMPs can be divided into two categories: wet ponds and channel improvements. Sites above and below each BMP were also identified for EII sampling.

**Table 1. Major COA BMPs completed between 1995 and 2004**

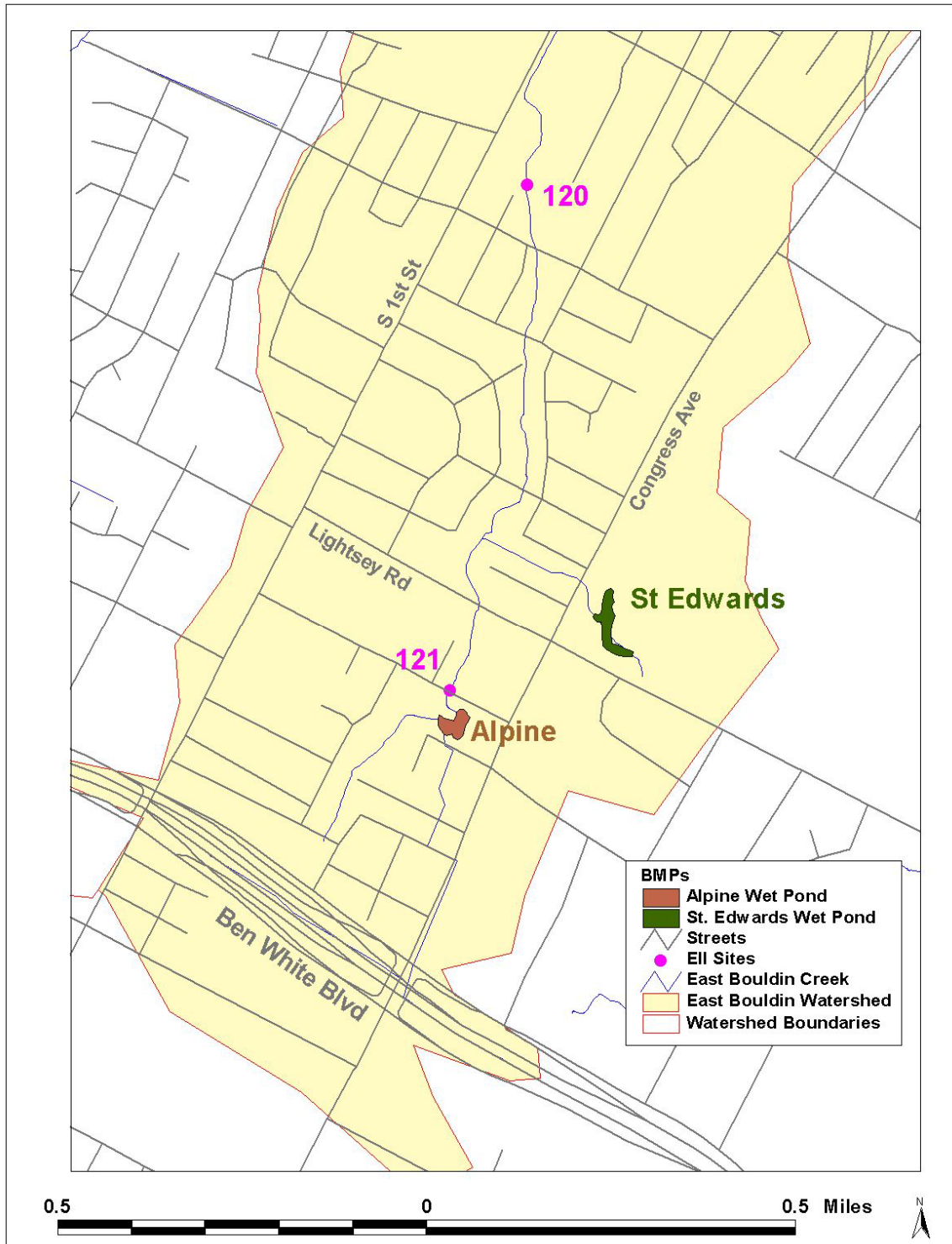
<b>Project name</b>	<b>Project type</b>	<b>Begin date</b>	<b>End date</b>	<b>Address</b>	<b>Watershed</b>
<b>Alpine</b>	Wet pond		1998	100 Alpine Rd	East Bouldin
<b>St Edwards</b>	Wet pond		2000	Woodward and Congress (200 Congress)	East Bouldin
<b>Riata</b>	Wet pond	1997	1998	Riata Trace Pkwy at Riata Vista Cir	Walnut
<b>Upper Shoal</b>	Wet pond		1999	NE corner of US183 and MoPac	Shoal
<b>Central Market</b>	Wet pond		1995	W 38th St and Guadalupe St	Waller
<b>Bartholomew Park</b>	Erosion control (channel restoration)	1999	2000	E 51st St at Manor Rd	Tannehill
<b>Crystal Brook</b>	Flood control (channelization)	2003	2004	Crystalbrook Dr	Walnut
<b>Creek Bend</b>	Flood control (minor channel re-vegetation)	2001	2004	E William Cannon at S. Pleasant Valley Rd	Williamson

EII scores and sub-indices for each site were plotted over time to assess the impact of the BMPs. Insufficient data are currently available for statistical analysis. However, an comparative evaluation of EII scores and sub-indices for each project is discussed below.

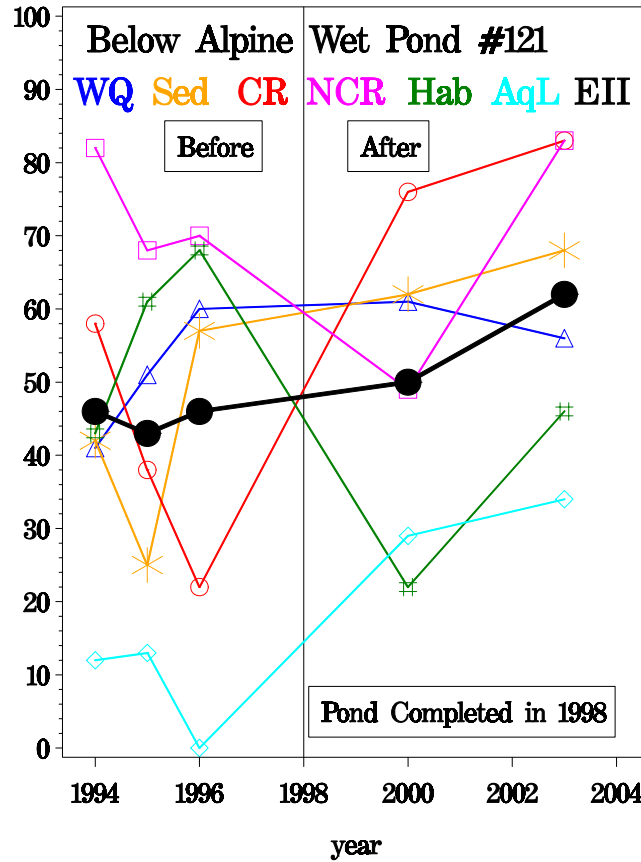
***Alpine wet pond***

Samples were taken five times at site 121 just below Alpine wet pond (see Figure 1): three before construction and two afterward. These data are plotted in Figure 2. The average EII site and sub-index scores before and after construction are shown in Table 3.

**Figure 1. Alpine wet pond, St. Edwards wet pond and related EII sites**



**Figure 2. Site 121 EII site and sub-index scores below Alpine wet pond before and after construction.**



Definitions:

- WQ = Water Quality
- Sed = Sediment Quality
- CR = Contact Recreation
- NCR = Non-Contact Recreation
- Hab = Habitat Quality
- AqL = Aquatic Life Support
- EII = Site Environmental Integrity Index

**Table 3. Site 121 average EII scores and sub-indices before and after construction**

Score	Before (94-96)	After (00-03)	Change
Water quality	51	59	+8
Sediment quality	41	65	+24
Contact recreation	39	80	+41
Non-contact recreation	73	66	-7
Habitat quality	57	34	-33
Aquatic life support	8	32	+24
Site EII	45	56	+11

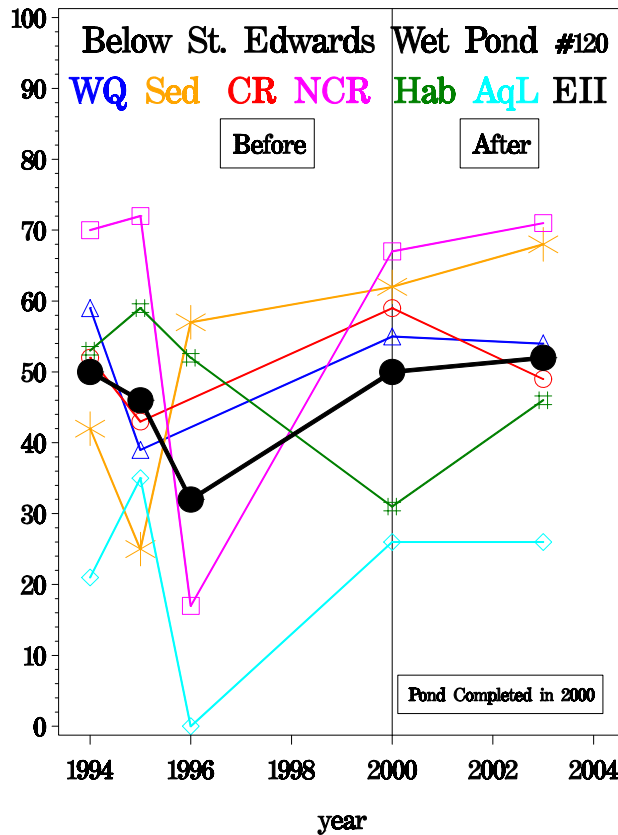
The EII score at site 121, just below the Alpine wet pond, changed from 45 before construction to 56 after construction, representing an improvement from the EII marginal category (38-50) to the EII fair category (51-62). The largest improvements were in contact recreation, sediment quality and aquatic life support.

The sub-indices that fell were habitat quality and non-contact recreation. Some drop in these sub-indices is expected following construction. Both improved substantially between 2000 and 2003, with non-contact recreation scores better in 2003 than before construction.

### St. Edwards wet pond

Samples were taken five times at site 120, downstream of St. Edwards wet pond and also downstream of Alpine wet pond (see Figure 1); three were taken prior to construction, one in 2000 either during or just after construction, and one later (see Figure 3). The average EII site and sub-index scores before and after construction are shown in Table 4.

**Figure 3. Site 120 EII site and sub-index scores below St. Edwards wet pond before and after construction**



**Table 4. Site 120 average EII scores and sub-indices before and after construction**

Score	Before (94-96)	After (2003)	Change
Water quality	49	54	+5
Sediment quality	41	68	+27
Contact recreation	48	49	+1
Non-contact recreation	53	71	+18
Habitat quality	55	46	-9
Aquatic life support	19	26	+7
Site EII	43	52	+9

The EII score at site 120, downstream of both St. Edwards wet pond and Alpine wet pond, changed from 43 before construction to 52 after construction, representing an improvement from the EII marginal category (38-50) to the EII fair category (51-62).

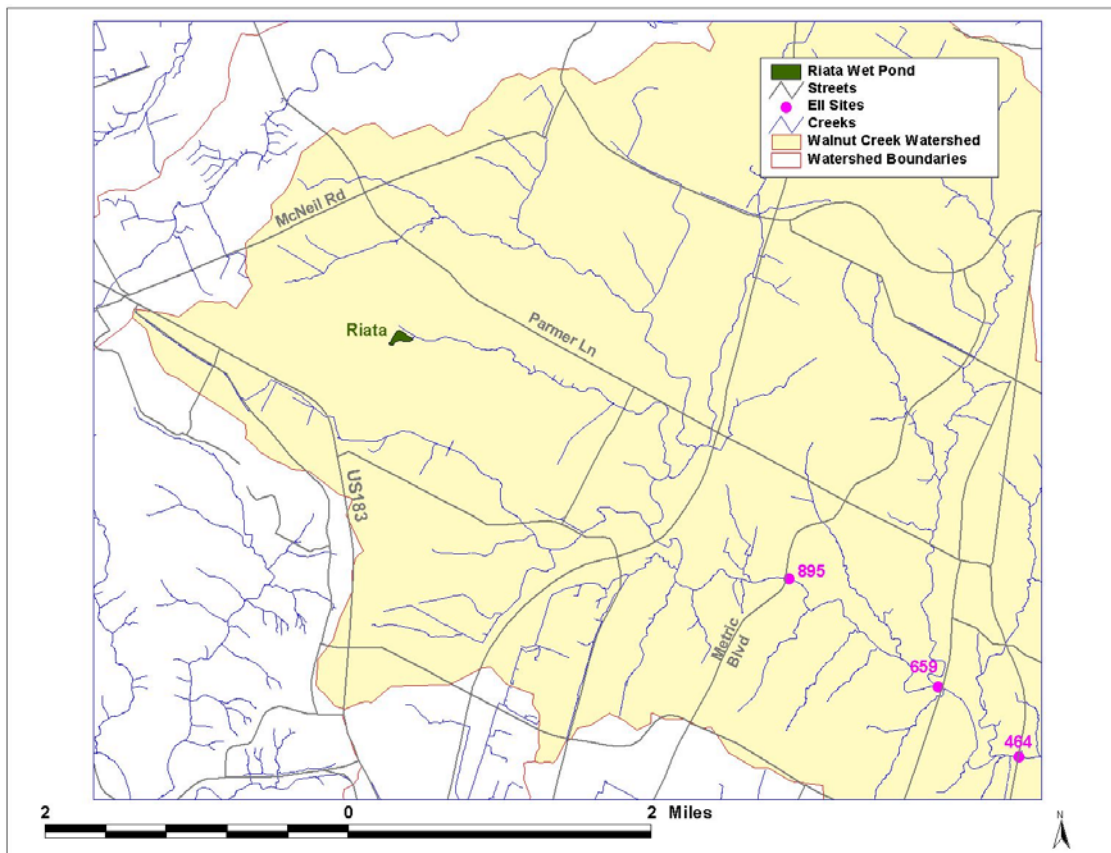
The 2003 sub-indices are mostly equivalent to the samples taken in 1994 and 1995. The 1996 samples were taken during drought conditions. The largest improvement is in sediment quality; the only sub-index that fell was habitat quality.

Between 1996 and 2000, additional construction in the area included a pipe discharging stormwater from Ben White Blvd. into East Bouldin Creek between sites 120 and 121. Diverting additional highway runoff into a creek is expected to worsen environmental quality. Thus the continuance of similar scores, rather than a decline, implies that the ponds probably have a beneficial effect.

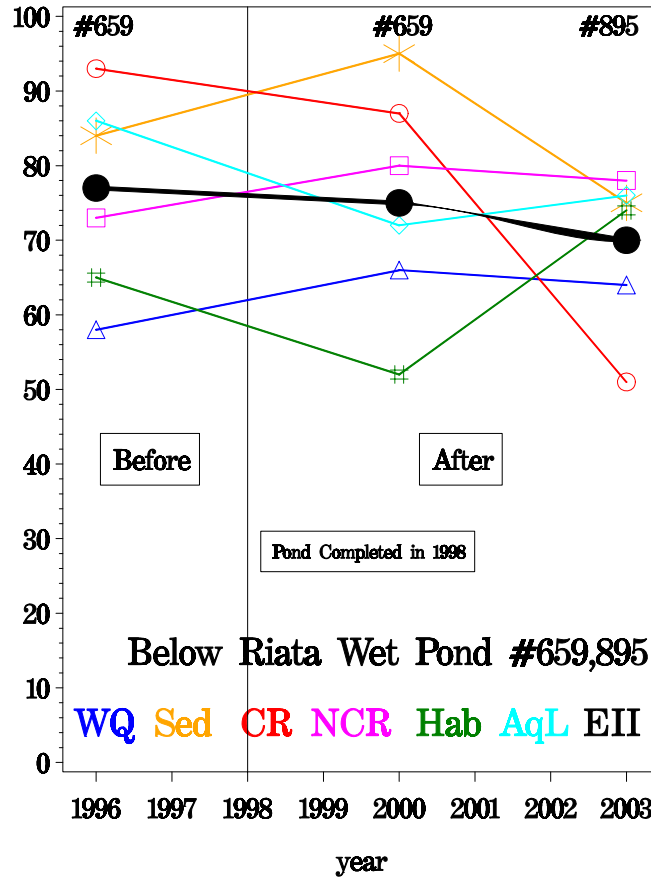
### ***Riata wet pond***

Samples were taken twice at the EII site 659 downstream of Riata wet pond (Figure 4): once before construction and once after construction (see Figure 5). Also, a sample was taken at site 895 in 2003. The average EII site and sub-index scores at site 659 before and after construction are shown in Table 5.

**Figure 4. Riata wet pond and related EII sites**



**Figure 5. Sites 659 and 895 EII site and sub-index scores below Riata wet pond before and after construction**



**Table 5. Site 659 average EII scores and sub-indices before and after construction**

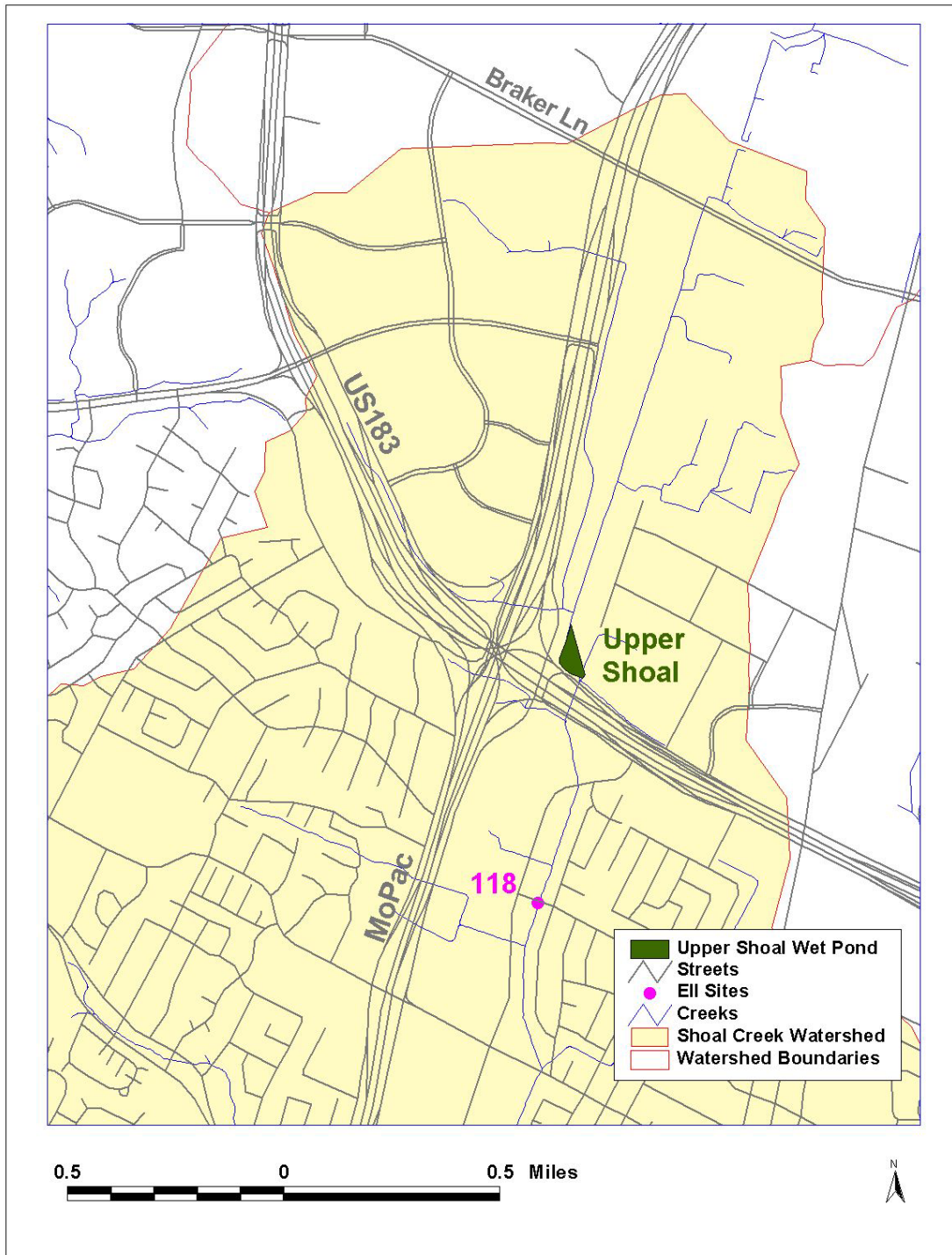
Score	Before (1996)	After (2000)	Change
Water quality	58	66	+8
Sediment quality	84	95	+11
Contact recreation	93	87	-6
Non-contact recreation	73	80	+7
Habitat quality	65	52	-13
Aquatic life support	86	72	-14
Site EII	77	75	-2

The overall EII site score remained about the same from 1996 to 2000. However, a large area that drains into the Riata wet pond was developed during this time period. The lack of a substantial decline in EII site score at site 659 may indicate the effectiveness of the wet pond. However, site 659 is more than 4 miles downstream from the pond and the project may have little effect on EII site scores.

## Upper Shoal wet pond

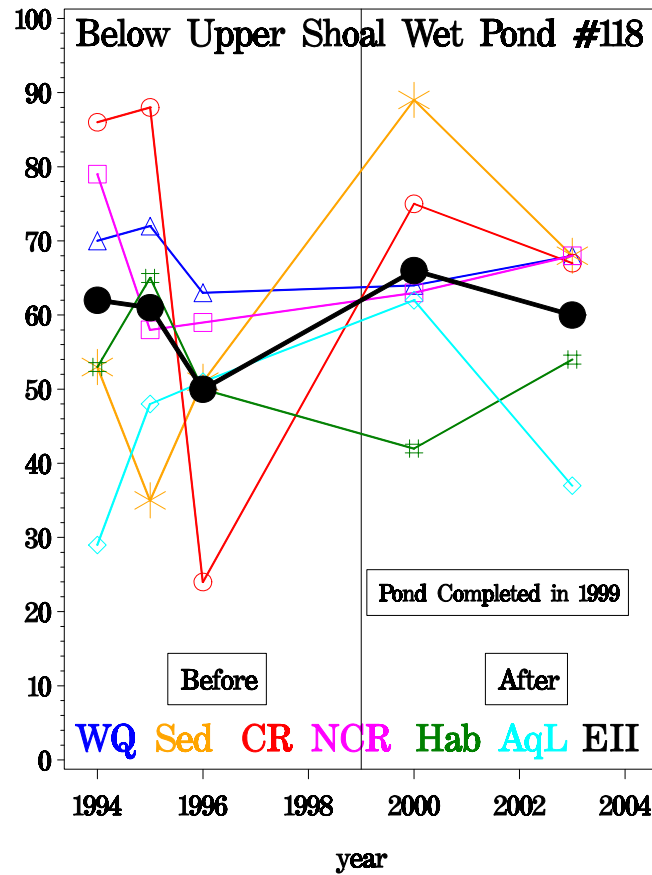
Samples were taken five times at the site 118, downstream of Upper Shoal wet pond (see Figure 6); three before construction and two after construction (see Figure 7). The average EII site and sub-index scores before and after construction are shown in Table 6.

**Figure 6. Upper Shoal Wet Pond and related EII sites**





**Figure 7. Site 118 EII site and sub-index scores below Upper Shoal wet pond before and after construction**



**Table 6. Site 118 average EII scores and sub-indices before and after construction**

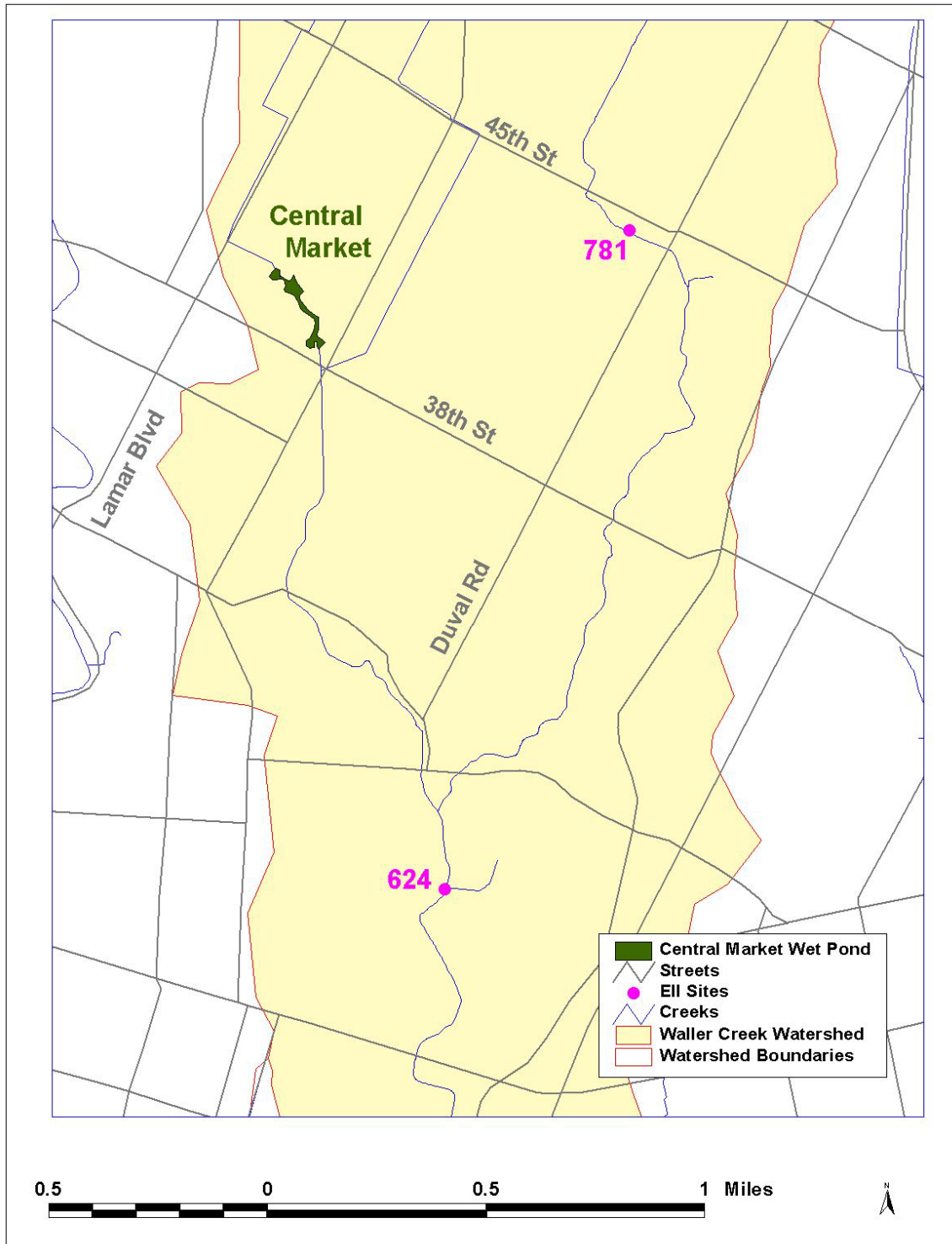
Score	Before (94-96)	After (00-03)	Change
Water quality	68	66	-2
Sediment quality	46	79	+33
Contact recreation	66	71	+5
Non-contact recreation	65	66	+1
Habitat quality	56	48	-8
Aquatic life support	43	50	+7
Site EII	58	63	+5

With the exception of sediment quality, which improved substantially, the scores before and after construction of the wet pond are similar.

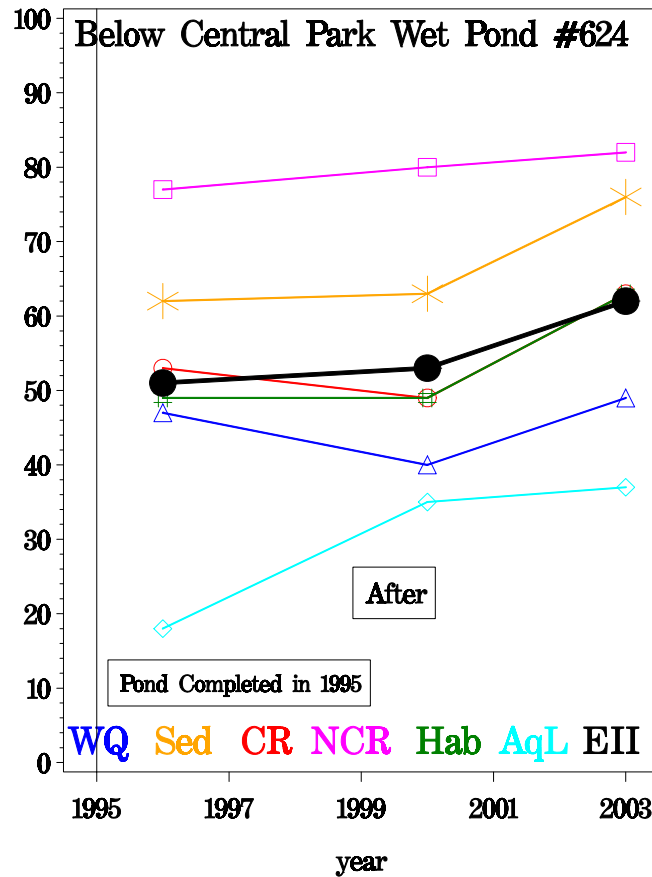
**Central Market wet pond**

Samples were taken three times at site 624, downstream of the Central Market wet pond (see Figure 8), after construction (see Figure 9). The site EII site and sub-index scores improved during the period after construction as shown in Table 7.

**Figure 8. Central Market wet pond and related EII sites**



**Figure 9. Site 624 EII site and sub-index scores below Central Market wet pond after construction**



**Table 7. Site 624 average EII scores and sub-indices after construction**

Score	1996	2003	Change
Water quality	47	49	+2
Sediment quality	62	76	+14
Contact recreation	53	63	+10
Non-contact recreation	77	82	+5
Habitat quality	49	63	+14
Aquatic life support	18	37	+19
Site EII	51	62	+11

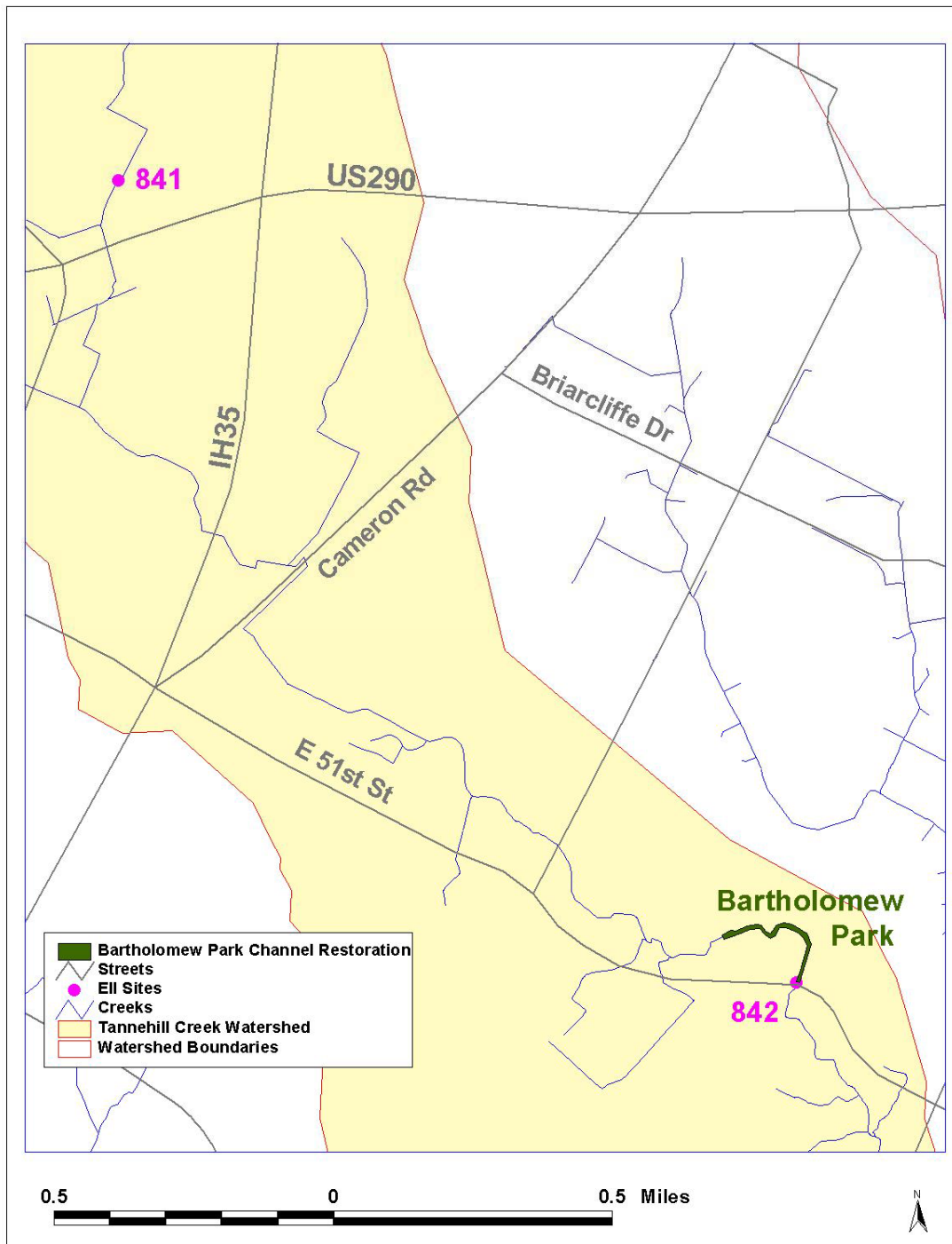
Changes in the EII scores at site 624 were very similar to those at site 781. Site 781, on Waller Creek, is more than a mile upstream from where the tributary from the Central Market wet pond enters the mainstream. Thus the increase in scores at site 624 could be due to changes in other upstream factors in addition to the Central Market wet pond. The largest improvements are in sediment quality, habitat quality and aquatic life support.

***Bartholomew Park channel restoration***

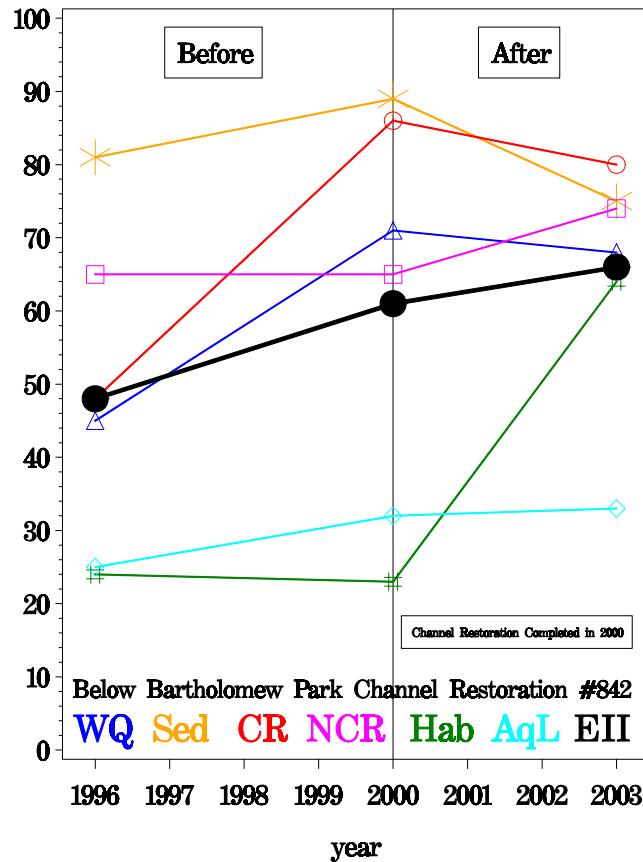
Samples were taken at the site 842, downstream of the Bartholomew Park channel restoration (see Figure 10), three times: before construction, during construction and after construction (see

Figure 11). The average EII site and sub-index scores before and after construction are shown in Table 6.

**Figure 10. Bartholomew Park channel restoration and related EII sites.**



**Figure 11. Site 842 EII site and sub-index scores below Bartholomew Park channel restoration before, during and after construction**



**Table 8. Site 842 average EII scores and sub-indices before and after construction**

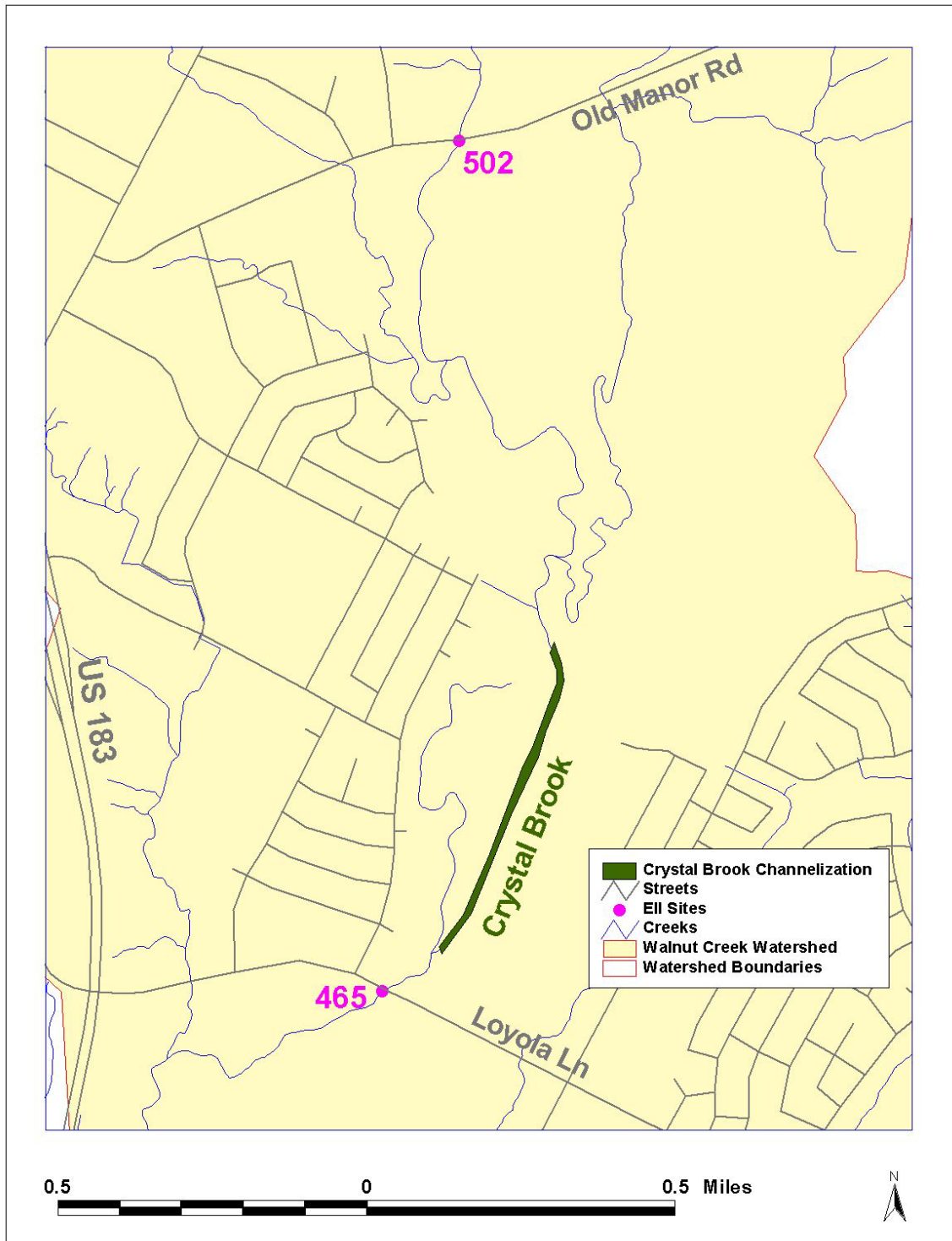
Score	Before (1996)	After (2003)	Change
Water quality	45	68	+23
Sediment quality	81	75	-6
Contact recreation	48	80	+32
Non-contact recreation	65	74	+9
Habitat quality	24	64	+40
Aquatic life support	25	33	+8
Site EII	48	66	+18

The EII score at site 842 changed from 48 before construction to 66 after construction. This represents an improvement from the EII marginal category (38-50) to the EII good category (63-75). With the exception of a decline in sediment quality, the EII sub-indices improved following channel restoration. The largest improvements were in habitat quality, contact recreation and water quality. At site 843, 1.4 miles below the channel restoration, the EII site score did not change from 1996 to 2003 indicating that the impact of the channel restoration with respect to EII scores is localized.

***Crystal Brook channelization***

Because construction of the Crystal Brook Project (see Figure 12) was completed in 2004, no EII data after construction is available. Walnut Creek EII sampling will occur 2006.

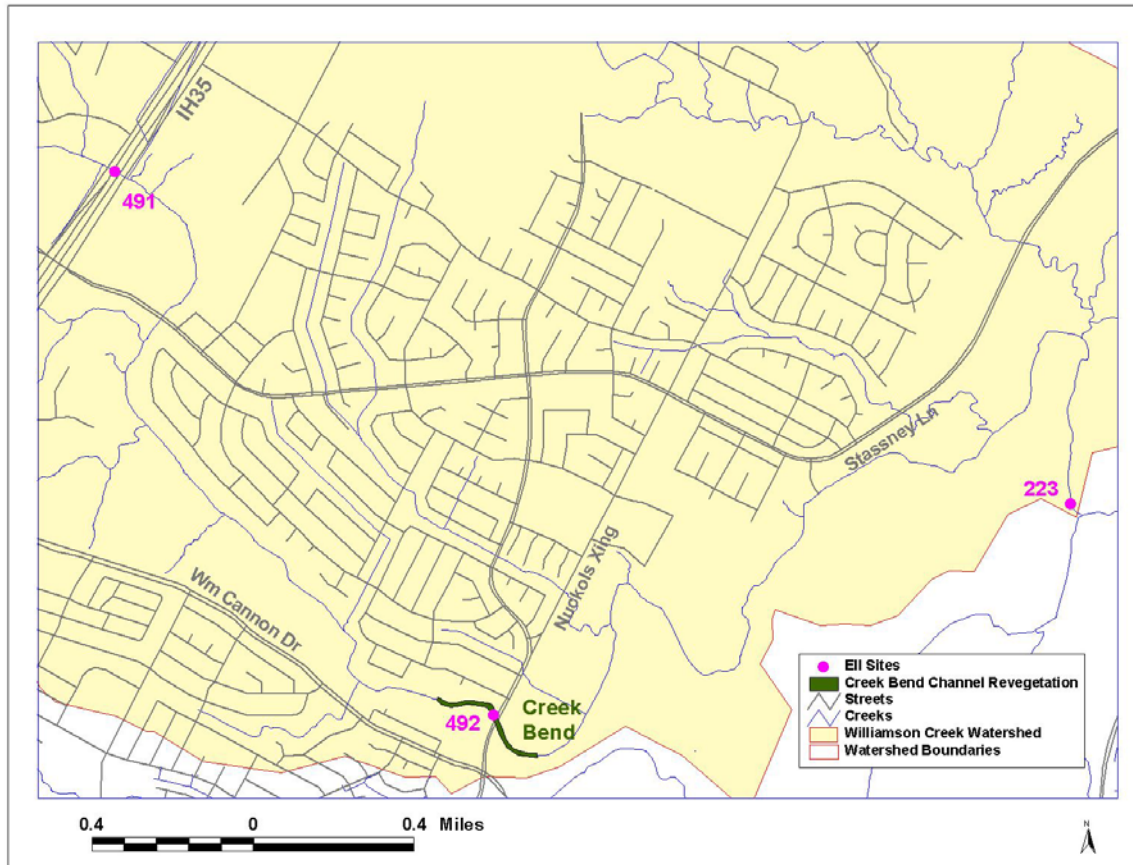
**Figure 12. Crystal Brook channelization and related EII sites**



***Creek Bend Channel re-vegetation***

Because construction of the Creek Bend Project (Figure 13) was only completed in 2004, EII data following construction is not available. Williamson Creek EII sampling will occur in 2006.

**Figure 13. Upper Shoal wet pond and related EII sites.**



### Summary

The change in EII score following the completion of these projects was generally positive (see Table 9), with the exception of habitat quality. However, all sites where two samples were collected after construction showed that habitat quality improved by the second sample after the construction.

**Table 9. Change in EII sites and sub-index scores after projects**

Score	Wet ponds						Channel
	Alpine	St. Edwards	Riata	Upper Shoal	Central Market	Wet pond avg. change	Bartholomew Park
Water quality	+8	+5	+8	-2	+2	+4	+23
Sediment quality	+24	+27	+11	+33	+14	+22	-6
Contact recreation	+41	+1	-6	+5	+10	+10	+32
Non-contact recreation	-7	+18	+7	+1	+5	+5	+9
Habitat quality	-33	-9	-13	-8	+14	-10	+40
Aquatic life support	+24	+7	-14	+7	+19	+9	+8
Site EII	+11	+9	-2	+5	+11	+7	+18

The average change in EII site scores and sub-indices at the two site types, wet pond and channel restoration, was compared with the average change between the first and last EII sample at all EII sites with more than one sample (Table 10). This was done to rule out improvement due to citywide changes affecting all sites, for example: rainfall amount.

**Table 10. BMP influenced changes compared to all EII site score changes**

Score	5 wet ponds average site EII score changes	1 channel restoration site EII score change	Avg. EII site score change (last sample – first sample)	Wet pond site score change –all EII site change	Channel rest. site score change –all EII site score change
Water quality	+4	+23	-1	+5	+24
Sediment quality	+22	-6	+4	+18	-10
Contact recreation	+10	+32	-8	+18	+40
Non-contact recreation	+5	+9	+3	+2	+6
Habitat quality	-10	+40	-2	-8	+42
Aquatic life support	+9	+8	+3	+6	+5
Site EII	+7	+18	0	+7	+18

From this assessment we can predict with reasonable certainty that following a project, sediment quality and contact recreation improves while habitat quality degrades initially, but improves over time to at least its pre-construction score. Aquatic life support and water quality also improves following wet pond installation.



The data gathered from the one channel modification project is insufficient to make generalizations. The site of EII sampling for was immediately downstream from the project. Only site 121, below Alpine wet pond, associated with wet pond construction, was as close.

Several other factors affect EII sites in addition to the projects. Some factors, which are different between these sites, are:

- Distance of the EII site from the project (some immediately downstream, others up to several miles downstream)
- The number of samples taken from which to estimate the means before and after construction
- The availability of preconstruction data. The Central Market wet pond had only post-construction data with which to measure site change.
- Other construction such as drainage tunnels, apartment/commercial development, etc. occurring in the area

Because of the small number of site data profiles gathered for this investigation, it is impossible to accurately and quantitatively predict the impact of similar projects on EII scores.

To improve the significance of data from which to draw conclusions about in stream impacts of BMPs, we suggest that an EII sampling site be within ½ mile downstream of proposed BMP construction, and that at least two samples be taken both before and after construction.

The Water Quality Management Team suggested the BMPs presented in this report. It may be that other, less prominent projects completed within the past few years could also be examined through this process.