3.20 Joseph's Branch Mainstem Stream Restoration

3.20.1 Introduction

The Joseph's Branch Mainstem is part of the Lower Rock Creek watershed. Much of the watershed was developed without any stormwater management controls in place to manage runoff from this highly urbanized area of the County (***Figure 3.20.3***). Joseph's Branch was rated as a high priority watershed to be restored based on the Rock Creek Watershed Feasibility Study and was recommended for restoration. The Joseph's Branch Mainstem restoration project was completed in January, 2005. Restoration associated with this project included the construction of in-stream structures to control erosive stream flows from within the watershed and to improve stream habitat. Additionally, one vernal pool was created for this project to enhance the riparian zone and provide habitat for herpetofauna. ***Figures 3.20.1*** and ***3.20.2*** show examples of the restoration associated with the project.

Figure 3.20.1 – Joseph's Branch Stream Restoration in 2005

Figure 3.20.2 – Joseph's Branch Created Vernal Pool in 2009

Subwatershed facts

Subwatershed Drainage Area: 1,783 acres
Subwatershed Imperviousness: 24 percent

Project Facts

Project Area: The Joseph's Branch subwatershed consists of residential and commercial properties with only limited, older stormwater designs to capture pollutant-enriched runoff during storms. It is located in the middle of the Lower Rock Creek watershed and is bisected by Viers Mill Road (MD 586). The stream restoration project begins at Connecticut Avenue and continues 1.3 miles downstream to the mainstem of Rock Creek. North of Connecticut Avenue, the stream is partially piped underground and is receiving direct street runoff with no stormwater management. DEP also implemented three other stream restoration projects within the Joseph's Branch subwatershed. The other projects included Upper Joseph's Branch – Wheaton High School, Joseph's Branch - Claridge Park, and Joseph's Branch – Spruell Drive. These projects were completed in 2006 and are discussed in ***Section 3.20*** of this report.
Costs: Structural ($615,000), Reforestation ($85,000) Funded in part through the Maryland State Highway Administration TEA-21 Enhancement Program, administered by the Federal Highway Administration.
Completion Date: January, 2005
Property Ownership: Maryland-National Capital Park and Planning Commission

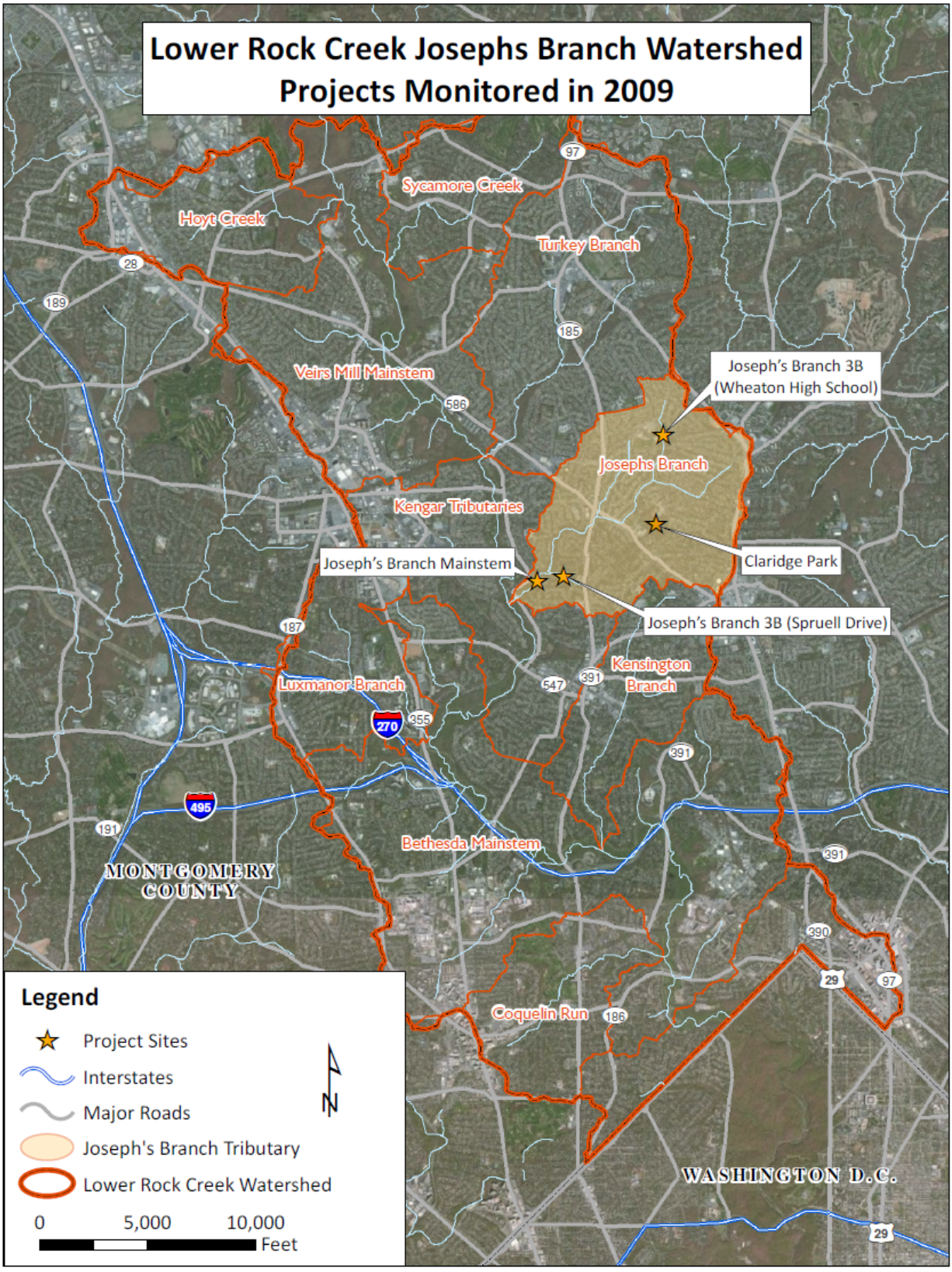


Figure 3.20.3 – Lower Rock Creek Watershed Showing Joseph's Branch Restoration Projects Monitored in 2009

Project Selection

Montgomery County has a continuing commitment to protect and improve its water resources. The Countywide Stream Protection Strategy, (CSPS, 1998, updated 2003), published by DEP, evaluated biological, chemical, and habitat conditions of streams in the County, and identified impaired "priority" subwatersheds for restoration, including the Joseph's Branch subwatershed. Following the CSPS, The Rock Creek Watershed Feasibility Study (April 2001) evaluated more than 14 miles of Rock Creek and its tributaries to identify specific stream restoration and stormwater management opportunities. The Study identified 23 priority stream restoration sites, including the Joseph's Branch tributary of Rock Creek.

Pre-Restoration Conditions

Much of the lower Rock Creek Watershed, including the Joseph's Branch subwatershed, contains a high percentage of impervious surfaces and was developed prior to regulations requiring stormwater management. Uncontrolled stormwater runoff from highly impervious areas creates erosive, high velocity or "flashy" flows that cause damage to receiving streams. The Rock Creek Watershed Feasibility Study identified several impaired conditions in Joseph's Branch. Uncontrolled stormwater created severe streambank erosion and unstable banks. Undercut trees fell into the stream and created debris jams blocking the stream and causing additional bank erosion.

Over time, the stream channel down-cut and became over-widened, limiting the stream's access to the original floodplain. The down-cutting and over-widening exposed sewer manholes, threatened buried sewer lines, and destroyed habitat necessary for diverse aquatic life. Large amounts of sediment from eroded banks and road grit accumulated in the stream, further degrading stream habitat conditions.

Restoration Actions Taken

The Joseph's Branch Mainstem Project used in-stream restoration techniques and reforestation to help stabilize streambanks and enhance riparian habitat. Newly built in-stream structures included rock and log vanes, which direct water away from unstable streambanks and form downstream scour pools that provide stable and suitable habitat for fish. Rock cross vanes were also incorporated into the restoration and function as grade control structures, which slow the erosive process of stream down-cutting. In-stream rootwad revetments are were added to help stabilize streambanks, create scour holes, and provide overhead cover for fish. Boulder rock was also installed at the toe of the streambank, stabilizing the area of the stream channel subjected to the greatest erosive energy, or "shear" stress. The slopes above the reinforced toe were graded back to create new floodplain terraces and planted with native trees and shrubs to further stabilize the streambanks.

Undercut and undermined trees were reinforced with supportive "rock packing." More seriously damaged trees were flush cut, allowing the root systems to remain in the bank for stabilization. Other efforts to enhance the riparian habitat and buffer included creating a shallow vernal pool at the upper end of the project, and planting more than 1,400 native plants and trees throughout the project limits.

Montgomery County also worked closely with the Washington Suburban Sanitary Commission (WSSC) to protect buried sewer lines with channel grade controls, and divert stream water flow away from exposed manholes. The WSSC made use of the County's temporary construction

access to clean and reline existing sewer lines, further protecting sewer infrastructure and guarding against water quality impairment from leaking pipes.

3.20.2 Restoration Goals

Restoration goals were defined during the planning and implementation of the Joseph's Branch project. Pre- and post-restoration monitoring was conducted within the stream. This is a fifth year monitoring report and summarizes the pre- and post-restoration conditions within the Joseph's Branch project area. ***Table 3.20.1*** below presents the restoration goals, monitoring performed to evaluate the success of the goals, and when and where the monitoring occurred.

Table 3.20.1 – Summary of Restoration Project Goals and Associated Monitoring

Why: Restoration Goals	What: Monitoring Done to Evaluate Goal	When: Years Monitored	Where: Station or Location Monitored
• Improve aquatic habitat conditions in Joseph's Branch • Improve water quality in Joseph's Branch	• Aquatic Communities: ▪ Benthic macroinvertebrates ▪ Fish • Qualitative Habitat • In-situ Water Chemistry	2002 (pre) 2005, 2007, 2009 (post)	LRJB203A, LRJB203B, LRJB204
• Reduce stream erosion and sedimentation • Reduce erosive stream flows	• Quantitative Habitat (stream morphology surveys)	2005, 2010, 2011[1] (post)	LRJB203A, LRJB203B, LRJB204
• Create amphibian habitat	• Vernal pool	2005, 2007, 2009 (post)	LRJB203A

[1] Quantitative habitat surveys were scheduled for 2009, but were delayed due to missing benchmarks. These benchmarks were located and survey work was performed in 2010 and 2011. 2010 and 2011 reports will include updates for this monitoring.

3.20.3 Methods to Measure Project Goals

Three sites were sampled to determine pre- and post-restoration conditions on the Joseph's Branch mainstem, LRJB203A, LRJB203B, and LRJB204. At all three sites, the County monitored biological communities (benthic macroinvertebrates and fish), performed rapid habitat assessments (RHAB), and collected in-situ water chemistry to evaluate the aquatic habitat conditions and water quality during the pre- and post-restoration periods. At these same three sites, survey crews measured the shape of the stream profile and cross section and assessed channel bed materials to evaluate sediment transport and erosion. Since survey monuments could not be located in 2009, the survey work was delayed to 2010 and 2011. Crews also monitored the created vernal pool at site LRJB203A for amphibians and other wetland fauna. A map showing the monitoring locations and created vernal pool is provided in ***Figure 3.20.4***. All data collected prior to 2005 are considered pre-restoration data and all subsequent data are considered post-restoration. These data are presented in the results section below. For more information on how this monitoring is performed and used to measure stream health in the County, see the Methods section (***Section 2***).

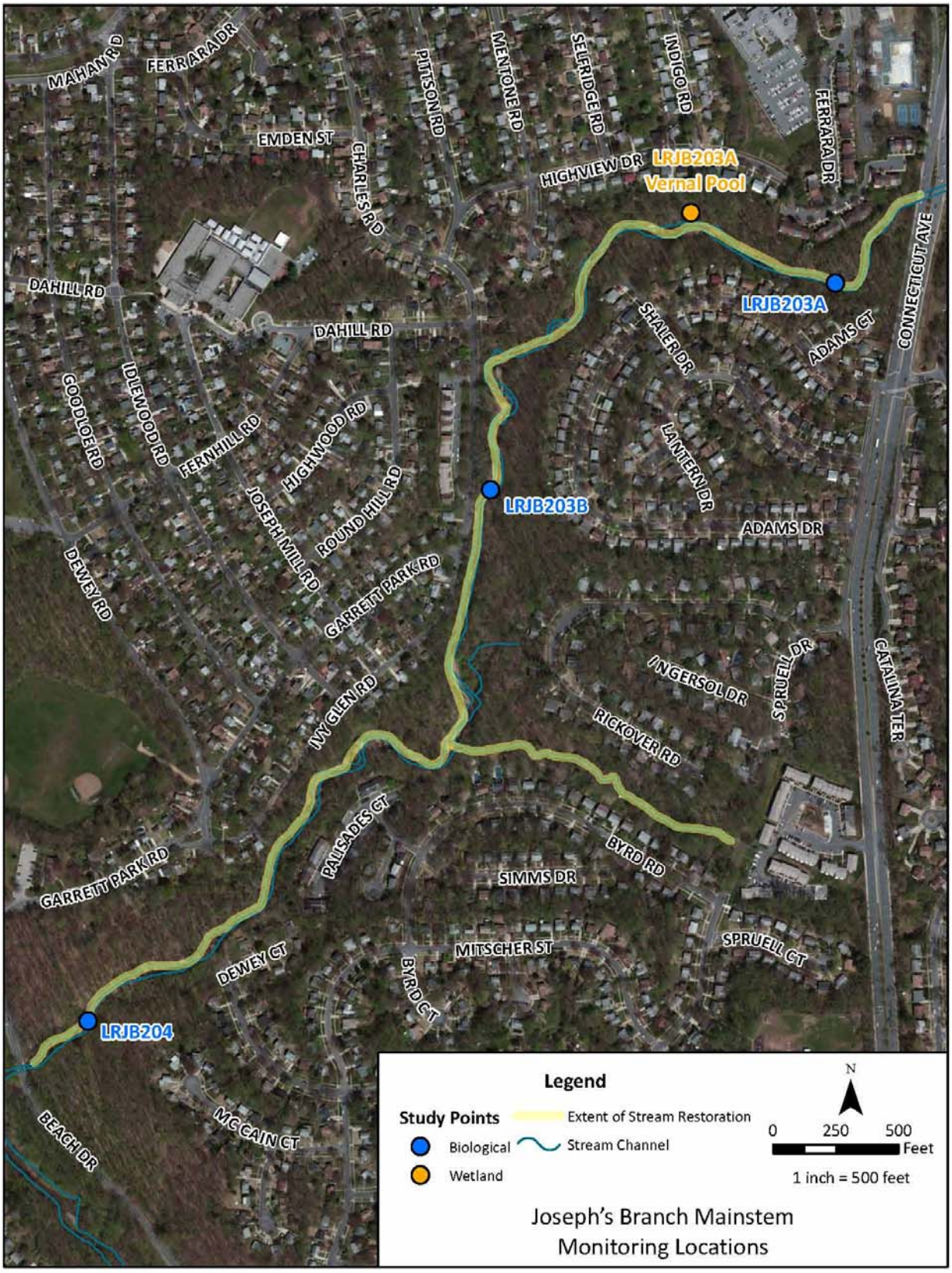


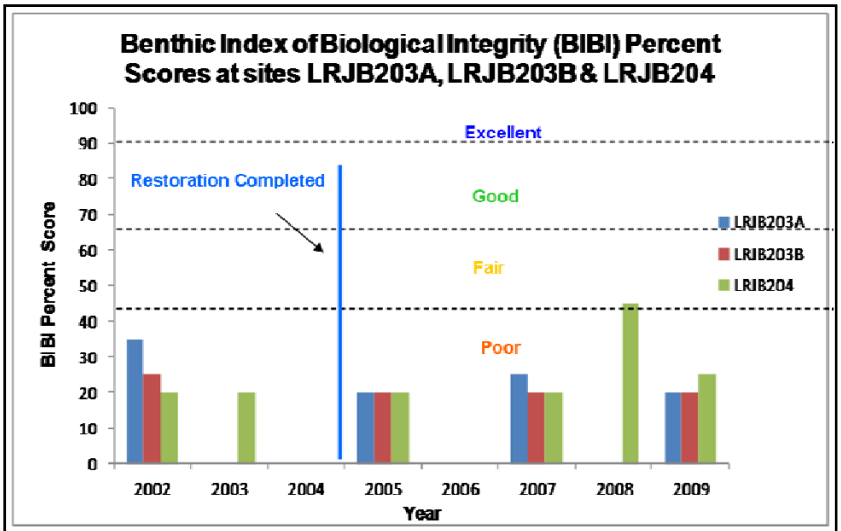
Figure 3.20.4 – Map of 2009 Monitoring Locations for Joseph's Branch Mainstem Project

3.20.4 Results and Analysis

Benthic Macroinvertebrates

BIBI (Benthic Index of Biological Integrity) Scores

Pre- and post-restoration monitoring was conducted at three monitoring sites within the Joseph's Branch Mainstem project area. The benthic macroinvertebrate community, as assessed by the MCDEP Benthic Index of Biological Integrity (BIBI), was Poor at all sites in all years, with the exception of one site, LRJB204 which scored in the lower Fair range in 2008. In many years, very few benthic macroinvertebrates were collected: 50 percent of the samples prior to construction and over 37 percent of the samples collected after construction had fewer than the requisite 60 individuals to calculate an accurate BIBI. In these circumstances, the sites were automatically given the lowest possible score, 20 percent. The continued low benthic macroinvertebrate abundance suggests an impaired stream quality not suited for full colonization, or perhaps a limitation to re-colonization potential. The increase in BIBI ranking from Poor to Fair at LRJB204 in 2008 was partially due to a decrease in the proportion of Hydropsyche and Cheumatopsyche of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (collectively abbreviated as EPT), a decrease in the proportion of dominant taxa, and an increase in the proportion of shredders (***Figure 3.20.5***). Overall, the benthic macroinvertebrate community in the project area was degraded prior to restoration and has remained degraded for five years after restoration activities occurred. Field data sheets for the benthic macroinvertebrate task in 2009 are included in ***Appendix D***.



Station ID	BIBI Percentage (Narrative Ranking)					
	2002	2003	2005	2007	2008	2009
LRJB203A	35 (Poor)	-	20 (Poor)	25 (Poor)	-	20 (Poor)
LRJB203B	25 (Poor)	-	20 (Poor)	20 (Poor)	-	20 (Poor)
LRJB204	20 (Poor)	20 (Poor)	20 (Poor)	20 (Poor)	45 (Fair)	25 (Poot)

Figure 3.20.5 – Pre- and Post-Restoration Benthic Index of Biological Integrity (BIBI) Percentages at LRJB203A, LRJB203B, and LRJB204

Dominant Taxa

Generally, the communities at all three sites both prior to and after restoration were dominated by tolerant taxa including Chironomidae (midges), Oligochaeta (aquatic worms), and Gastropoda (snails). Midges, most commonly represented by the subfamily Orthocladiinae, were the most dominant taxon at all sites in all years except 2009, when aquatic worms were the most dominant taxon. The most dominant benthic macroinvertebrate taxon prior to restoration at all three sites comprised 75 to 83 percent of the community. After restoration, the most dominant taxon comprised 51 to 59 percent of the community, suggesting an improvement. However, the percent dominance by the two most dominant taxa ranged from 85 to 89 percent in the pre-restoration period and from 86 to 90 percent in the post-restoration period. Therefore, it doesn't appear that dominance has changed much since the restoration occurred.

Tolerance Values

Prior to restoration, tolerant benthic macroinvertebrate taxa comprised 80 percent or more of the community and sensitive taxa made up only two percent of the community at all three sites. After restoration, the percentage of tolerant individuals increased at all sites, the percentage of individuals intermediate in sensitivity decreased and individuals sensitive to urbanization were absent in the post-restoration period. ***Figures 3.20.6 – 3.20.11*** show the proportion of tolerances at all three sites prior to and after restoration.

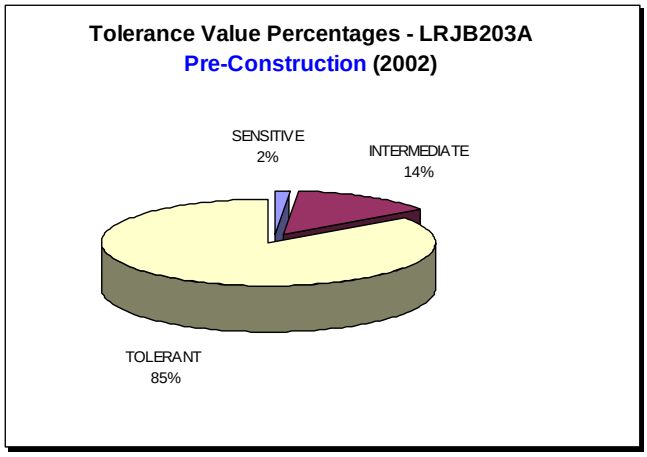


Figure 3.20.6 – Benthic Macroinvertebrate Tolerance Composition at LRJB203A Prior to Restoration

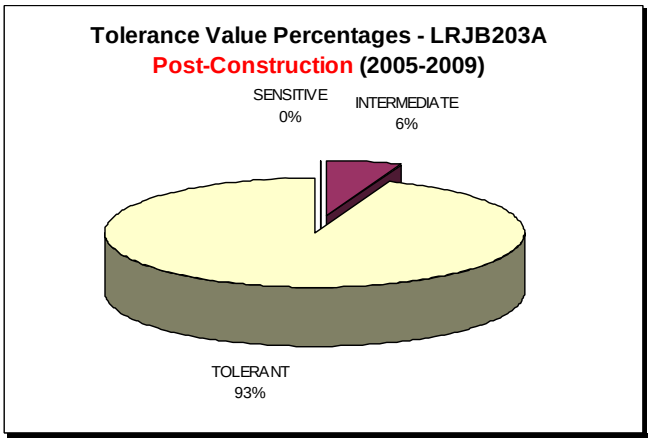


Figure 3.20.7 – Benthic Macroinvertebrate Tolerance Composition at LRJB203A After Restoration

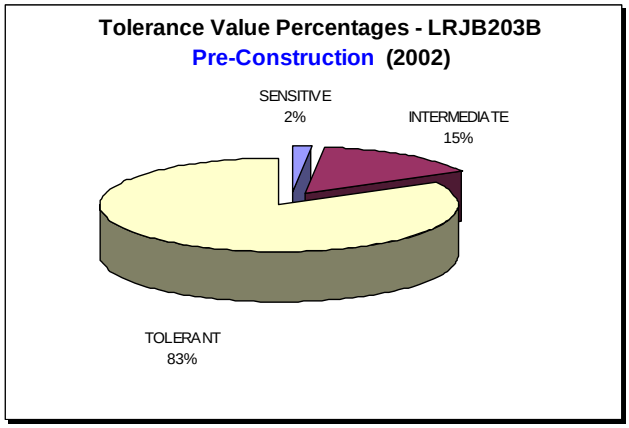


Figure 3.20.8 – Benthic Macroinvertebrate Tolerance Composition at LRJB203B Prior to Restoration

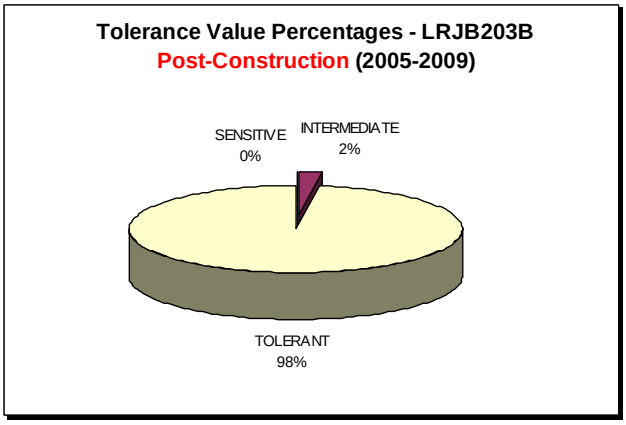


Figure 3.20.9 – Benthic Macroinvertebrate Tolerance Composition at LRJB203B After Restoration

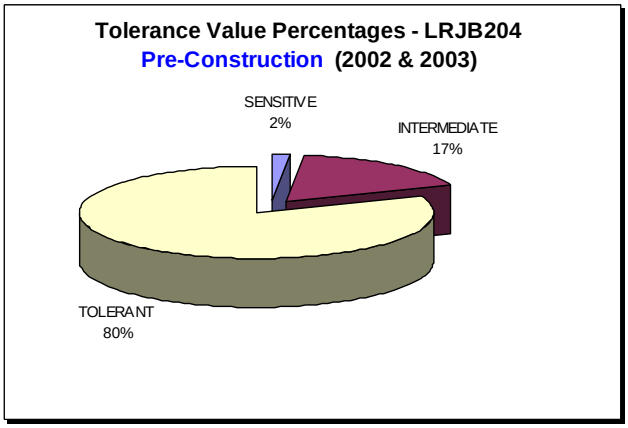


Figure 3.20.10 – Benthic Macroinvertebrate Tolerance Composition at LRJB204 Prior to Restoration

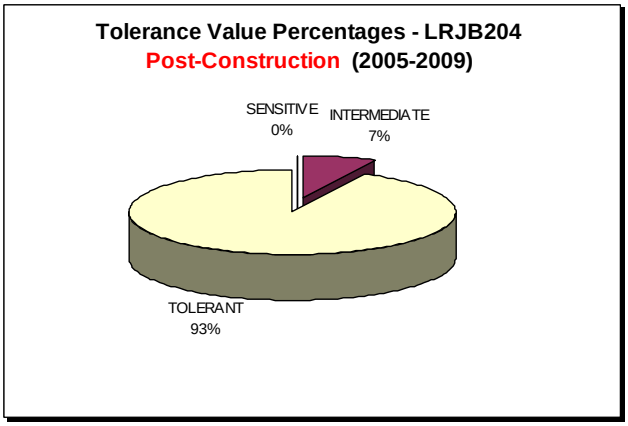


Figure 3.20.11 – Benthic Macroinvertebrate Tolerance Composition at LRJB204 After Restoration

Functional Feeding Groups

Functional feeding groups of benthic macroinvertebrates are helpful in describing the condition, habitat, and food availability in a stream. More specialized feeders, including scrapers and shredders, often require less degraded stream conditions or specific habitat features. Benthic macroinvertebrates classified as generalist feeders, such as collectors and filterers, can often persist in more impacted streams (EPA 2010). At all sites, collectors were the most dominant feeding group both prior to and after restoration, with the proportion of collectors increasing in the post-restoration period. Additionally, most of the specialized feeding groups declined to very low proportions after restoration at all sites in the Joseph's Branch Mainstem project area. ***Figures 3.20.12 – 3.20.17*** show the proportions of functional feeding groups at all Joseph's Branch Mainstem sites prior to and after restoration activities occurred.

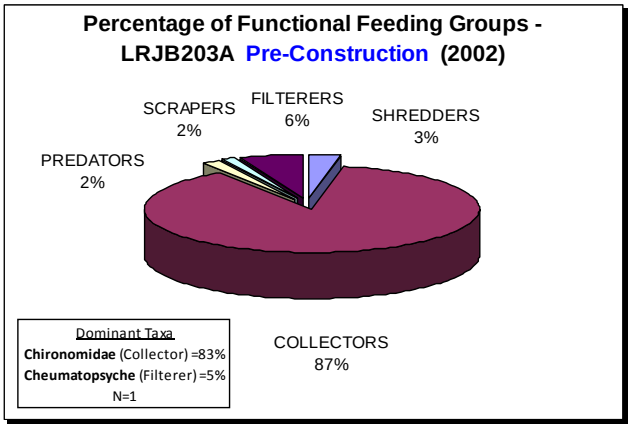


Figure 3.20.12 – Benthic Macroinvertebrate Feeding Group Composition at LRJB203A Prior to Restoration

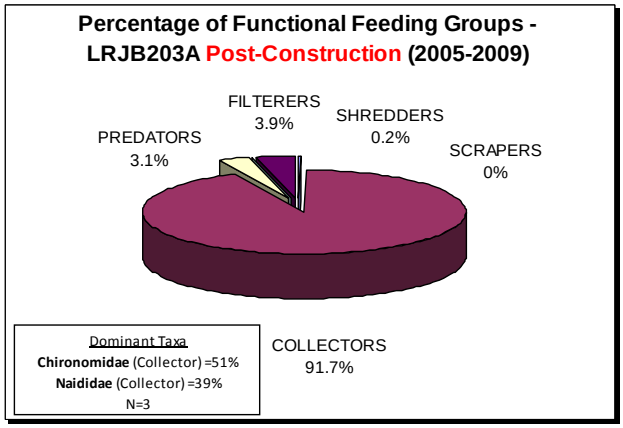


Figure 3.20.13 – Benthic Macroinvertebrate Feeding Group Composition at LRJB203A After Restoration

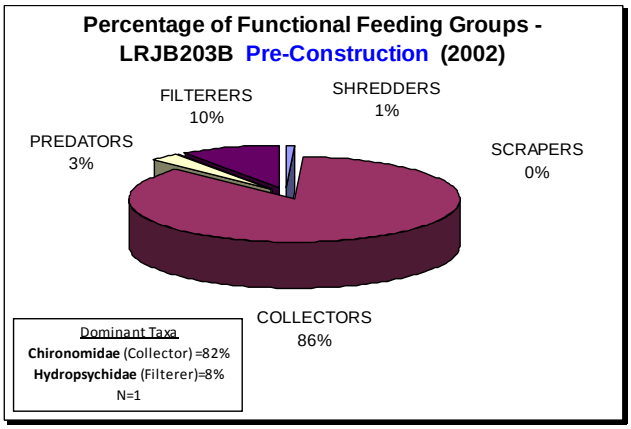


Figure 3.20.14 – Benthic Macroinvertebrate Feeding Group Composition at LRJB203B Prior to Restoration

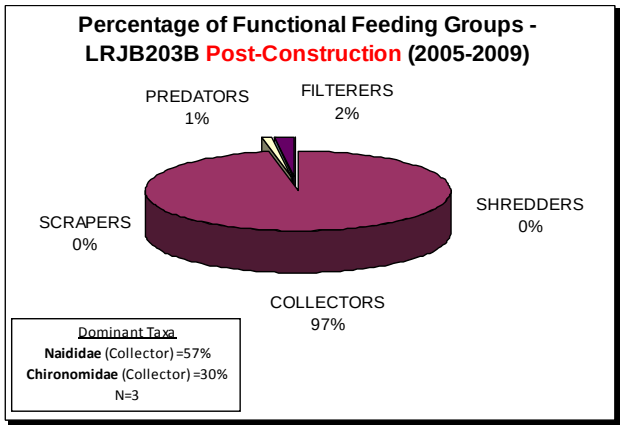


Figure 3.20.15 – Benthic Macroinvertebrate Feeding Group Composition at LRJB203B After Restoration

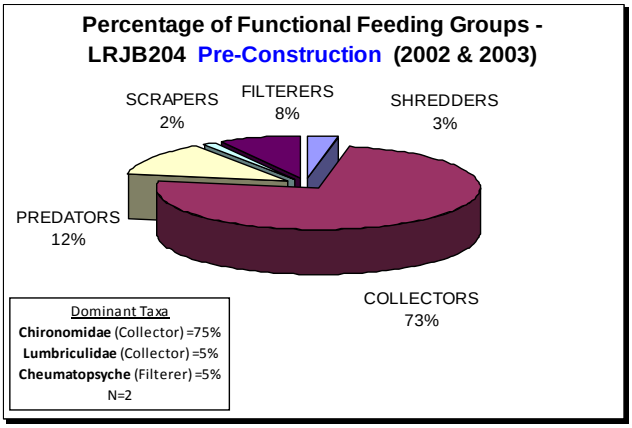


Figure 3.20.16 – Benthic Macroinvertebrate Feeding Group Composition at LRJB204 Prior to Restoration

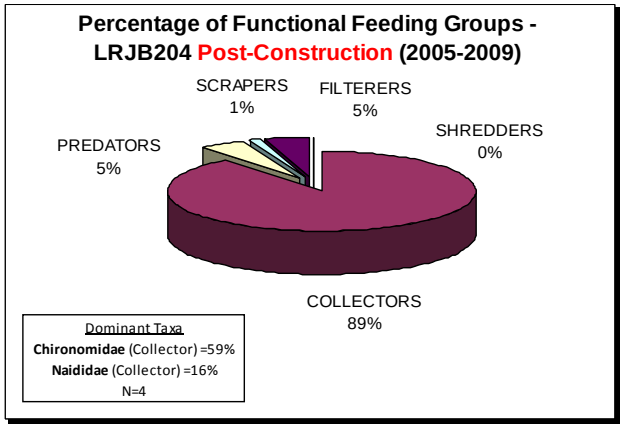


Figure 3.20.17 – Benthic Macroinvertebrate Feeding Group Composition at LRJB204 After Restoration

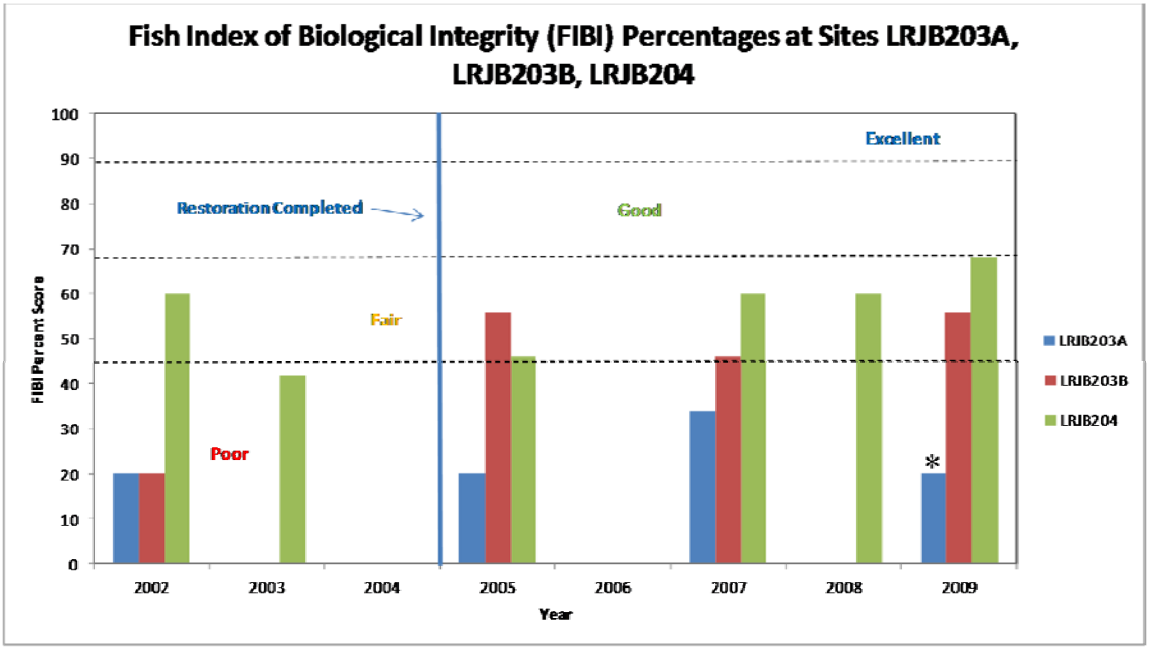
Fish

FIBI (Fish Index of Biological Integrity) Scores

The pre-restoration (2002 and 2003) fish community, as assessed by the MCDEP Fish Index of Biological Integrity (FIBI), was rated as Poor at three out of four of the pre-restoration surveys, including LRJB203A and LRJB203B in 2002 and at LRJB204 in 2003. Site LRJB204 was rated as Fair in 2002 (***Figure 3.20.18***). The decline in the FIBI score at LRJB204 between 2002 and 2003 was due to the absence of the benthic insectivorous fish, *Etheostoma blennioides* (greenside darter), and an increase in the proportion of tolerant fish species in 2003.

The post-restoration (2005 through 2009) fish community in the Joseph's Branch project area was generally rated as higher, with 30 percent of fish surveys scoring in the Poor range and 70 percent scoring in the Fair range. The post-restoration community at LRJB203A was similar to the pre-restoration community; FIBI percentages were the lowest possible in all years except in 2007 when they were slightly higher, but remained in the Poor range. However, in 2009, only one *Rhinichthys atratulus* (blacknose dace) and one *Anguilla rostrata* (American eel) were found dead, and notes were made about a possible chlorine discharge at the upstream community pool. Site LRJB203B, showed an improvement in FIBI scores to the Fair range after restoration. At site LRJB204, FIBI percentages were similar in the post-restoration period to those prior to restoration, but scores improved in 2009. The increase in FIBI scores at LRJB203B and LRJB204 was due to an increase in the diversity of the fish community and in the number of minnow species.

There is an overall increasing trend in percent FIBI scores at the Joseph's Branch mainstem project sites (***Figure 3.20.19***). Field data sheets for fish sampling in 2009 are included in ***Appendix D***.



Station ID	FIBI Percentage (Narrative Ranking)					
	2002	2003	2005	2007	2008	2009
LRJB203A	20 (Poor)	-	20 (Poor)	33 (Poor)	-	20 (Poor)*
LRJB203B	20 (Poor)	-	56 (Fair)	47 (Fair)	-	56 (Fair)
LRJB204	60 (Fair)	42 (Poor)	47 (Fair)	60 (Fair)	60 (Fair)	68 (Fair)

* only dead fish were found at this site in 2009, indicating a possible water quality incident. This score may not reflect an accurate restoration condition at this time.

Figure 3.20.18 – Pre- and Post-Restoration Fish Index of Biological Integrity (FIBI) Percentages at LRJB203A, LRJB203B, and LRJB204

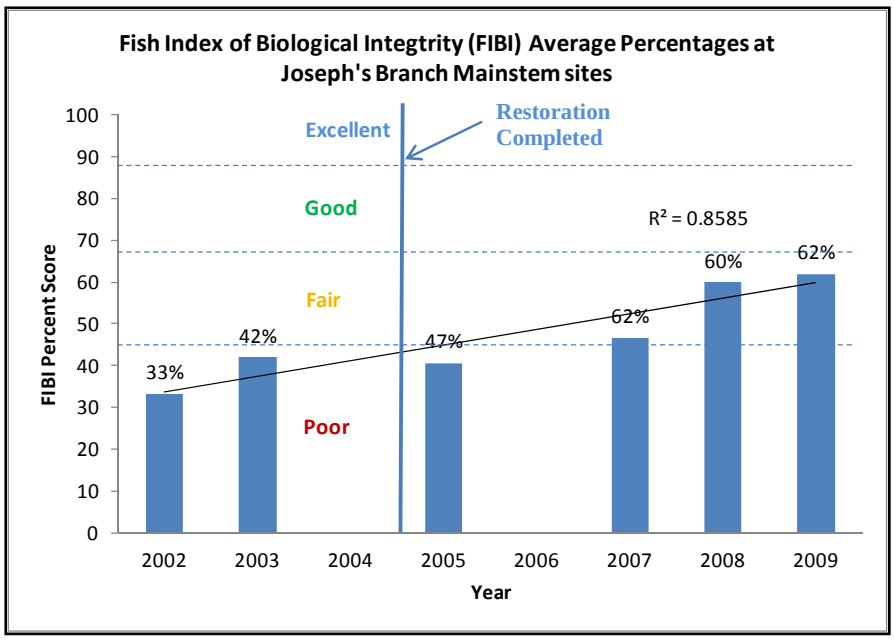


Figure 3.20.19 – Average FIBI Percent Scores at Joseph's Branch Mainstem Sites, Pre- and Post-Restoration. LRJB203A was excluded from 2009 average due to suspected water quality incident at time of sampling.

Dominant Taxa

The pre- and post-restoration fish communities at all three sites were heavily dominated by *Rhinichthys atratulus* (blacknose dace). *Rhinichthys cataractae* (longnose dace) was second most dominant at both LRJB203A and LRJB204 prior to restoration but was absent at LRJB203B, since only blacknose dace were collected there in 2002. After restoration, *Semotilus atromaculatus* (creek chub) was second most dominant at LRJB203A, longnose dace was second most dominant at LRJB203B, and *Notropis procne* (swallowtail shiner) was second most dominant at LRJB204.

Tolerance Values

Tolerant fish species were dominant at all three sites in the Joseph's Branch project area prior to and after restoration activities occurred (***Figures 3.20.20 – 3.20.25***). At sites LRJB203A and LRJB204 the percentage of tolerant fish species increased after restoration. However, at LRJB203B, a greater proportion of fish species intermediate in sensitivity were present after restoration, suggesting a slight improvement in the fish community at this site.

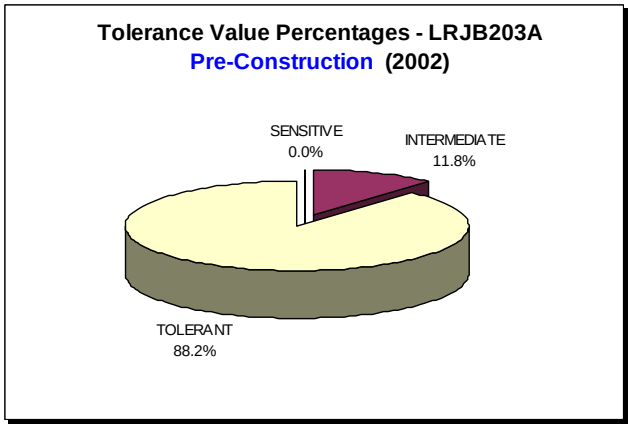


Figure 3.20.20 – Fish Tolerance Composition at LRJB203A Prior to Restoration

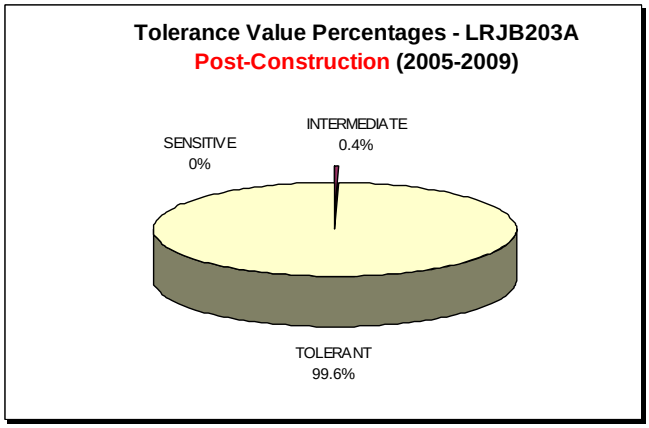


Figure 3.20.21 – Fish Tolerance Composition at LRJB203A After Restoration

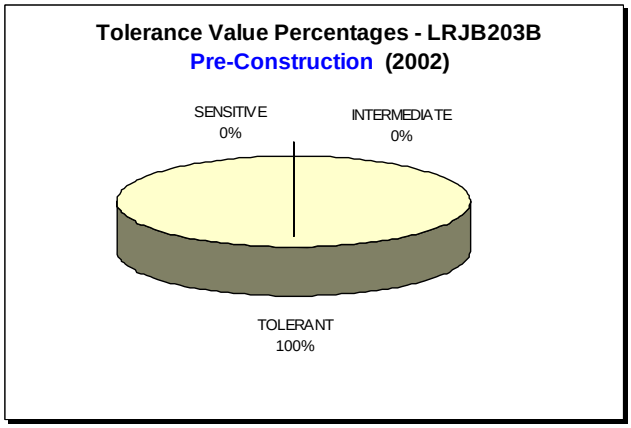


Figure 3.20.22 – Fish Tolerance Composition at LRJB203B Prior to Restoration

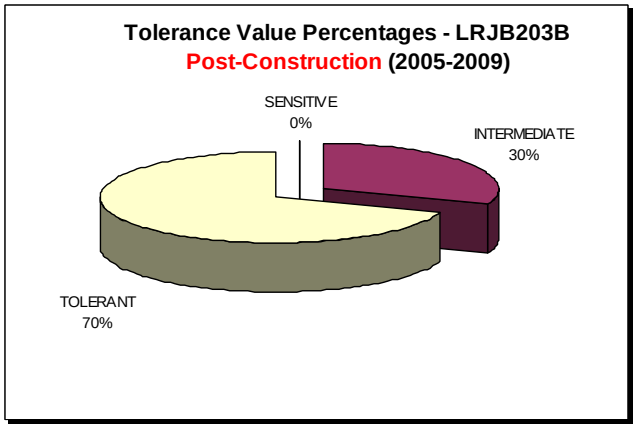


Figure 3.20.23 – Fish Tolerance Composition at LRJB203B After Restoration

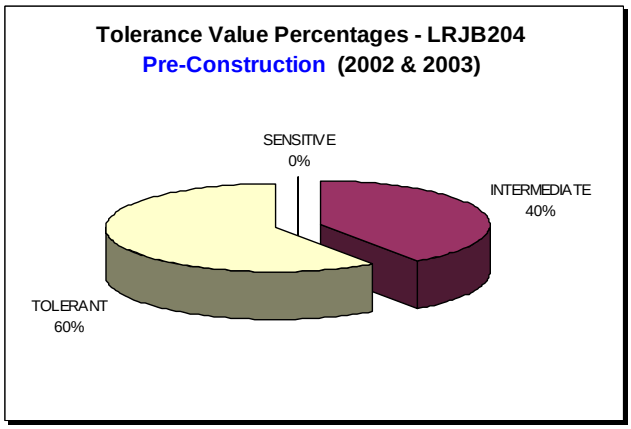


Figure 3.20.24 – Fish Tolerance Composition at LRJB204 Prior to Restoration

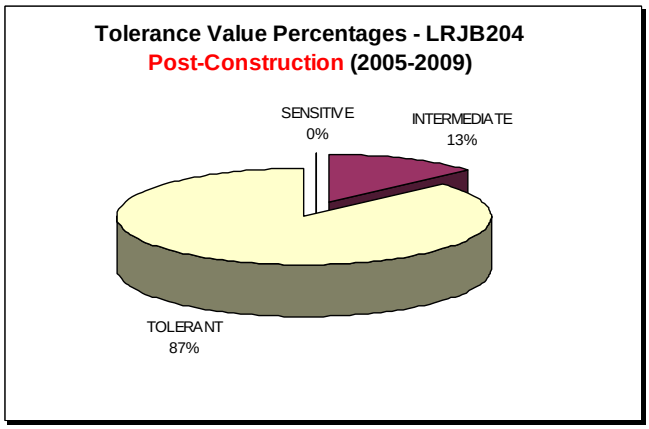


Figure 3.20.25 – Fish Tolerance Composition at LRJB204 After Restoration

Functional Feeding Groups

The compositions of fish functional feeding groups were similar among Joseph's Branch Mainstem sites in both the pre- and post-restoration periods. ***Figures 3.20.26 – 3.20.31*** show the

proportions of each functional feeding group at each site prior to and after restoration. All sites were dominated by omnivore fish species before and after restoration. At sites LRJB203A and LRJB203B, no generalist fish species were found prior to restoration but were found in low proportions in the post-restoration period at two and four percent, respectively. The increase in generalists was due to a presence of creek chub at LRJB203A after restoration and a presence of *Anguilla rostrata* (American eel), *Lepomis cyanellus* (green sunfish), and creek chub at LRJB203B. Site LRJB204 had a slight decline in generalists and insectivores, and a slight increase in the percentage of invertivores from the pre- to post-restoration period. The increase in invertivores at LRJB204 after restoration was due to a presence of *Cyprinella analostana* (satinfin shiner), *Cyprinella spilopterus* (spotfin shiner), *Etheostoma olmstedi* (tessellated dater), and *Lepomis macrochirus* (bluegill). Overall, the fish communities at all three sites had very few specialist feeders, and the shifts in functional feeding groups between the pre- and post-restoration are very subtle and describe only minor improvements in the post-restoration period.

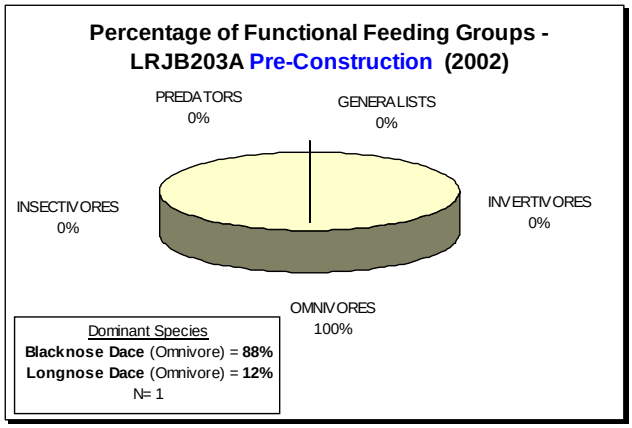


Figure 3.20.26 – Fish Functional Feeding Group Composition and Dominant Species at LRJB203A Prior to Restoration

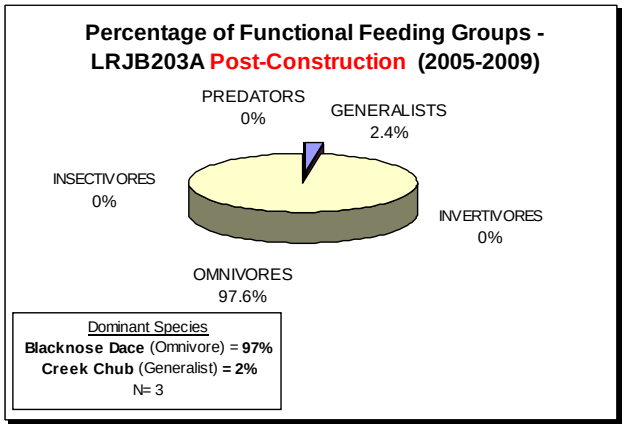


Figure 3.20.27 – Fish Functional Feeding Group Composition and Dominant Species at LRJB203A After Restoration

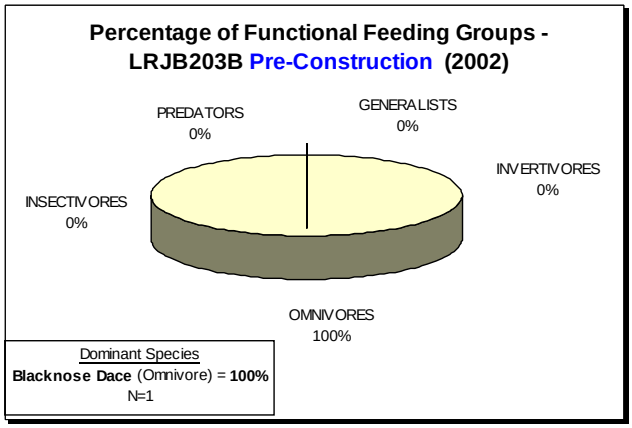


Figure 3.20.28 – Fish Functional Feeding Group Composition and Dominant Species at LRJB203B Prior to Restoration

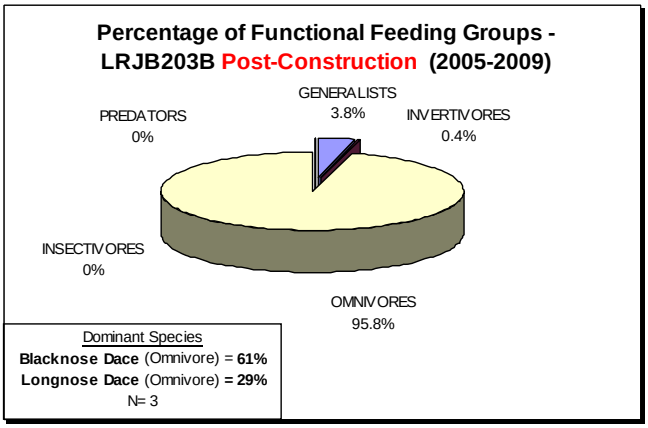


Figure 3.20.29 – Fish Functional Feeding Group Composition and Dominant Species at LRJB203B After Restoration

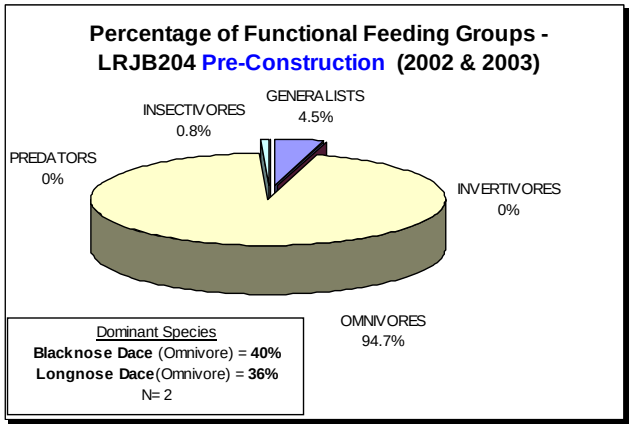


Figure 3.20.30 – Fish Functional Feeding Group Composition and Dominant Species at LRJB204 Prior to Restoration

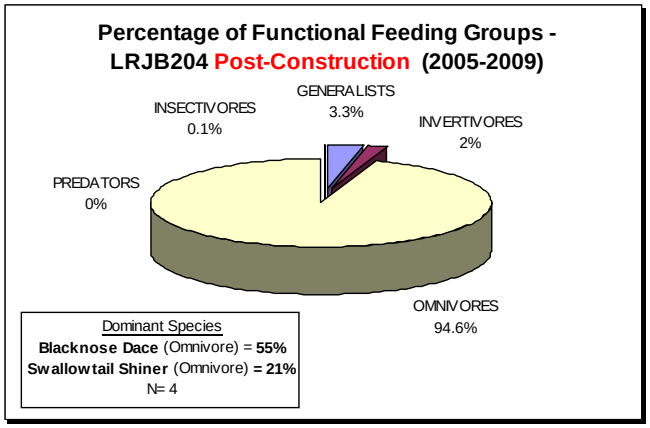
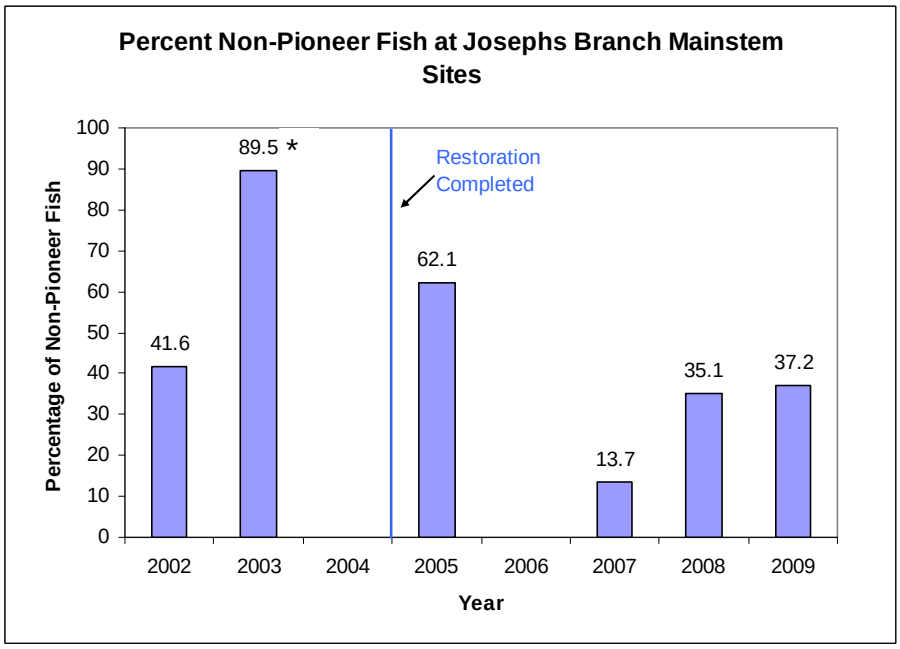


Figure 3.20.31 – Fish Functional Feeding Group Composition and Dominant Species at LRJB204 After Restoration

Pioneer Fish

The percentage of non-pioneering individuals appears to have declined overall from the pre-restoration period to the post (***Figure 3.20.32***). Non-pioneering fish are generally unable to live in degraded conditions. However, it is important to note that the rise in non-pioneering fish in 2003 may be because only one site was sampled in this year, LRJB404, the site with the highest scoring fish community. Therefore, the non-pioneer fish percentage in 2003 this year may be skewed.

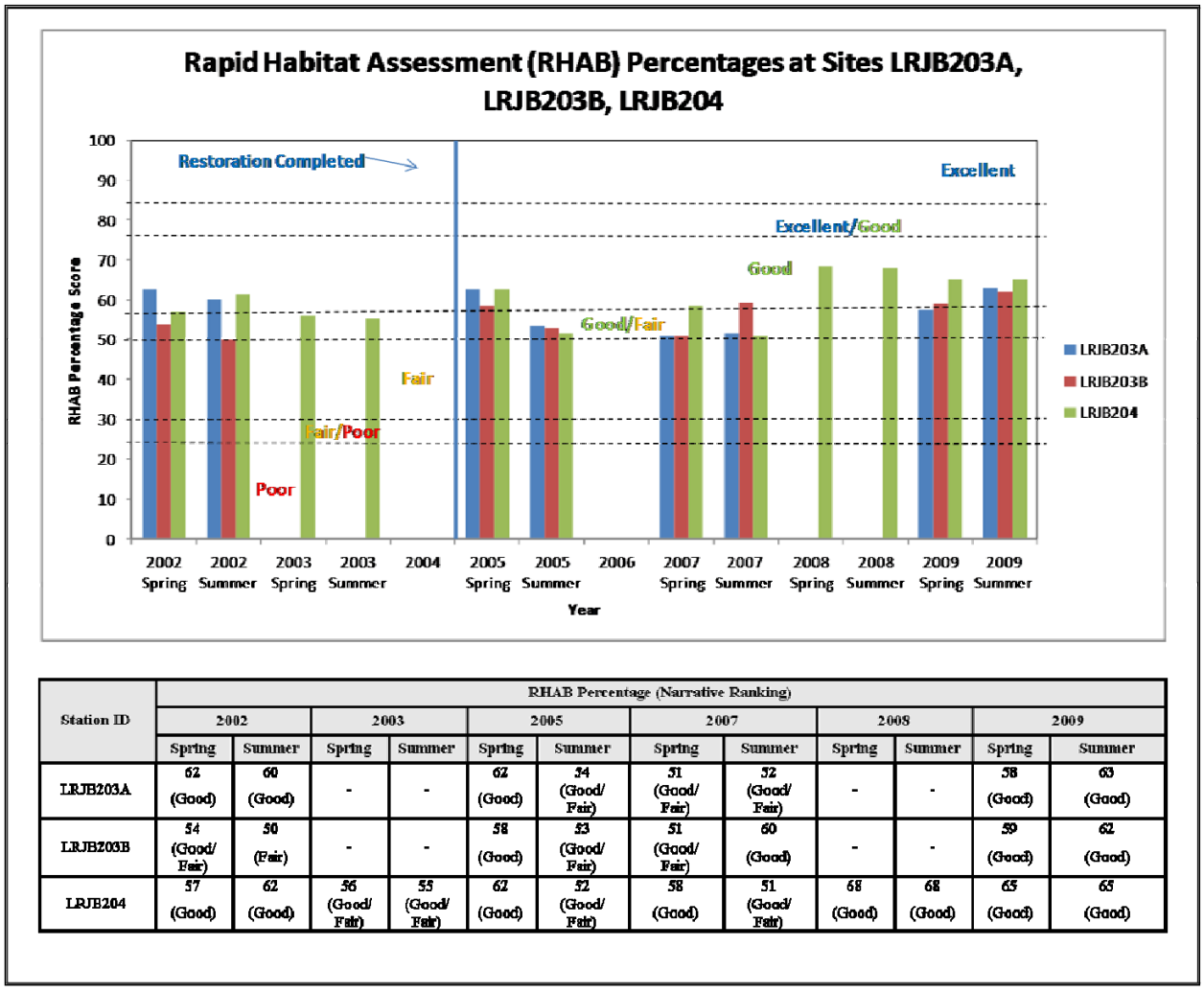


* Fish were only collected at LRJB204 in this year; this is generally the highest scoring site of all three sites and therefore, the percentage of non-pioneering individuals may have been skewed in this year.

Figure 3.20.32 – Non-Pioneer Fish Present at Josephs Branch Sites Before and After Restoration

Qualitative Habitat

Pre-restoration aquatic habitat was evaluated at LRJB203A, LRJB203B, and LJRB204 in the spring and summer of 2002 and at LRJB204 in the spring and summer of 2003 (***Figure 3.20.33***). Scores were generally in the Good/Fair, and Good ranges in the pre-restoration period. During this time, Joseph's Branch sites generally had marginal and suboptimal in-stream cover for fish, suboptimal epifaunal substrate for benthic macroinvertebrates, marginal to suboptimal sediment deposition, and moderately unstable banks on one of the streambanks. After restoration, in-stream cover for fish and bank stability improved slightly at all sites. Most other aquatic habitat parameters remained similar between the pre- and post-restoration periods.



Station ID	RHAB Percentage (Narrative Ranking)											
	2002		2003		2005		2007		2008		2009	
	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer
LRJB203A	62 (Good)	60 (Good)	-	-	62 (Good)	54 (Good/ Fair)	51 (Good/ Fair)	52 (Good/ Fair)	-	-	58 (Good)	63 (Good)
LRJB203B	54 (Good/ Fair)	50 (Fair)	-	-	58 (Good)	53 (Good/ Fair)	51 (Good/ Fair)	60 (Good)	-	-	59 (Good)	62 (Good)
LRJB204	57 (Good)	62 (Good)	56 (Good/ Fair)	55 (Good/ Fair)	62 (Good)	52 (Good/ Fair)	58 (Good)	51 (Good/ Fair)	68 (Good)	68 (Good)	65 (Good)	65 (Good)

Figure 3.20.33 – Pre- and Post-Restoration Rapid Habitat Assessment (RHAB) Percentages at LRJB203A, LRJB203B, and LRJB204

Quantitative Habitat

Quantitative survey data collection was scheduled for 2009, but was delayed until 2010 and 2011 due to problems locating the survey monuments. Data collected in 2010 and 2011 will be presented in the subsequent 2010 and 2011 reports.

Water Chemistry

Generally, in-situ water quality parameters were in compliance with COMAR standards (***Table 2.6***) for Use I streams during the pre-restoration period (***Table 3.20.2 – 3.20.4***). Only one site, LRJB203A, was out of compliance with State standards; one dissolved oxygen reading, taken during the summer of 2002, fell below the 5 mg/L instantaneous standard and one pH reading taken in the spring of 2002 exceeded the State's upper pH limit. All post-restoration in-situ water quality measurements were in compliance with COMAR standards for Use I streams. Typically, conductivity measurements above 500 µmhos are considered high for Maryland piedmont streams. Generally, the conductivity measurements at all three Joseph's Branch sites were above 500 µmhos, indicating a potential water quality issue. The summer 2009 monitoring noted dead fish with possible chlorine discharge from the upstream community pool. This potential point source water quality issue should be further investigated.

Table 3.20.2 – Pre-restoration and Post-restoration in-situ Water Chemistry Data at LRJB203A

Water Quality Parameter	2002		2005		2007		2009	
	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer
Dissolved oxygen (mg/L)	11.39	5.95	11.21	12.32	14.93	10.30	12.59	8.50
Dissolved oxygen (% saturation)	109	67	106	138	130	121	113	89
pH	9.12	7.06	7.83	7.87	8.04	7.92	7.32	7.57
Conductivity (µmhos)	133	625	880	638	648	623	703	587
Water temperature (ºF)	55.4	73.9	54.7	69.4	48.7	73.8	52.1	66.0

Table 3.20.3 – Pre-restoration and Post-restoration in-situ Water Chemistry Data at LRJB203B

Water Quality Parameter	2002		2005		2007		2009	
	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer
Dissolved oxygen (mg/L)	9.65	3.84	9.62	12.46	12.12	7.11	10.27	7.78
Dissolved oxygen (% saturation)	77	47	87	-	104	81	90	83
pH	7.67	6.97	7.71	8.18	7.98	7.58	7.16	7.45
Conductivity (µmhos)	382	464	946	636	660	616	692	580
Water temperature (ºF)	44.6	78.4	50.9	67.1	47.3	71.4	50.5	66.9

Table 3.20.4 – Pre-restoration and Post-restoration in-situ Water Chemistry Data at LRJB204

Water Quality Parameter	2002		2003	2005		2007		2008		2009	
	Spring	Summer	Summer	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer
Dissolved oxygen (mg/L)	11.27	5.13	6.3	10.62	12.85	15.13	7.49	14.43	7.91	11.1	7.56
Dissolved oxygen (% saturation)	100	59	72	99	139	134	85	136	91	106	81
pH	7.29	7.12	7.30	7.80	8.33	8.13	7.96	6.94	7.15	7.25	7.48
Conductivity (µmhos)	218	343	273	926	582	651	574	524	469	639	572
Water temperature (ºF)	50.0	74.3	71.4	53.6	66.6	50.0	71.4	54.5	71.8	54.9	67.3

Vernal Pool

In 2005, one vernal pool was constructed in the Joseph's Branch Mainstem project area at site LRJB203A in association with the stream restoration that occurred there. Prior to the construction of the vernal pool, the landscape consisted of a forested area in the Joseph's Branch floodplain. Since MCDEP's floodplain species searches had indicated various wetland obligate species in the Rock Creek watershed stream valley, including *Lithobates sylvaticusi* (wood frog), *Ambystoma maculatum* (spotted salamander), and *Pseudacris crucifer crucifer* (spring peeper), the County was confident the construction of a vernal pool would attract these various wetland-dependent species to this area.

The vernal pool was monitored post-restoration in May of 2005 and 2007, and April of 2009. The pool was approximately 56 feet long and 36 feet wide. In 2005, the pool depth was estimated at two feet and in 2007 and 2009 it was estimated at one foot. The temperature within the pond in 2009 was about 52°F at the time of monitoring. In all years the pool supported emergent, herbaceous vegetation. In 2007, submerged aquatic vegetation *Ludwigia palustris* (marsh seedbox) was also observed in the pool. In 2009, vegetation was noted on the edges of the pool, dominated by *Polygonum sp.* (smartweed), *Elymus virginicus* (Virginia wildrye), and other grasses and sedges (***Figure 3.20.34***). No herpetofauna adults or eggs were noted in either 2005 or 2007. In 2009, an abundance of *Anaxyrus. Sp.* (toad) tadpoles were observed in the pool and three *Plethodon cinereus* (Eastern red-backed salamanders) in the lead-back phase were found under logs around the perimeter of the pond. Several macroinvertebrate taxa were also seen in the pool in 2009 including, Gerridae (water striders), Hirudinea (leeches), and Gastropoda (snails). Field data sheets for vernal pool monitoring in 2009 are included in ***Appendix D***.

Figure 3.20.34 – Vernal Pool at LRJB203A in 2009, dominated by smartweed, Virginia wildrye, and unknown grass and sedge species

3.20.5 Discussion

Table 3.20.5 below provides a summary of project goals, the results of post-restoration monitoring, and whether each project goal has been met by the restoration actions as assessed by the fifth year of post-restoration monitoring. One of the project goals was successfully met, two were partially met, and two project goals could not be evaluated in 2009 and will be assessed in 2010.

Table 3.20.5 – Summary of Project Goal Results for Joseph's Branch Mainstem Stream Restoration

Goal	Result
Improve aquatic habitat conditions in the Joseph's Branch Mainstem	Partially successful – some aquatic habitat parameters improved slightly while most stayed the same or declined slightly after restoration
Improve water quality in the Joseph's Branch Mainstem	Partially successful – fish communities improved and benthic macroinvertebrate communities declined after restoration
Reduce erosive stream flows, stream erosion, and sedimentation	Unable to determine – quantitative survey data from 2010 & 2011 will suggest if these goals have been met
Create amphibian habitat	Successful – amphibian habitat has been created and two amphibian species were found in and around the pool

Partially Successful – Aquatic Habitat

Aquatic habitat scores remained similar after restoration, with some sites improving slightly and some declining slightly. All sites generally had marginal and suboptimal habitat scores for fish and benthic macroinvertebrates, moderate sediment deposition, and moderately stable banks, with slight improvements in in-stream cover for fish and bank stability at all sites after restoration. Most other aquatic habitat parameters remained similar between the pre- and post-restoration periods.

Partially Successful – Water Quality

The goal of improving water quality in the Joseph's Branch Mainstem project area has been partially met. Most parameters that evaluate water quality showed either no change after restoration occurred or a slight improvement, except the benthic macroinvertebrate community which declined slightly. Benthic macroinvertebrate communities were Poor, having the lowest possible BIBI percentages both prior to and after restoration at most sites, with some declines in the community composition after restoration. Tolerant benthic macroinvertebrate taxa were dominant at all three sites before and after restoration; sensitive taxa were present in only minor amounts prior to restoration and were absent in the post-restoration period. In addition, generalist functional feeding groups occupied a majority of the benthic macroinvertebrate community in Joseph's Branch mainstem, with the more specialized feeding groups occurring in minor amounts prior to restoration and becoming even less abundant after restoration.

There is an overall trend of improvement in the fish communities for the Joseph's Branch mainstem sites. Fish communities improved slightly at sites LRJB203B and LRJB204 with an increase in the diversity of the fish community and the number of minnow species collected at each site. However, the percentage of non-pioneer fish generally decreased from the pre-restoration period to the post-restoration period while the percentage of tolerant fish increased. This indicates that the fish community in the post-restoration period is comprised of fish that are less sensitive to urbanization, which is a considered to be a decline in the community. In-situ water chemistry readings exceeded State standards on two occasions at LRJB203A prior to restoration but were in compliance with the COMAR standards after restoration. Conductivity measurements were generally high (greater than 500 µmhos) at all sites for all years, with dead fish and possible chlorine discharge noted during the 2009 sampling. Further investigation of a point source water quality issue is recommended.

Although minor improvements were noted in association with restoration activities at Joseph's Branch, biological communities have not improved greatly. Water quality may be too impaired due possible point source pollution and the watershed's highly impervious cover to show notable biological improvements within five years after restoration. Site LRJB204, showed the most improvements, including increases in the quality of the benthic macroinvertebrate community and aquatic habitat, and greater improvements in the fish community (***Figure 3.20.35***).

Figure 3.20.35 – Site LRJB204 Showing a Restored Section of Stream Successful – Creating Amphibian Habitat

The vernal pool created in association with this project appears to have improved the riparian buffer habitat within the project area. The pool supported emergent vegetation in all monitored years. Additionally, in 2009, the pool was found to support two amphibian species, an unknown species of toad, of which hundreds of tadpole individuals were found, and three Eastern red-backed salamanders which were found in the pool's periphery. However, amphibians were only found in the last year of monitoring. It is recommended that County monitor this site one more time in the next couple of years to determine if amphibians still inhabit the created vernal pool.

3.20.6 Conclusions

Overall, the Joseph's Branch Mainstem restoration project has met or partially met some of the project goals. The restoration has created amphibian habitat, thereby improving the riparian zone of the Joseph's Branch mainstem. Fish communities have improved in the project area, as has streambank stability and in-stream habitat for fish. Although in-situ water chemistry measurements were found to be in compliance with COMAR since completion of this restoration project, there may still be a point source water quality issue as evidenced by the high conductivity measurements and observation of dead fish in 2009. It is recommended that this potential water quality issue be further investigated. The restoration has not contributed to improved macroinvertebrate communities, but perhaps those communities are limited by a lack of nearby sources of colonization, not enough time to establish after restoration, or issues with stream water quality. The watershed in which the Joseph's Branch mainstem flows is highly urbanized and may not be able to assimilate impacts from impervious surface runoff or treat all of the contaminated stormwater without implementation of watershed-wide stormwater management improvements.