ENGLESBY BROOK
STORMWATER MANAGEMENT EVALUATION

Prepared For:
Lake Champlain Basin Program
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PART 2: Individual Watershed Stormwater Management Evaluations

The findings of this project are presented in the following individual watershed evaluations. The intent of reporting results in watershed format is to facilitate the incorporation of these findings into comprehensive watershed management plans for each of the project watersheds. These evaluations are not comprehensive management plans and should not be viewed as such. The intent is for these evaluations to serve to focus planning efforts and to provide a basis for evaluating specific implementation activities that will most likely result in environmental benefits in the form of minimized pollutant loadings to the target watersheds and to Lake Champlain and restoration of impaired riparian and aquatic habitat and the biologic communities that those habitats support. Above all, it is the hope of this project that these findings will stimulate the development of comprehensive multi-jurisdictional watershed planning efforts within the project area, resulting in watershed management conducted across political boundaries with full investment by local and regional authorities.

This project has assembled and/or created a number of Geographical Information System (GIS) data layers relevant to watershed planning in the project area (see Part I). Information from these data layers is presented in a series of figures attached to each watershed evaluation. These data layers with their associated data tables, will be available to local and regional planners. It should be recognized that the pollutant projections presented here are planning estimates and caution should be exercised when interpreting these values.

This project recognizes that local governments in the project area have made tremendous commitments to protecting and preserving the natural resources associated with surface waters. Local and regional planning, zoning, and conservation commissions have established a strong record of environmental concern. In order to fully realize effective watershed management, it is critical that individual missions, goals, objectives, and policies be consolidated under the umbrella of comprehensive watershed planing and management. It is hoped that the findings of this project will assist those responsible for planning and environmental management in the project area in their efforts to restore, protect, and preserve the aquatic resources of these highly vulnerable developing watersheds.

Englesby Brook Stormwater Management Evaluation

Watershed Description

Englesby Brook is named for LB Englesby who lived adjacent to the stream on Shelburne Road and owned much of the watershed between the railroad and Shelburne Road. The watershed was converted from forest to residential lots and grazing lots in the late 18th century. The lower watershed held the agricultural exposition fields until conversion to industrial use in the early 20th century.

Englesby Brook is a highly developed watershed of approximately 600 acres in the south end of Burlington. The stream drains a watershed that has been largely developed for over 100 years. The stream rises in a series of manmade ponds near the UVM campus and out falls to Lake Champlain at Oakledge Park. Water quality impairment is severe in the stream due to stormwater runoff.

Land Use

In 1995 land use in the watershed was approximately 70% residential, 10% commercial-industrial and 20% open space. Significant changes in land use for the future are not predicted although construction of new roads and buildings will continue to fill in any undeveloped existing open space. The watershed is 20% impervious **(Table 4-1)**.

Table 4-1. Englesby Brook: Current and Projected Land Use as percent watershed area. Projected land use is indicated in terms of zoning or planning categories.

	Ag/Open	Forest	Res/Dev	Com/Ind	Urban/ Mixed	Regional Growth Center	*Impervious Surface Area*
1995	20%		70%	10%			*20%*
Projected	20%		70%	10%			

Soils

Englesby Brook experiences frequent bank-full flooding as a result of stormwater runoff. This flooding accelerates erosion of the lower stream channel which is a highly erodible Munson soil type. Channel cutting has lowered the channel up to 10 feet in several places. Erodible Vergennes Clay also exists in the headwaters on the expanding UVM Redstone-Gutterson campus. Several wet pond sites exist on the Burlington Golf Course which could provide excellent sources of groundwater recharge for the stream. Soils suitable for infiltration practices are rare but do exist along Crescent St in the hill section. Soils suitable for a wet pond exist near the targeted Shelburne Road storm sewers, the soil types are Scantic B and Belgrade B, and the site is on public land. Instream wetponds below Shelburne Road as proposed (Havens and Emerson, 1990) may not adequately retain water without a constructed liner due to the loamy soil type **(Figures 4.3-5)**.

Riparian Corridor and Biological Evaluation

The riparian corridor of Englesby Brook varies in width from 10-100 meters. Habitat has been almost completely lost where the stream has been piped under the Burlington Golf Course fairways and from Pine Street to the lake where the dissected banks have been reclaimed with commercial fill. Between Pine Street and S. Prospect Street the corridor remains intact **(Figure 4.6)**. Stormwater discharges below

Shelburne Road however have severely limited biological life in this reach. Sedimentation in the brook is extremely severe. Stormwater flows fluctuate between 0-50 cfs (Cassell, 1994) and have caused large sediment "plugs" to move downstream. Because of the scouring, little silt appears to accumulate throughout most of the channel. However, immediately below the UVM Redstone Campus stormwater ponds, where Covington Clays have been exposed by construction, silt constituted 70% of the channel sediment fraction. A significant decrease in macroinvertebrate density and richness occurs below the Shelburne Road-Outlet Mall storm drains. No fish populations have existed in the stream in the last 4 years although transient fish from Lake Champlain inhabit the mouth. The stream does not currently meet the Class B water quality standard for biological integrity **(Figure 4.7)**.

Watershed Management Goals

The following are watershed management goals suggested by the findings of this evaluation:

1. Minimize the discharge of bacterial pollutants from stormwater conveyances for the protection of swimming water quality at public beaches (Blanchard-Oak Ledge) located near the mouth of Englesby Brook; minimize the discharge of toxic contaminants identified as Contaminants of Concern to Lake Champlain by the Lake Champlain Basin Program "Opportunities for Action".

2. Ensure the maintenance and protection of any existing high quality biological communities and habitats.

3. Restore, to the degree possible, impaired aquatic and riparian habitat such that biological integrity consistent with Class B water quality standards is attained.

4. Ensure that watershed residents are aware of watershed management issues and are well educated in the principles of stream and watershed protection.

Existing Zoning

No existing zoning protects the stream from encroachment by development. A flood plain conservation buffer does not exist for Englesby Brook. The city of Burlington owns a small amount of land traversed by the stream of which part has been designated a conservation buffer by the Department of Parks and Recreation.

Protection of water quality from stormwater degradation has caused the Burlington Conservation Board to adopt a storm water policy (City of Burlington,1995) as a general policy citywide.

The Burlington Department of Public Works, VTDEC, UVM School of Natural Resources, U.S. Natural Resources Conservation Service, and the Lake Champlain Committee have formed a watershed restoration work group for Englesby Brook. USEPA, Region 1 has supported an Englesby Brook Watershed Restoration Project with financial and technical assistance (Morehouse, personal communication). A proposal to carry out a highly detailed analysis and plan for storm water runoff management has been submitted to the EPA for funding (Meals, 1996).

Education Strategy

An education strategy for urban nonpoint source pollution should include the following actions: 1) informational mailings and public service announcements to watershed residents on clean stream habits, 2) public involvement in cleanup, erosion and habitat restoration projects, 3) storm drain stenciling, 4) school natural history programs and, 5) citizen monitoring (Drinkwin, 1995; Lake Champlain Committee, 1992). Englesby Brook currently has a USEPA funded educational strategy in place.

Implementation Strategy

Englesby Brook has 3 targeted storm sewers and one targeted storm water discharge permit **(Table 4-2, Figures 4.9-4.12)**.

A regional wetpond facility is the recommended BMP to handle polluted runoff from the Proctor St-Hadley St and Shelburne Rd-Outlet Mall storm sewers. The best location for this facility is on the Champlain Elementary School property (map 2; Part 1) or at the Champlain Parkway site. The Richardson Terrace outfall will have a storm water compost filter constructed in 1997. However, only a portion of the total runoff will be treated; further treatment could be provided by the above wetpond regional facility. Total annual sediment and phosphorus reduction to the brook resulting from implementation at these sites is estimated to be 20,985 kg/yr and 25 kg/yr respectively.

Modification to the permitted UVM Redstone Campus storm water ponds to handle 1-2 year design storms could reduce annual TSS and TP loading by 3686 kg and 5 kg respectively. TSS and TP reductions for all implemented BMP's is estimated to be 60% and 46% respectively. Total Fecal Coliform load reduction is estimated to be about 50% of existing annual load. Capital costs are estimated to range from $16,514-$330,277 (an estimate in 1990 for a storm water disinfection pond system was approximately $396,000 (Havens and Emerson, 1990)). Modifications to the UVM ponds would cost significantly less than projected here. Implementation recommendations, estimated treatment efficiencies and loading reductions, and estimated capital and annualized capital costs are summarized in **Table 4-3.** Annualized capital costs for phosphorus and suspended solids loading reductions at individual sites range from $17 - $1,395 per kg/yr for phosphorus and $0.02 - $1.62 per kg/yr for suspended solids.

Future construction of the Champlain Parkway over Englesby Brook could provide an opportunity for a regional storm water pond or wetland at the road crossing. Storm water wetpond/wetland treatment at this site would provide a final treatment site before outfall to the beach and construction here would also provide an opportunity to remove all the landfill industrial debris accumulated over the last 100 years.

Additional pollutant reductions could be accomplished through one or more of the following:

- 1) enhanced base flow by expansion or creation of new ponds at the Burlington Country Club, the club is interested in improving water quality in Englesby Brook,

- 2) increased street sweeping in targeted storm sewersheds,

- 3) enhanced citizen education on and enforcement of illegal dumping and animal waste "pooper scooper" ordinances in the watershed and,

- 4) establishment of a storm water overlay district requiring all new storm water discharges to meet strict pollutant criteria (Cohen, personal communication).

Recommendations: The following recommendations are made as technical suggestions that, if implemented, have a high likelihood of positively influencing water quality goals for the watershed. They are not intended to replace the development of a fully comprehensive watershed management plan.

- A comprehensive watershed management plan should be developed for the Englesby Brook watershed. It is recommended that such a plan include strict pollutant criteria that all new stormwater discharges will be required to meet.

- Biological communities appear to be limited both by extremes in hydrologic regime and by sedimentation. Efforts to reduce sediment discharge, minimize peak flows, and restore base flow should result in improvements to the aquatic habitat and biological communities. Therefore:

    - Modification of the UVM Redstone Campus stormwater ponds to handle 1-3 year design storms would reduce suspended solids and bacterial loading and reduce the frequency of high discharges. Implementation of these modifications should be pursued.

    - Funding should be secured for the expansion of existing or creation of new ponds at the Burlington Country Club. Resulting enhancement of base flows will be critical to the restoration of biological integrity in Englesby Brook.

    - Feasibility studies for a regional wetpond BMP facility to handle flows from the Proctor-Hadley Street and Shelburne Road-Outlet Mall storm sewers should be conducted.

- Investigations into the sources of toxic contaminants in the storm sewer system, primarily silver, should be continued.

- Efforts to develop the Englesby Brook watershed as a stormwater management model should be encouraged.

Englesby Brook Resources

Preliminary Design of Stormwater Disinfection Facilities For Recreational Beaches, City of Burlington. 1990. Havens and Emerson, Boston, MA.

The Estimation of Annual Loadings in the Urban Runoff For the Englesby Watershed in Burlington, VT. 1992. T. Schwindt, Senior Thesis, Environmental Program, University of Vermont, Burlington, VT.

Unpublished data. 1993. Eric Clapp, School of Natural Resources, University of Vermont, Burlington, VT.

Assessment of Urban Runoff: A Tool for Managers and Planners. 1994. E. Allen Cassell, Vermont Water Resources and Lake Studies Center. University of Vermont, Burlington, VT.

Planning For Urban Stream Restoration: The Englesby Brook Watershed Restoration Plan. 1996. Donald Meals, School of Natural Resources, University of Vermont, Burlington, VT.

Englesby Brook Watershed Restoration Project, Final Report, Part A. 1996. Stephen Roy, Department of Public Works, City of Burlington, Burlington, VT.

Englesby Brook Watershed Restoration Project, Final Report, Part B. 1997. Stephen Roy, Department of Public Works, City of Burlington, Burlington, VT.

Table 4-2. Significant Stormwater Discharges in the Englesby Brook Watershed: Discharges are targeted based on estimated exceedance of annual loading thresholds for: suspended solids (4,536 kg/year); total phosphorus (6.8 kg/year); total metals (5.4 kg/year); total PAH'S (36 kg/year); fecal coliform (500,000 colonies/yr). Existing treatment structures are indicated. *Italics indicate stormwater discharges with VTDEC stormwater discharge permits.* EIA% is the percent surface area as Effective Impervious Surface Area. Loadings are calculated from the means of ranges in export coefficients taken from the literature. See Part 1 of this report for loading calculation methods.

Recwater	**Storm sewershed**	**Treatment (Appendix 4)**	**EIA%**	**Loading kg/yr**
	• Highest Total Suspended Solids **(Figure 4.10)**			
Englesby	Shelburne Rd.-Outlet Mall	CB	60.8	19,774
Englesby	Richardson Terrace	CB/CF	12.5	7,754
Englesby	Proctor St-Hadley St	CB	11.1	7,448
Englesby	*Redstone Campus*	*DP/CB*	35.4	6,144
	Highest Total Phosphorus **(Figure 4.11)**			
Englesby	Shelburne Rd.-Outlet Mall			31
Englesby	Richardson Terrace			12
Englesby	Proctor St-Hadley St			12
Englesby	*Redstone Campus*			10
	Highest Total PAH **(Figure 4.12)** (Commercial Landuses Only)			
Englesby	Shelburne Rd.-Outlet Mall			212
Englesby	*Redstone Campus*			66
	Highest Total Metals **(Figure 4.13)**			
Englesby	Shelburne Rd.-Outlet Mall			24
Englesby	Richardson Terrace			9
Englesby	Proctor St-Hadley St			9
Englesby	*Redstone Campus*			7
	Highest Total Fecal Coliform (Colonies/year)			
Englesby	Shelburne Rd.-Outlet Mall			3.1×10^6
Englesby	Richardson Terrace			1.2×10^6
Englesby	Proctor St-Hadley St			1.1×10^6
Englesby	*Redstone Campus*			9.8×10^5

Table 4-3. Englesby Brook Watershed: Stormwater BMP implementation treatment and capital costs estimates for targeted sewersheds. All estimates are based on a mean of a range of export coefficients for TP and TSS.

Rec. Wat.	Sewershed	BMP	TP Pre BMP kgs/year	TP Post BMP kgs/year	TP Reduction kgs/year	TSS Pre-BMP kgs/year	TSS Post-BMP kgs/year	TSS Reduction kgs/year	Capitol Cost-Low dollars	Capitol Cost-High dollars
Englesby	Proctor-Hadley St	Wetpond	12	6	6	7448	2979	4469	$5,567	$111,346
Englesby	Richardson Terr.	Wetpond	12	7	5	7754	3102	4652	$5,363	$107,256
Englesby	Shel Rd Outlet Mall	Wetpond	31	17	14	19774	7910	11864	$3,716	$74,315
Englesby	Redstone	Wetpond	10	5	5	6144	2458	3686	$1,868	$37,360
		TOTALS	**65**	**35**	**30**	**41120**	**16449**	**24671**	**$16,514**	**$330,277**

	Capital Cost/kg				***Annualized Capital Costs***					
Sewershed	**TP Cost Low Dollars/kg**	**TP Cost High Dollars/kg**	**TSS Cost Low Dollars/kg**	**TSS Cost High Dollars/kg**	**Annual TP Costs $/kg 30 yrs @ 5% Low**	**High**	**Annual TSS costs $/kg 30 yrs @ 5% Low**	**High**	**Total Annualized Costs 30 Years @ 5% Low**	**High**
Proctor-Hadley St	$928	$18,558	$1.25	$25	$60	$1,207	$0.08	$1.62	$362	$7,243
Richardson Terr.	$1,073	$21,451	$1.15	$23	$70	$1,395	$0.07	$1.50	$349	$6,977
Shel Rd Outlet Mall	$265	$5,308	$0.31	$6	$17	$345	$0.02	$0.41	$242	$4,834
Redstone	$374	$7,472	$0.51	$10	$24	$486	$0.03	$0.66	$122	$2,430
AVERAGE	**$550**	**$11,009**	**$0.67**	**$13**	**$36**	**$716**	**$0.04**	**$0.87**	**$1,074**	**$21,485**

Englesby Brook

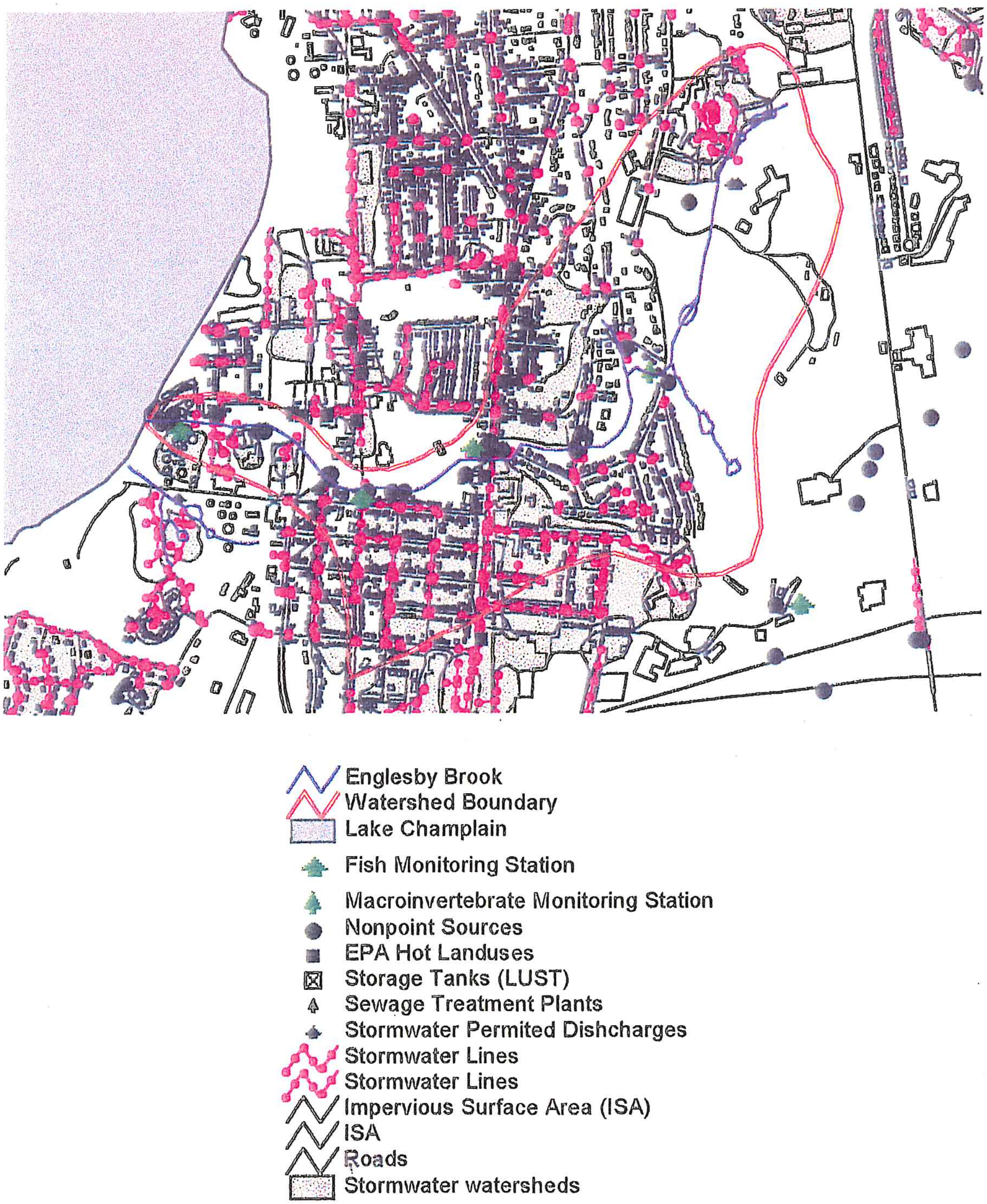


Figure 4.1: Englesby Brook watershed showing: roads, surface waters, impervious surface areas, permitted wastewater and stormwater discharges, stormwater lines, nonpoint sources such as eroding stream banks, EPA hot land uses (gasoline service areas), underground storage tanks, and biological monitoring sites.

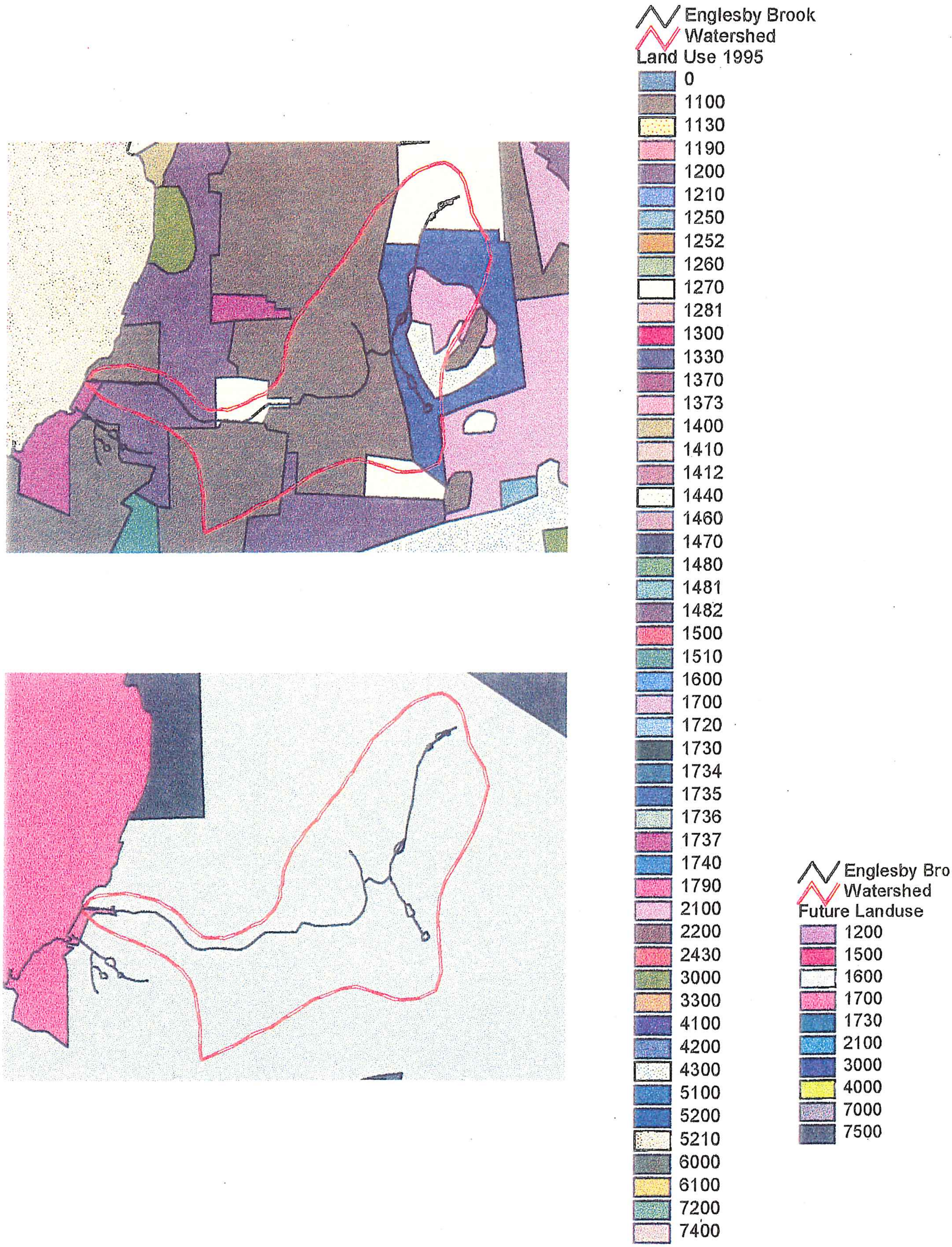


Figure 4.2: Englesby Brook watershed 1995 actual land use; and future land use as defined by zoning designation.

Figure 4.3: Englesby Brook generalized soils map.

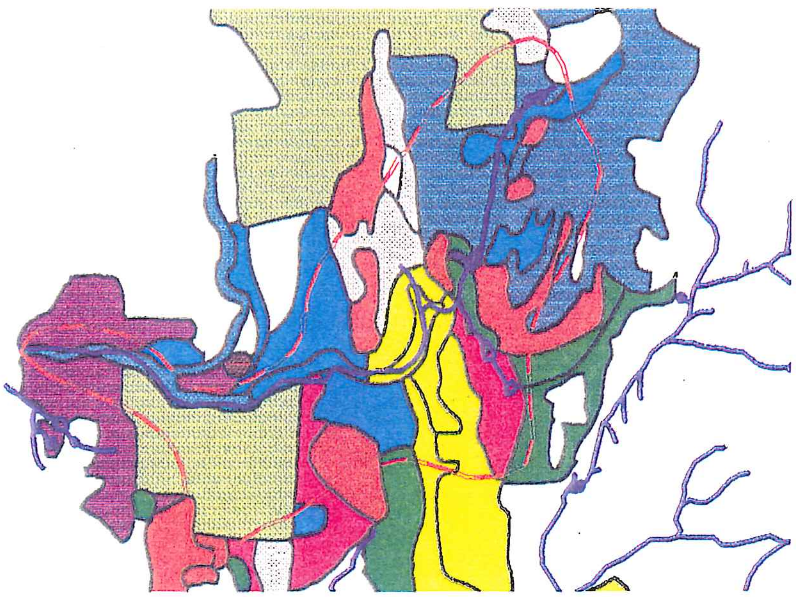


Figure 4.4: Englesby Brook watershed - areas of highly erodible soils. These soils are easily displaced.

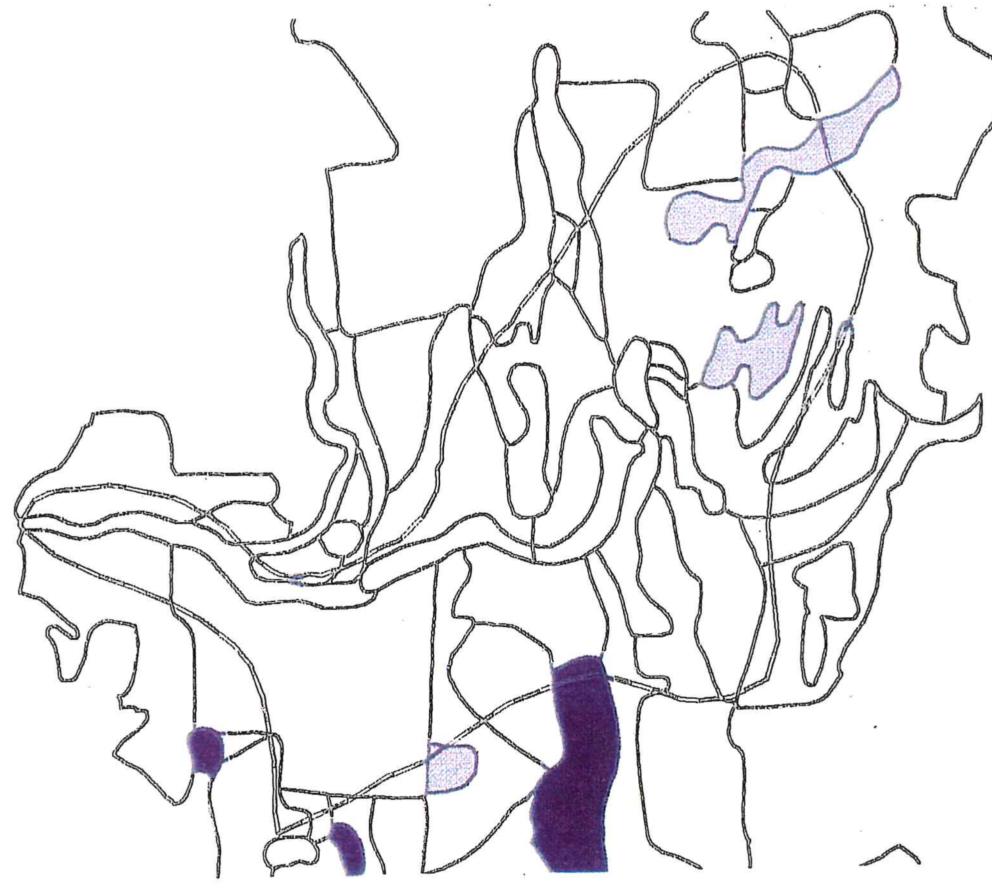


Figure 4.5: Englesby Brook watershed - wetpond/wetland soils.

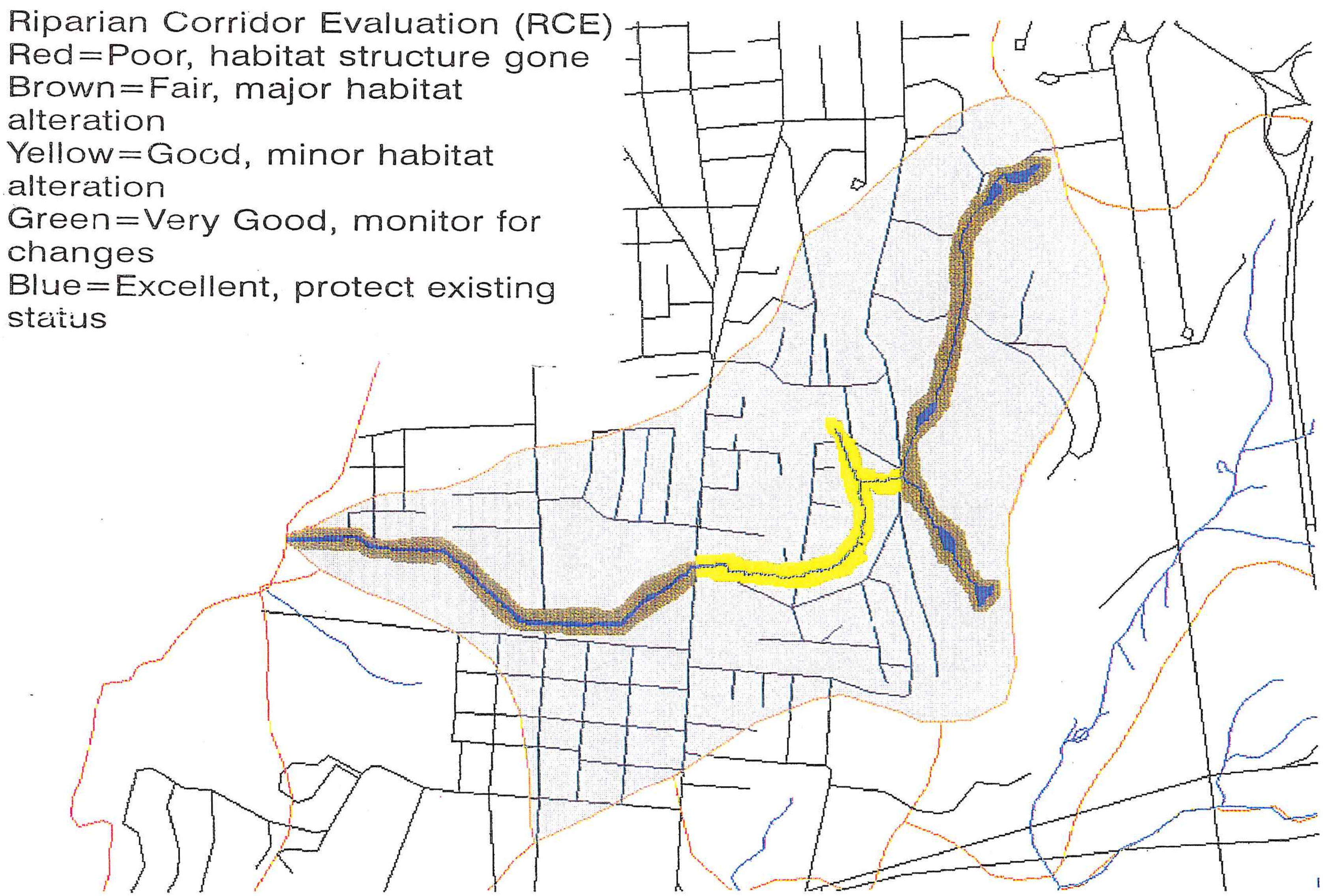
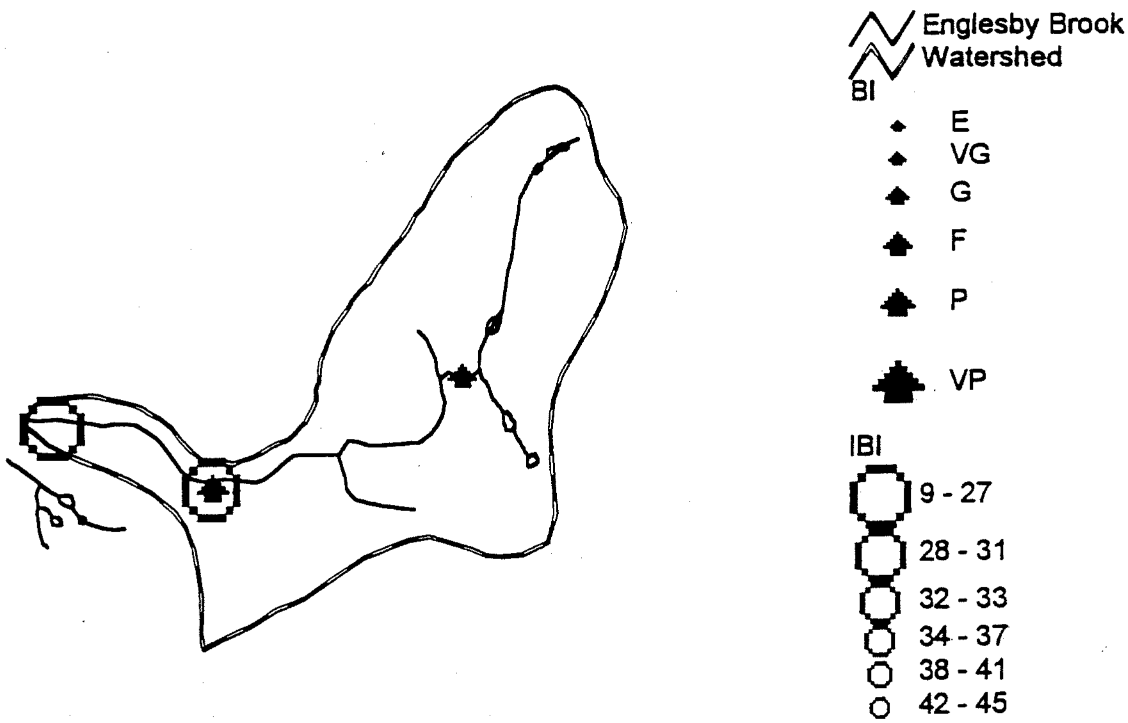
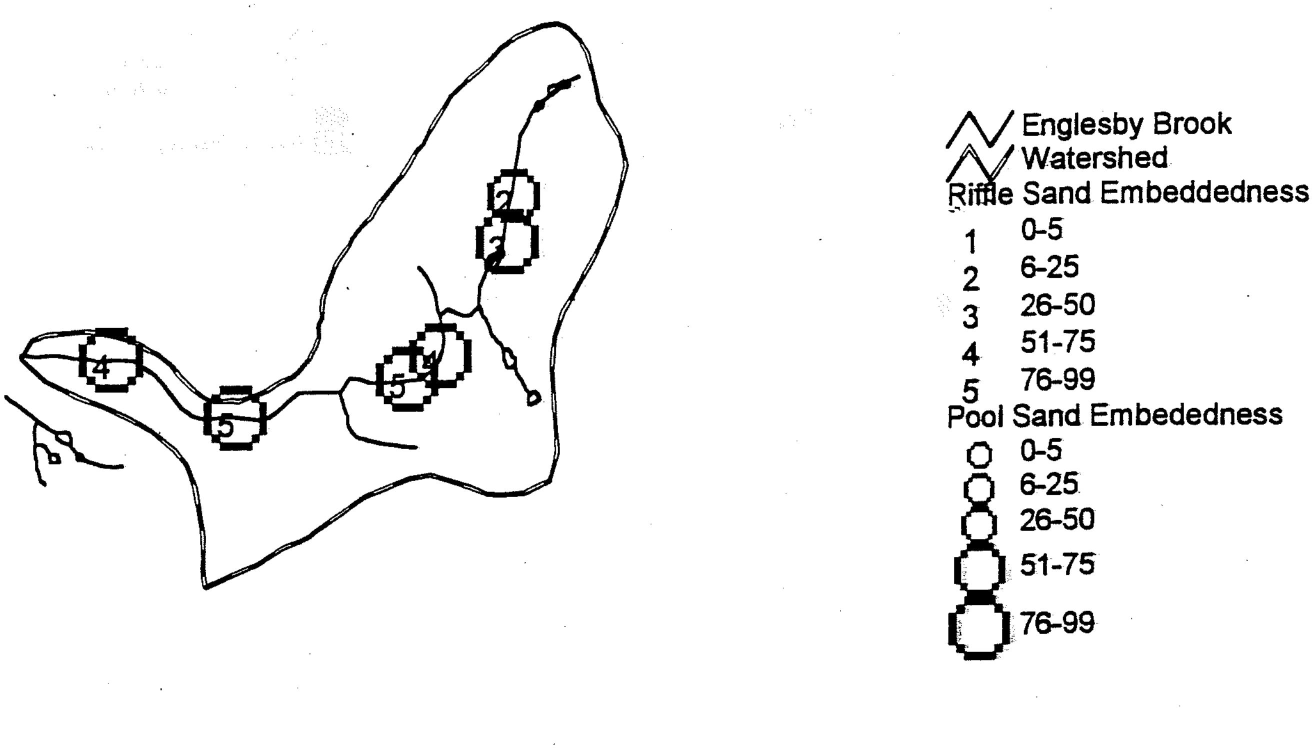


Figure 4.6: Englesby Brook Riparian Corridor Evaluation. Evaluation was conducted using the Riparian Corridor Evaluation methodology (Petersen, 1992). A series of measurements and observations are recording while walking the stream channel.

Figure 4.7: Englesby Brook watershed - biological condition. Fish and macroinvertebrate community measures of integrity. A macroinvertebrate biotic index (BI) rating of less than good is indicative of sub-Class B condition. A fish Index of Biotic Integrity (IBI) rating of less than 31 is indicative of sub-Class B condition.





Watershed measure of pool and riffle sedimentation. A high degree of sand embeddedness indicates excessive erosion and impairs aquatic habitat and the biological communities that are supported by that habitat.

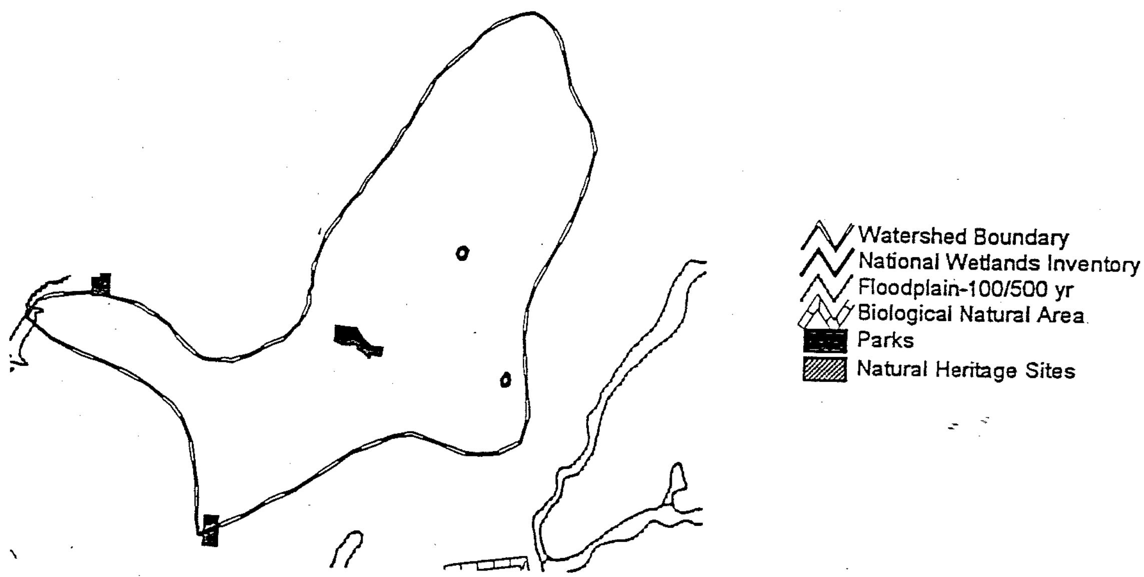


Figure 4.8: Englesby Brook watershed - mapped wetlands, 100 yr. floodplain, biological natural areas, parks, and Natural Heritage sites.

Figure 4.9: Targeted Stormwater Sewersheds in Englesby Brook Watershed - Sewersheds were targeted based on exceedences of loading thresholds as described in Table 2.1. BMP recommendations are made for each targeted sewershed. Four sewersheds in the Englesby Brook watershed have been targeted.

Figure 4.10: Estimated total suspended solids loading from sewersheds in the Englesby Brook watershed.

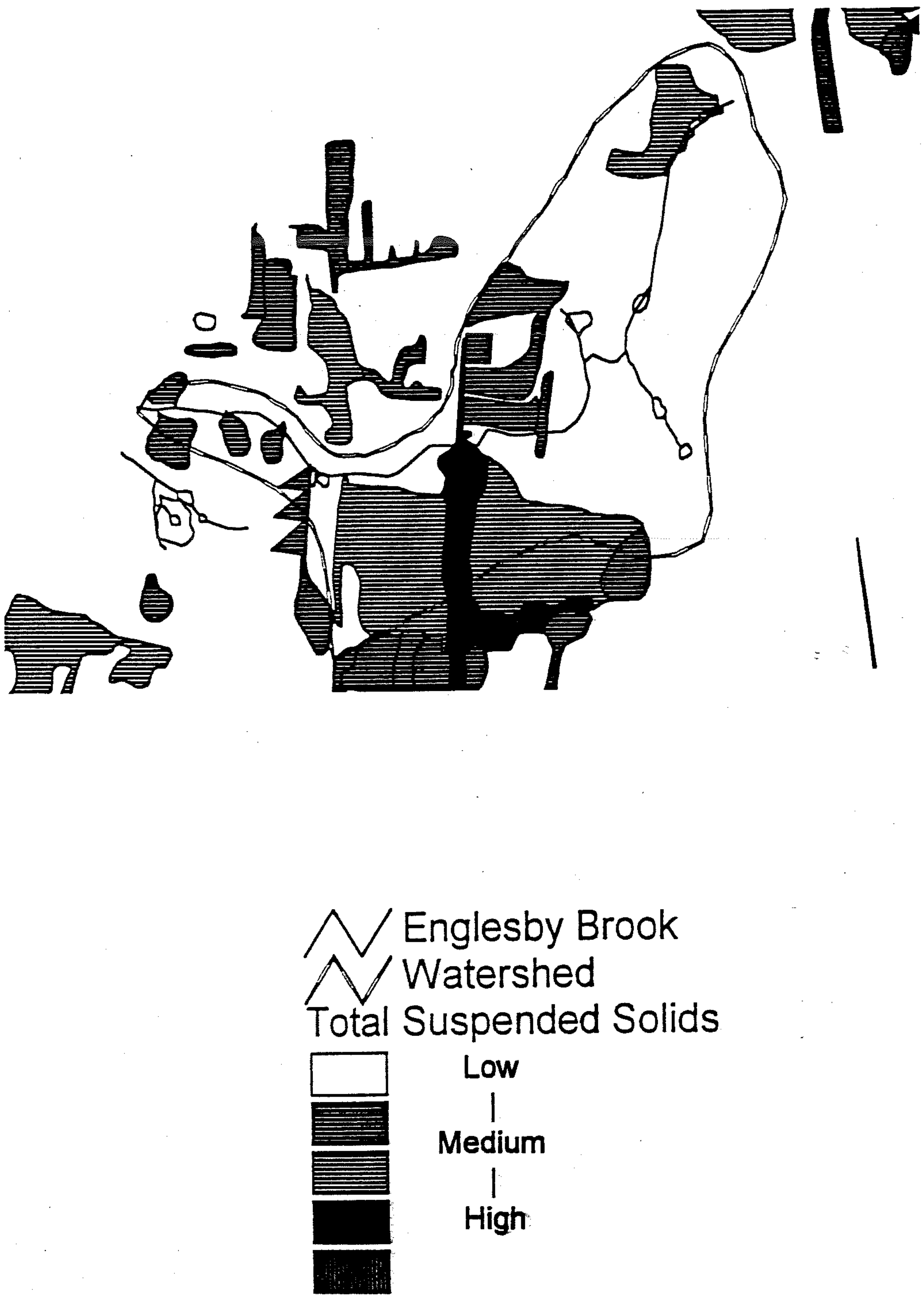


Figure 4.11: Estimated total phosphorus loading from sewersheds in the Englesby Brook watershed.

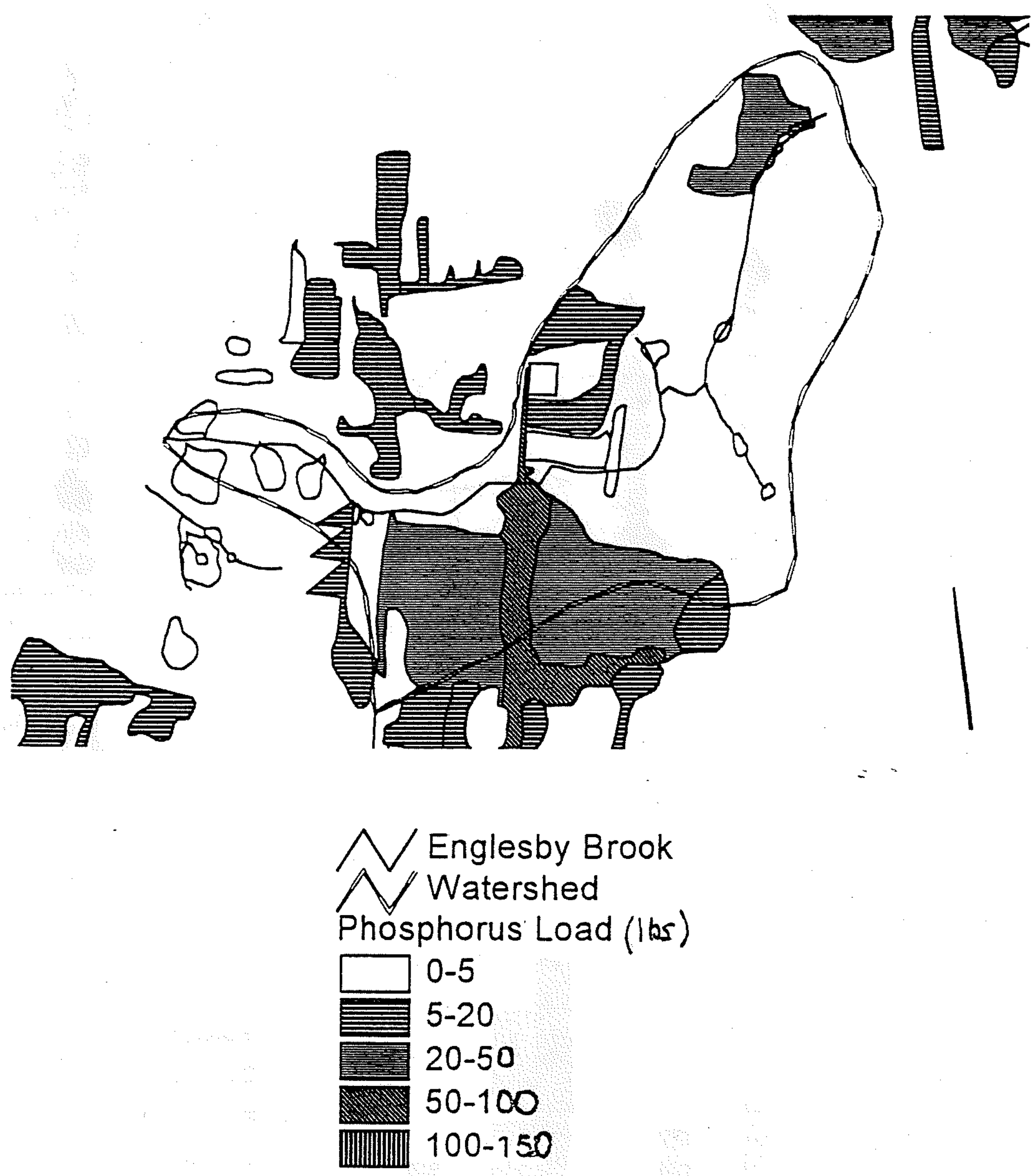
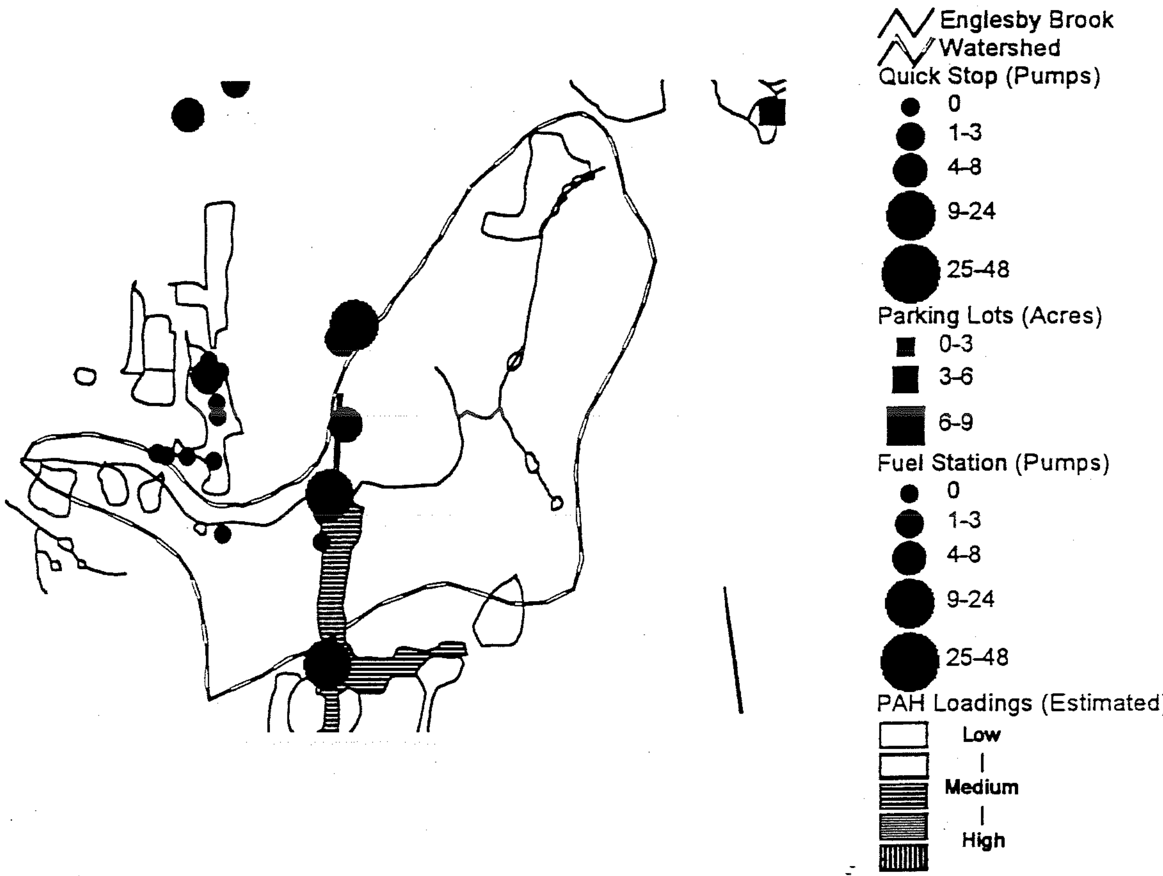
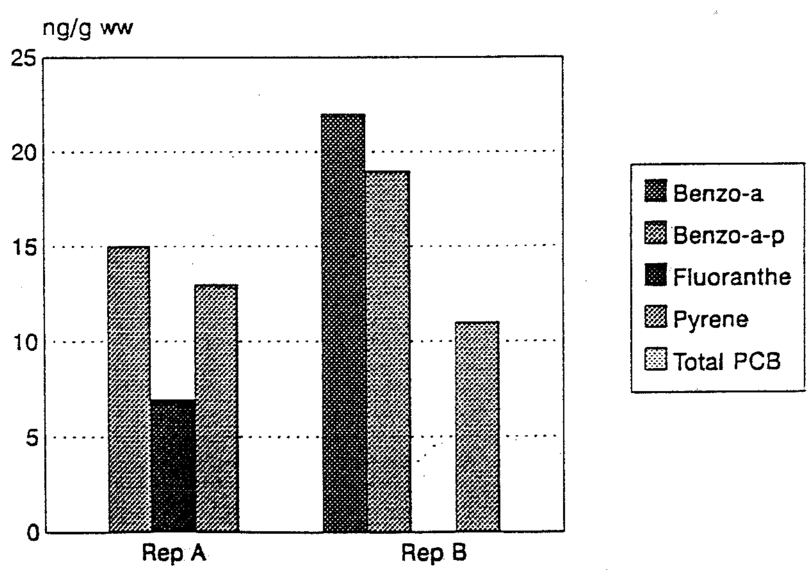


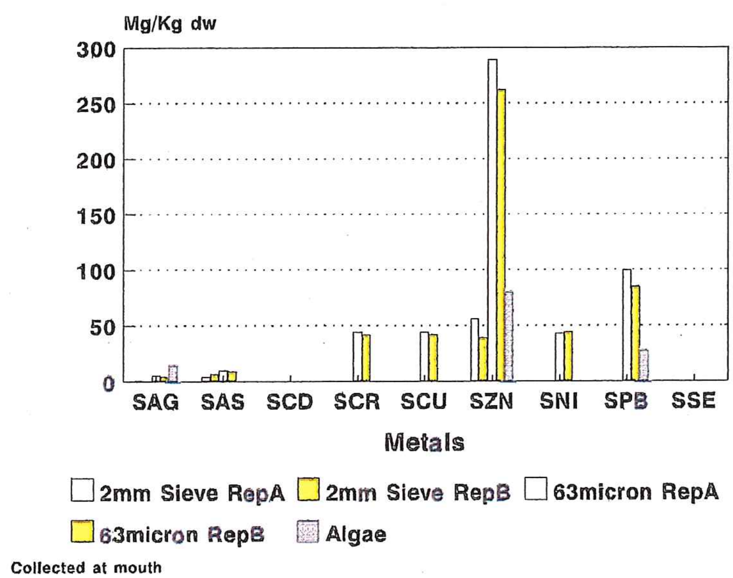
Figure 4.12: Estimated total PAH loading from sewersheds in the Englesby Brook watershed. Graph at bottom shows concentrations of PAHs in sediments at the mouth of the Englesby watershed. Samples collected in 1995. Potential sources of PAHs are identified as EPA hot spots - parking lots and gasoline service areas.





(Detected in Mussels)

Figure 4.13: Estimated total metals loading from sewersheds in the Englesby Brook watershed. Graph at bottom shows concentrations of metals in whole (2mm) and fine fraction (63u) sediments at the mouth of the Englesby watershed. Samples collected in 1995.



Soils

AdA
AdA
AdA - AdB
AdB - AdD
AdD - AdE
AdE - Au
Au - BlA
BlA - Br
Br - Cv
Cv - DdA
DdA - EwA
EwA - FaC
FaC - FaE
FaE - FsB
FsB - Fu
Fu - HlB
HlB - HlE
HlE - HnB
HnB - Le
Le - Lf
Lf - MuD
MuD - MyB
MyB - MyC
MyC - Rk
Rk - ScB
ScB - TeE
TeE - W
W - Wo

Land Use 1995

- 0
- 1100-Residential
- 1130-Residential-Single Family
- 1190-Residential-Other
- 1200-Commercial
- 1230-Commercial Services
- 1250-Government
- 1252-Military
- 1260-Institutional
- 1270-Educational
- 1281-Museum
- 1300-Industrial
- 1330-Industrial-Stone
- 1370-Industrial-Mining
- 1373-Sand/Gravel
- 1400-Transportation
- 1410-Transportation-Air
- 1412-Transportation-Air
- 1440-Transportaiton-Road
- 1460-Utilities
- 1470-Utilities
- 1480-Utilities
- 1481-Utilities
- 1482-Utilities
- 1500-Industrial
- 1510-Industrial Park
- 1600-Mixed Use
- 1700-Outdoor Built
- 1720-Outdoor Built
- 1730-Outdoor Recreation
- 1734-Ski Area
- 1735-Golf Course
- 1736-Campground
- 1737-Parks
- 1740-Cemetaries
- 1790-Other outdoor built
- 2100-Cropland
- 2200-Orchards
- 2430-Other Agriculture
- 3000-Brush
- 3300-Mixed Brush-grass
- 4100-Broadleaf Forest
- 4200-Coniferous Forest
- 4300-Mixed Forest
- 5100-Rivers
- 5200-Lakes/Ponds
- 5210-Lakes/Ponds
- 6000-Wetlands
- 6100-Forested Wetland
- 7200-Beaches/River banks
- 7400-Exposed Rock

Future Landuse

- 1200-Commercial
- 1500-Industrial
- 1600-Mixed Use
- 1700-Outdoor Built
- 1730-Outdoor Recreation
- 2100-Cropland
- 3000-Brush
- 4000-Forest
- 7000-Growth Center
- 7500-Subregional Growth Center