SUNDERLAND 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.

Sunderland Brook Stormwater Management Evaluation

Watershed Description

Sunderland Brook was probably named for a hunter, Peleg Sunderland, who got lost in the lower Winooski River valley while hunting for beaver. Because of its extensive wetlands and dissected "hollow" topography it appears to have been largely ignored by early commercial development. The watershed was converted from forest to agriculture in the 19th century but the central section has reverted to forest since establishment of a military reserve there. The lower section which bisects the Winooski intervale has been relocated from its original outlet at McCrea Farm and used for agriculture since the mid 18th century.

Sunderland Brook watershed is a moderately sized watershed (14 km2) located in Colchester, Essex and Essex Junction (**Figure 8.1**). The central section of the watershed is protected from development as part of the Camp Johnson military reservation. The brook traverses a unique system of wetlands, beaver ponds and sand plain habitat. The brook rises in the Champlain Valley Fairgrounds and flows west to the Winooski River about 8 miles from Lake Champlain. The watershed contains a significant amount of the last remaining Pine-Oak-Heath Sand Plain Forest. At least eleven rare or uncommon plant species reside in the forest.

Land Use

In 1995 the land use composition of the watershed was 45% residential-commercial, 15% agricultural, 20% mixed forest and 20% protected open space (military). The regional planning commission forecasts land use to change to 70% subregional growth center, 10% urban mixed use and 20% agriculture. The watershed is approximately 11% impervious (**Table 8-1, Figure 8.2**).

Table 8-1. Sunderland Brook: Current and Projected Land Use as percent watershed area. Projected land use is indicated in terms of zoning or planning categories.

	Open Protected	Ag	Res/Dev	Forest	Urban/ Mixed	Regional Growth Center	*Impervious Surface Area*
1995	20%	15%	45%	20%			*11%*
Projected		20%			10%	70%	

Soils

Soils sensitive to stormwater erosion (Hartland, Covington and Vergennes) are common in the central watershed stream channel and in the Rte. 7 Corridor. Soils suitable for wetland/wetpond stormwater treatment facilities are rare. Soils (Adams) suitable for infiltration are extremely abundant in this watershed. Protection of the unique aquatic ecosystem and the highly erodible channel soils and clays could be maintained by requiring stormwater infiltration best management practices in this watershed (**Figures 8.3-5**).

Riparian Corridor and Biological Evaluation

The riparian habitat of Sunderland Brook is in overall good health with a few exceptions. The headwater area from the Fairgrounds west to Suzie Wilson Rd. has been largely filled in or intensively developed. The southern tributary receives a large amount of runoff although degradation has not yet become severe. The first 2.5 miles of the brook are impacted by agriculture including habitat loss, water withdrawal and nutrient enrichment (**Figure 8.6**).

Sunderland Brook is a natural sand plain stream and therefore has high levels of sand in the stream channel sediments (>85%). The stream has very little riffle habitat being largely a wetland and linked series

of beaver ponds. Silt levels average less than 5% of the total sediment channel fraction. Sedimentation levels are high however between milepost 0-2.5. Channelization has reduced the amount of riparian habitat suitable for macroinvertebrates and fish in this reach. The south tributary fish population also reflects a loss of riparian habitat. Sedimentation in this tributary is high, silt levels average 6x higher than in the main brook **(Figure 8.7)**.

Watershed Management Goals

To maintain existing Class B water quality standard. To promote fishing and general recreational use and to protect the wild and scenic character of the stream. This stream harbors numerous natural heritage sites and provides a refuge for locally rare wildlife such as deer and moose. Watershed management should emphasize stream buffer protection and land acquisition.

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

1. Have in place the appropriate watershed planning and management infrastructure for the Sunderland Brook watershed such that comprehensive watershed management issues become an integral part of local planning processes. Watershed management should emphasize stream buffer protection, land acquisition, and watershed restoration.

2. Ensure the maintenance and protection of any existing high quality biological communities and habitats, including all existing wetlands, natural areas, and natural heritage sites through appropriate planning.

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

4. Establish consistent inter-jurisdictional (Essex, Essex Junction, Colchester) stormwater management and stream protection policies throughout the Sunderland Brook watershed.

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

7. Minimize the discharge of pollutants from stormwater discharges in the Sunderland Brook watershed.

Existing Zoning

The headwaters of Sunderland Brook in Essex are protected by a conservation flood plain buffer including a 25' or 5x stream width (whichever is greater) buffer where no flood plain exists. The majority of the brook is located in Colchester and has only a flood plain buffer zone. In Colchester the lower 1.25 miles of the mainstem of the brook are in a conservation flood plain-wetland buffer zone, no buffer zone exists for the upper reach or the tributaries. The watershed has been zoned for residential, commercial and industrial land uses. A 50' setback is required near all stream banks with a slope exceeding 45 degrees.

The stream bisects one of the last contiguous pieces of Sandplain Forest habitat left in the state. The Nature Conservancy and the Colchester Parks Department have taken steps to protect a small part of this habitat fragment where several rare or endangered plant species survive.

Additional watershed features, including wetlands, 100 yr flood plain, Natural Heritage sites, natural biological areas and public lands, are mapped on **Figure 8.8**. **Figure 8.9** shows mapped impervious surface, **Figure 8.10** shows sewershed outlines, and **Figure 8.11** shows nonpoint sources such as eroding banks, identified during watershed surveys.

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).

Implementation Strategy

There are 4 targeted storm sewers and no targeted storm water permits in this watershed **(Table 8-2, Figure 8.12-8.15)**. A wetpond BMP is recommended below the Meadows Industrial Park (map 12; Part 1); this area is a subregional growth center for Colchester. At the Ames, Pearl Street-East and Fort Ethan Allen 6 storm sewers (maps 9,10; Part 1) infiltration BMP's are recommended. Essex Shopping Center although having a high pollutant load is believed to discharge to dry wells and not to Sunderland Brook. Further investigations may reveal that this sewer is connected to the Pearl St-East storm sewer. Overall TSS reduction would be 26,509 kg/yr or 25% of the existing load from these targeted sewersheds. TP reduction would be 34 kg/yr or 57% of the existing load from these sewersheds. Estimated capital cost for full implementation of this strategy ranges from $10,144-$85,290.

Implementation recommendations, estimated treatment efficiencies and loading reductions, and estimated capital and annualized capital costs are summarized in **Table 8-3.** Estimated annualized capital costs for phosphorus and suspended solids loading reductions at individual sites range from $18 - $567 per kg/yr for phosphorus and $0.02 - $0.59 per kg/yr for suspended solids.

Recommendations: The following recommendations, deriving from the findings of this evaluation, 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.

1. The most significant recommendation that can be made here is for the establishment of a watershed planning process that will be able to incorporate the findings of this evaluation into a comprehensive watershed management plan. Such a plan would institutionalize stormwater and watershed management policies across political boundaries. Such a plan would also necessarily address the implementations issues such as prioritization and financing (Schueler, 1996).

2. Planning efforts should emphasize the protection of the existing natural areas in the watershed.

3. Restoration of Impaired Habitat - The most highly impacted areas in the watershed occur in the vicinity of the headwater areas from the Fairgrounds to Suzie Wilson Road, and the southern tributary. Both of these areas have the highest density of stormwater discharges and identified nonpoint sources of sediment in the watershed. Riparian and aquatic habitat in these areas are impaired. It is likely that measures to reduce the release of sediments and suspended solids to these portions of the watershed through riparian habitat restoration and BMP implementation at targeted sewersheds will result in improved habitat and biological integrity. Therefore:

- Additional feasibility studies for BMP implementation recommendations for targeted sewersheds **(Table 8-3)**, prioritized by estimated Total Suspended Solids loading **(Table 8-2)**, should be initiated (see implementation strategy).

- Efforts to reduce discharges from significant sources of nonpoint sediment, such as eroding or unstable banks identified by this **(Figure 8.11)** or other evaluations, should be pursued. Opportunities to implement stream and riparian habitat restoration and improvement activities should be fully explored. Programs such as the Youth Conservation Corps and the USFWS Partnership program are likely resources for implementing watershed restoration activities. Cooperative efforts between

landowners and various State, private, and Federal Agencies should be encouraged and coordinated.

4. Coordination - Resources should be allocated to provide for coordination of activities, including the acquisition of implementation resources, related to urban watershed management. VTDEC and USEPA are currently funding a limited service position to provide this function. If multi-jurisdictional urban watershed management is to be effective in the future, this function must be maintained, ideally through institutionalized regional planning.

5. Watershed Monitoring - Continued monitoring of watershed condition should be conducted. BMP implementation effectiveness should be monitored. While VTDEC plans to maintain a minimal level of biological monitoring at many of the sites previously monitored, its resources are limited. Monitoring issues should be developed through the watershed planning process that should evolve at the regional or local level (Brown, 1996).

6. Education - A watershed management educational strategy should be developed and implemented for the Sunderland Brook watershed. Generalized materials related to watershed protection are available from various private and governmental organizations (Lake Champlain Committee, 1992; Drinkwin, 1995).

Sunderland Brook Resources

Restoration of Pine-Oak-Heath Sandplain Forest at Camp Johnson, Colchester, Vermont. 1993. Brett Engstrom, Nongame and Natural Heritage Program, Agency of Natural Resources, State of Vermont.

Table 8-2. **Significant Stormwater Discharges in the Sunderland 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 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 8.13)			
Sunderland	Fort Ethan Allen 6	CB	92.0	17958
Sunderland	Pearl St-East	CB	86.0	7834
Sunderland	Essex Shopping Center	DW/CB	77.3	6923
Sunderland	Ames	CB	92.4	6596
Sunderland	Meadows Industrial Park 1	CB/DP/GS	40.1	6395
Sunderland	Fort Ethan Allen 5	CB	41.3	4591
Sunderland	Fort Ethan Allen 1	CB	65.8	4589
	Highest Total Phosphorus (Figure 8.14)			
Sunderland	Fort Ethan Allen 6			28
Sunderland	Pearl St-East			12
Sunderland	Essex Shopping Center			11
Sunderland	Ames			10
Sunderland	Meadows Industrial Park 1			10
Sunderland	Fort Ethan Allen 5			7
Sunderland	Fort Ethan Allen 1			7
	Highest Total PAH (Commercial Landuses Only)			
Sunderland	Fort Ethan Allen 6			192
Sunderland	Pearl St-East			84
Sunderland	Essex Shopping Center			74
Sunderland	Ames			71
Sunderland	Meadows Industrial Park 1			68
Sunderland	Fort Ethan Allen 5			49
Sunderland	Fort Ethan Allen 1			49
Sunderland	Sunderland Hollow Indust. Park	GS	32.7	44
Sunderland	Pearl St-West	CB	66.8	40
	Highest Total Metals (Figure 8.15)			
Sunderland	Fort Ethan Allen 6			22
Sunderland	Pearl St-East			9
Sunderland	Essex Shopping Center			8
Sunderland	Ames			8
Sunderland	Meadows Industrial Park 1			8
Sunderland	Fort Ethan Allen 5			6
Sunderland	Fort Ethan Allen 1			6

Table 8-3. Sunderland 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
Sunderland	Meadows Park	Wetpond	10	6	4	6395	2558	3837	$1,745	$34,892
Sunderland	Ames	Infiltration	10	4	6	6596	1979	4617	$1,678	$10,069
Sunderland	Pearl St East	Infiltration	12	5	7	7834	2350	5484	$2,135	$12,811
Sunderland	Fort Ethan Allen 6	Infiltration	28	11	17	17958	5387	12571	$4,587	$27,522
		TOTALS	**60**	**26**	**34**	**38783**	**12274**	**26509**	**$10,145**	**$85,294**

	Capital Costs/kg				*Annualized Capital Costs*					
Sewershed	TP Cost Low Dollars/kg	TP Cost High Dollars/kg	TSS Cost Low Dollars/kg	TSS Cost High ollars/kg	Annual TP Costs $/kg 30 yrs @ 5% Low	Annual TP Costs $/kg 30 yrs @ 5% High	Annual TSS costs $/kg 30 yrs @ 5% Low	Annual TSS costs $/kg 30 yrs @ 5% High	Total Annualized Costs 30 Years @ 5% Low	Total Annualized Costs 30 Years @ 5% High
Meadows Park	$436	$8,723	$0.45	$9	**$28**	**$567**	**$0.03**	**$0.59**	**$114**	**$2,270**
Ames	$280	$1,678	$0.36	$2	**$18**	**$109**	**$0.02**	**$0.14**	**$109**	**$655**
Pearl St East	$305	$1,830	$0.39	$2	**$20**	**$119**	**$0.03**	**$0.15**	**$139**	**$833**
Fort Ethan Allen 6	$270	$1,619	$0.36	$2	**$18**	**$105**	**$0.02**	**$0.14**	**$298**	**$1,790**
AVERAGE	**$298**	**$2,509**	**$0.38**	**$3**	**$19**	**$163**	**$0.02**	**$0.21**	**$660**	**$5,548**

Sunderland Brook

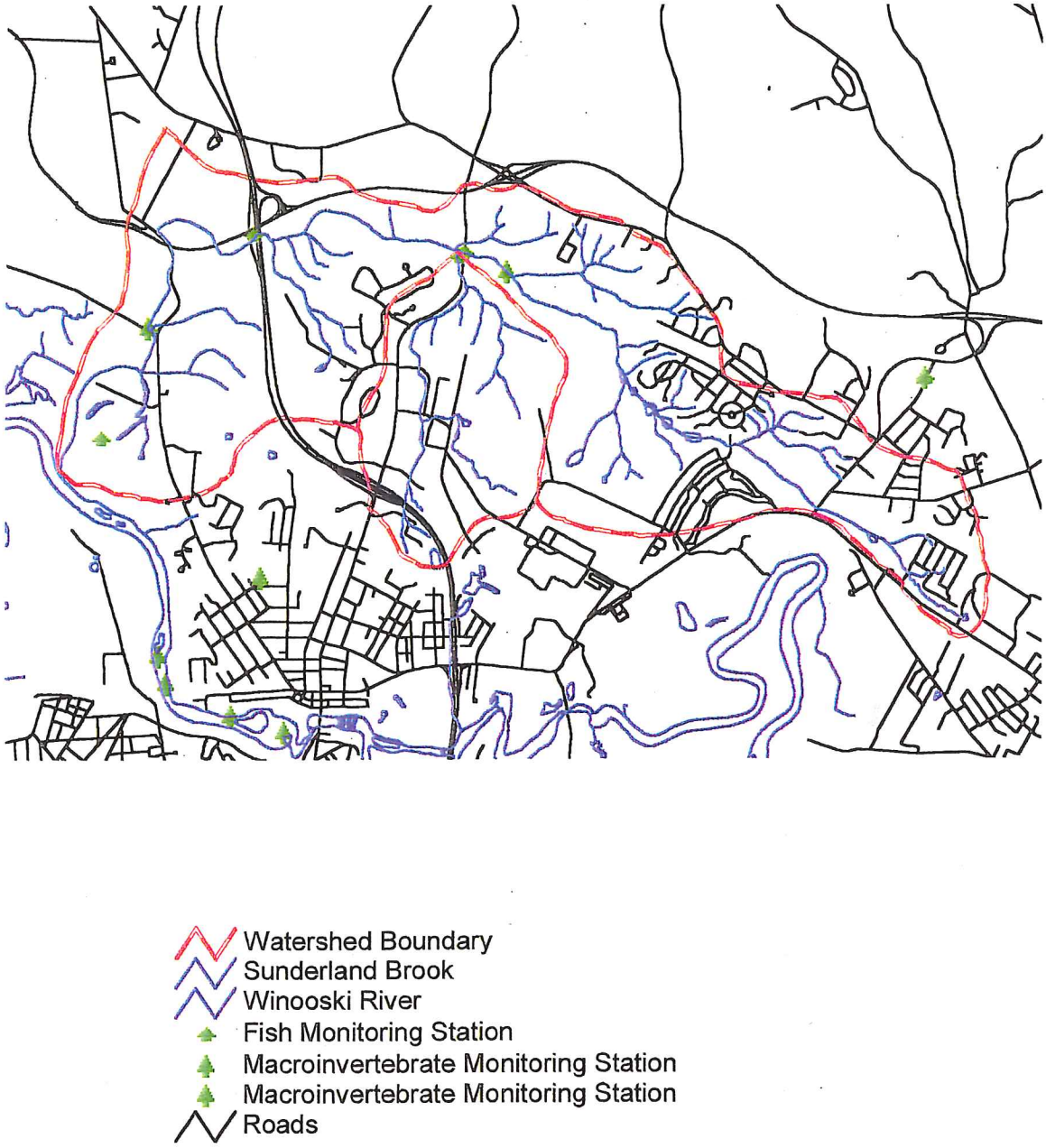
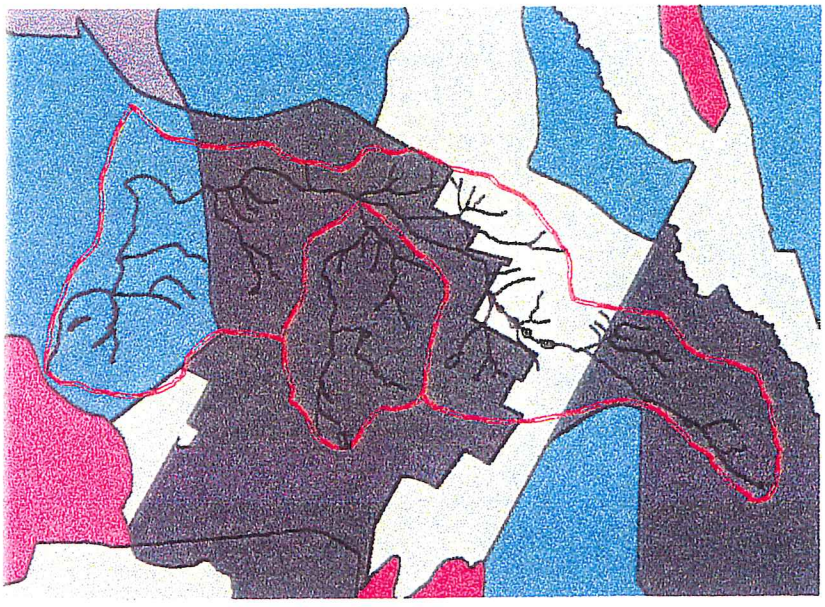


Figure 8.1: Sunderland Brook watershed showing roads and biological monitoring sites.

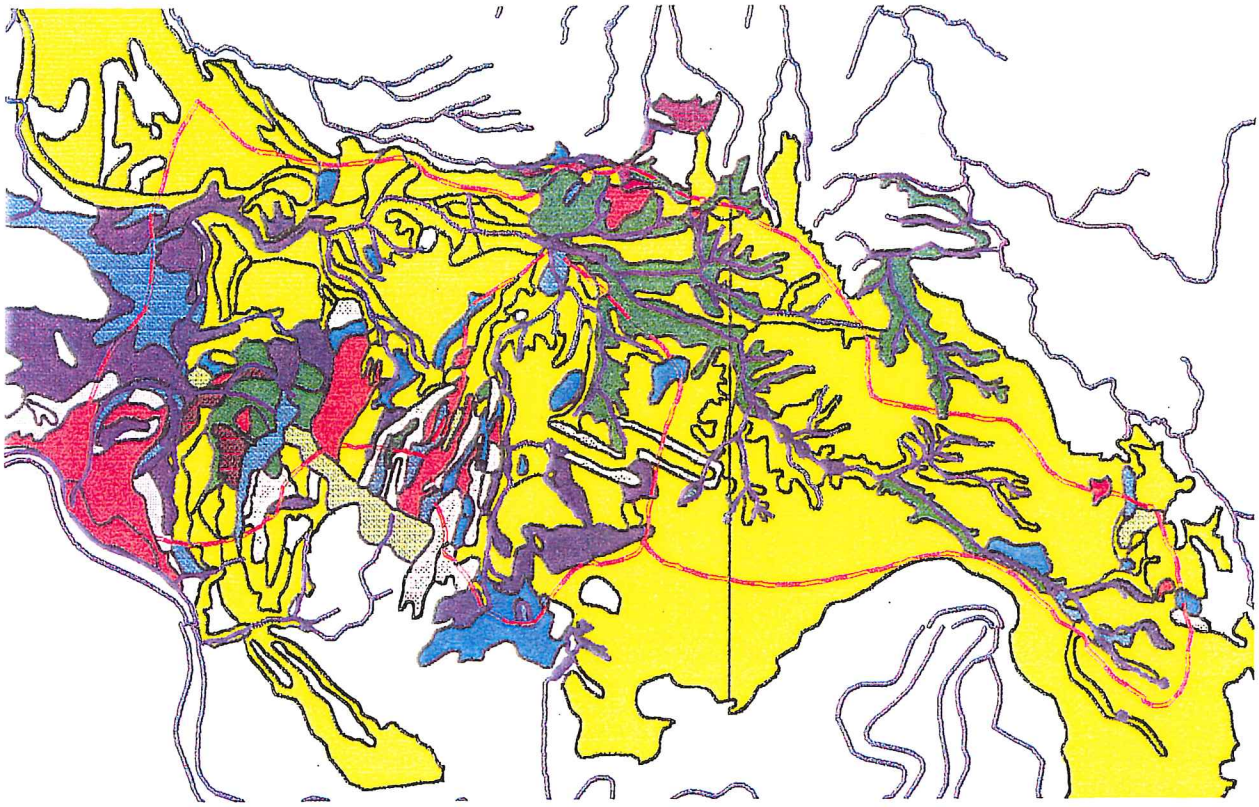
Figure 8.2: Sunderland Brook watershed 1995 actual land use; and future land use as defined by zoning designation.



Sunderland Brook Watershed
Land Use 1995
0
1100
1130
1190
1200
1210
1250
1252
1260
1270
1281
1300
1330
1370
1373
1400
1410
1412
1440
1460
1470
1480
1481
1482
1500
1510
1600
1700
1720
1730
1734
1735
1736
1737
1740
1790
2100
2200
2430
3000
3300
4100
4200
4300
5100
5200
5210
6000
6100
7200

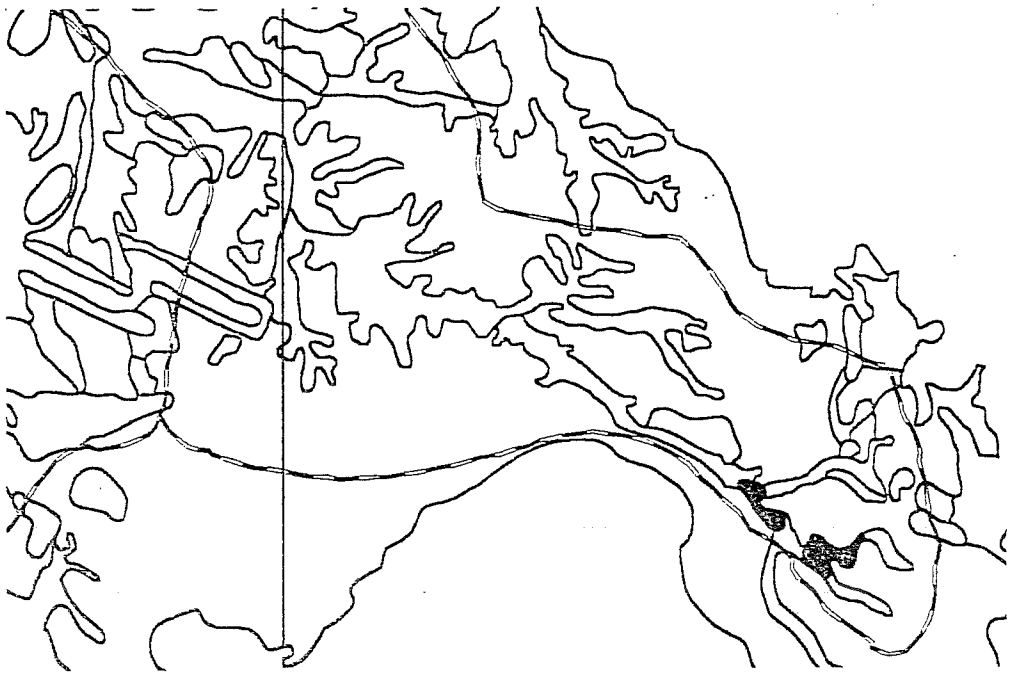
Sunderland Br
Watershed
Future Landuse
1200
1500
1600
1700
1730
2100
3000
4000
7000
7500

Figure 8.3: Sunderland Brook generalized soils map.

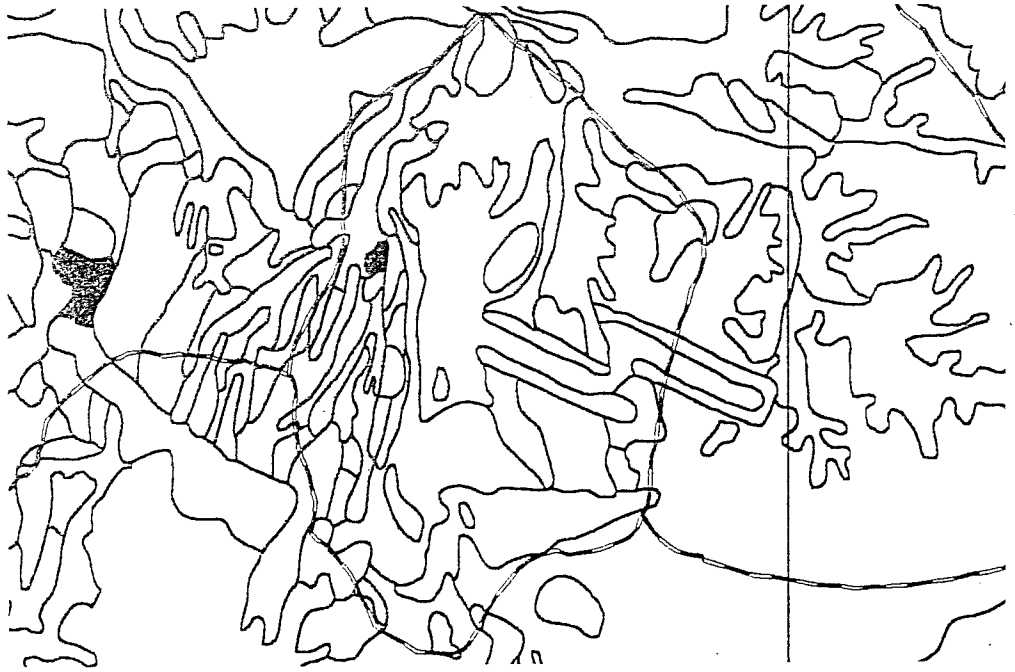


Sunderland Brook - Highly Erodible Soils

Figure 8.4: Sunderland Brook watershed - areas of highly erodible soils. These soils are easily displaced.



Sunderland Brook - Wetpond/Wetland Soils



Sunderland Brook trib. - Wetpond/Wetland Soils

Figure 8.5: Sunderland Brook watershed - wetpond/wetland soils.

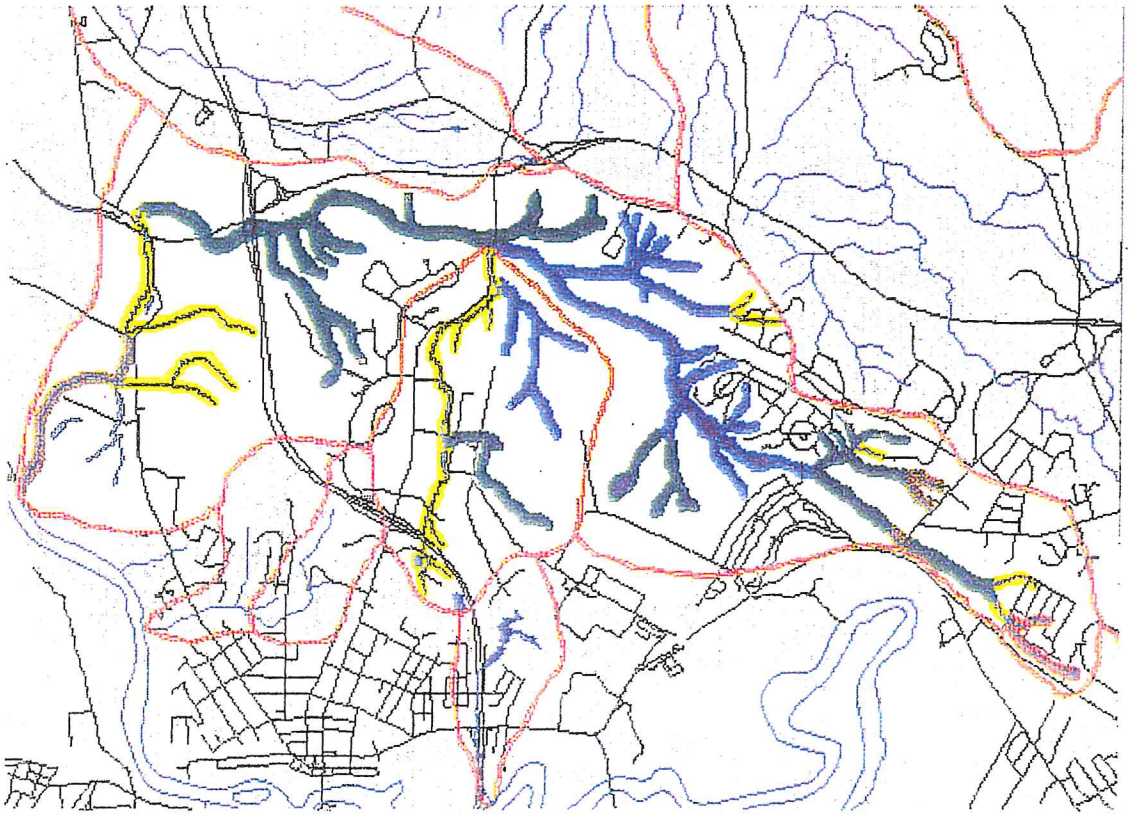
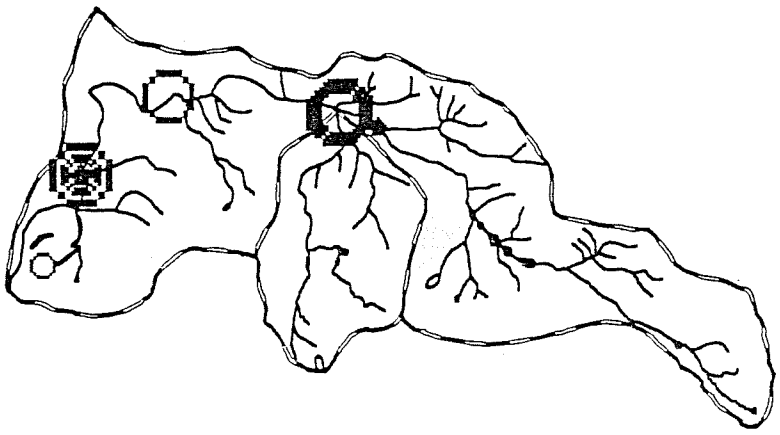


Figure 8.6: Sunderland Brook Riparian Corridor Evaluation. Evaluation was conducted using the Riparian Corridor Evaluation methodology (Petersen, 1992). A series of measurements and observations are recording while walking the stream channel.

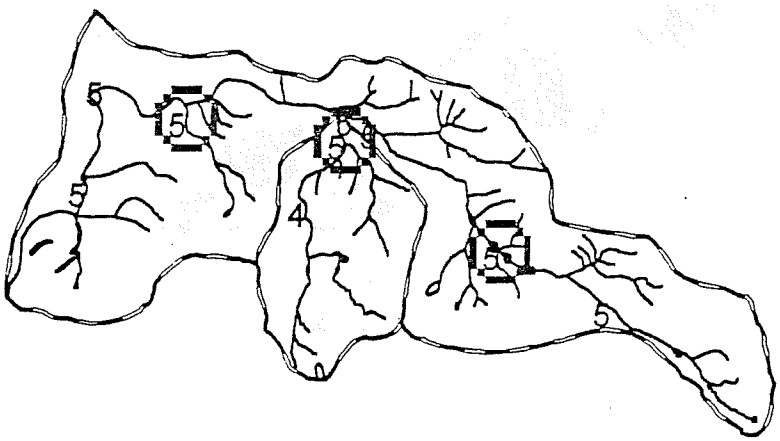
Figure 8.7: Sunderland Brook watershed - biological condition. Fish and macroinvertebrate community measures of integrity. A macroinvertebrate biotic index (BI) rating of less than good is indicative of sub-Class B condition. A fish Index of Biotic Integrity (IBI) rating of less than 31 is indicative of sub-Class B condition.



Sunderland Brook Watershed

BI
- E
- VG
- G
- F
- P
- VP

IBI
- 9 - 27
- 28 - 31
- 32 - 33
- 34 - 37
- 38 - 41
- 42 - 45



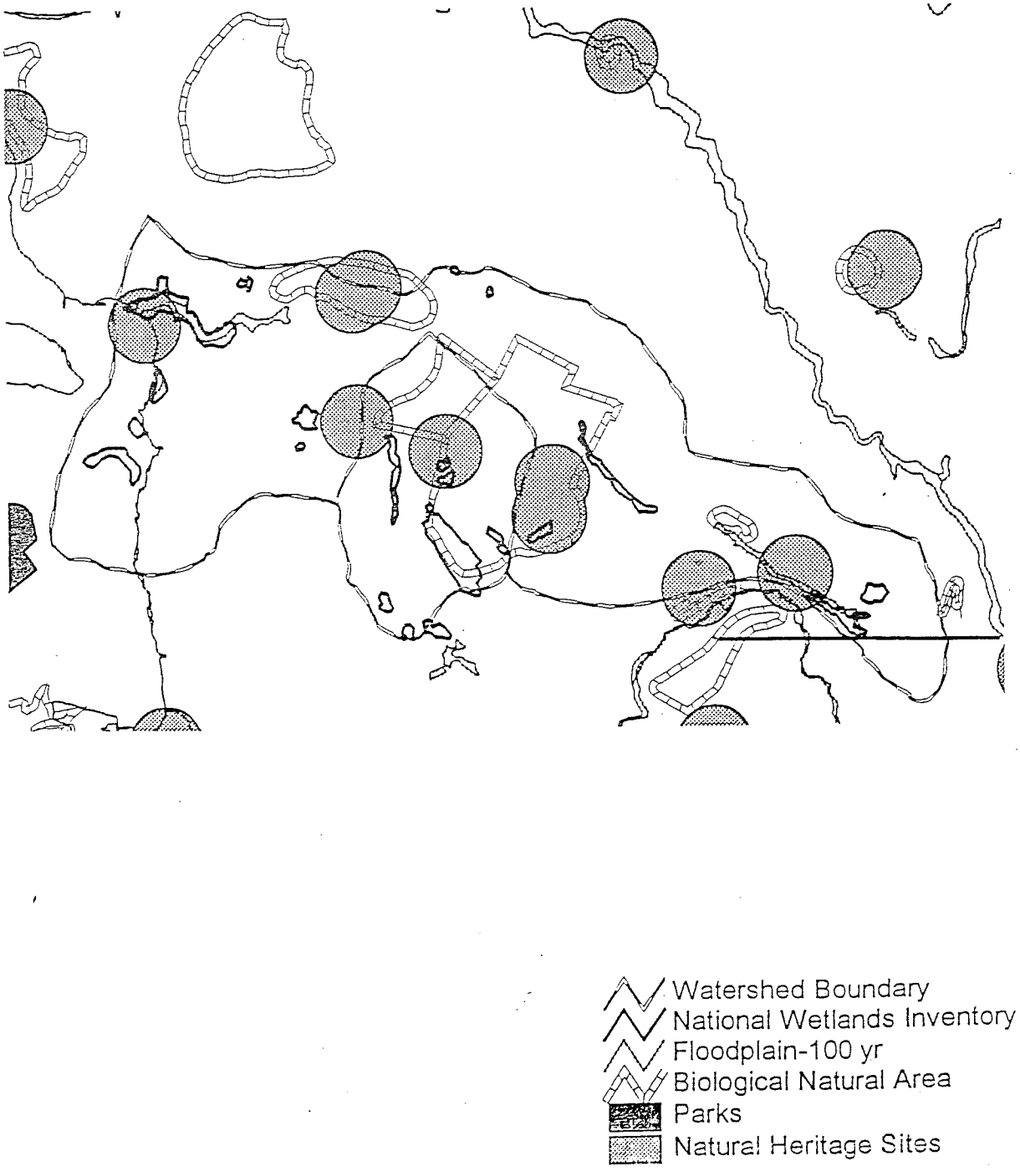
Sunderland Brook Watershed

Pool Sand Embeddedness
- 0-5
- 6-25
- 26-50
- 51-75
- 76-99

Riffle Sand Embeddedness
- 1 0-5
- 2 6-25
- 3 26-50
- 4 51-75
- 5 76-99

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 3.3: Sunderland Brook watershed - mapped wetlands, 100 yr. floodplain, biological natural areas, parks, and Natural Heritage sites.



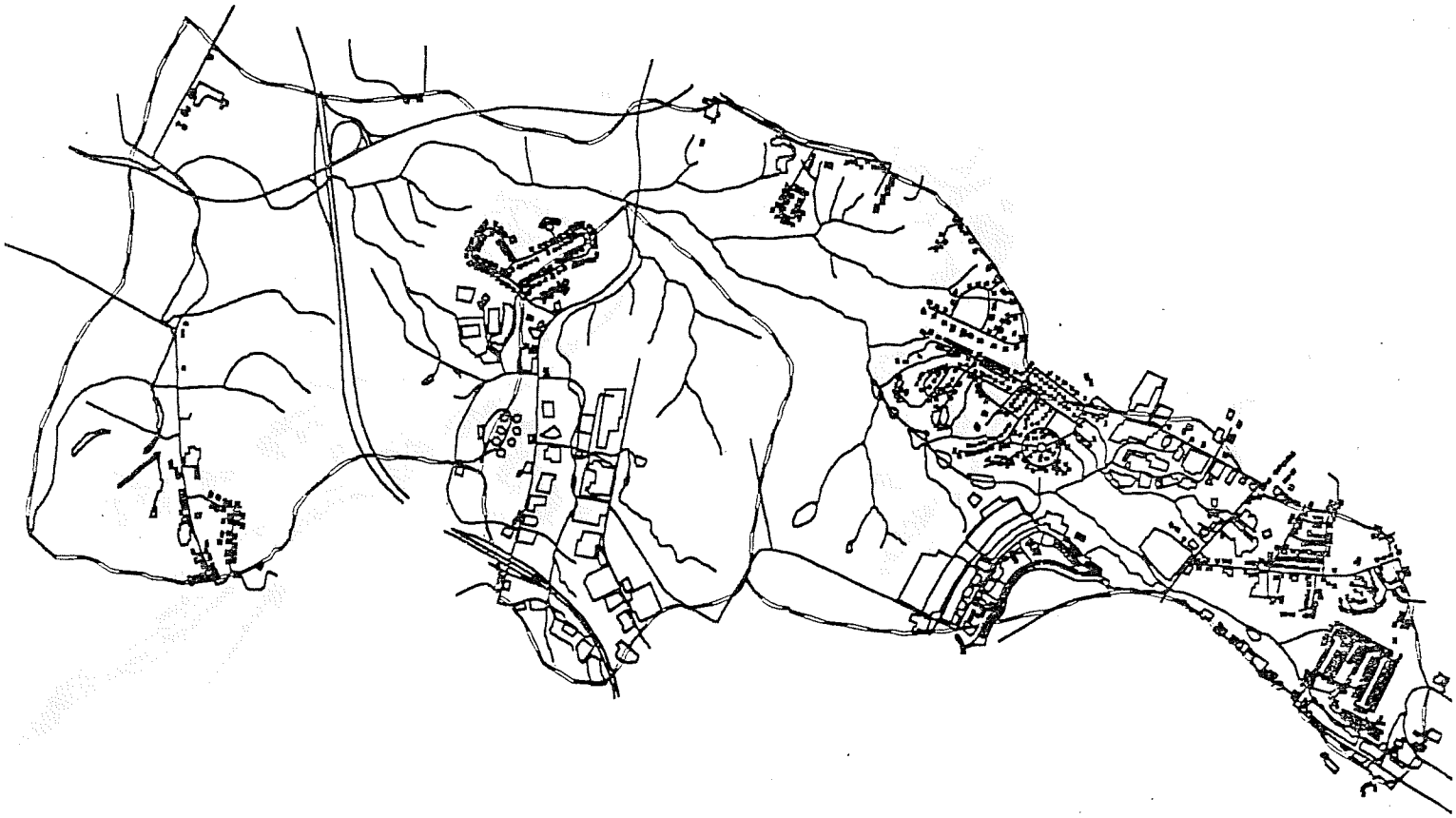
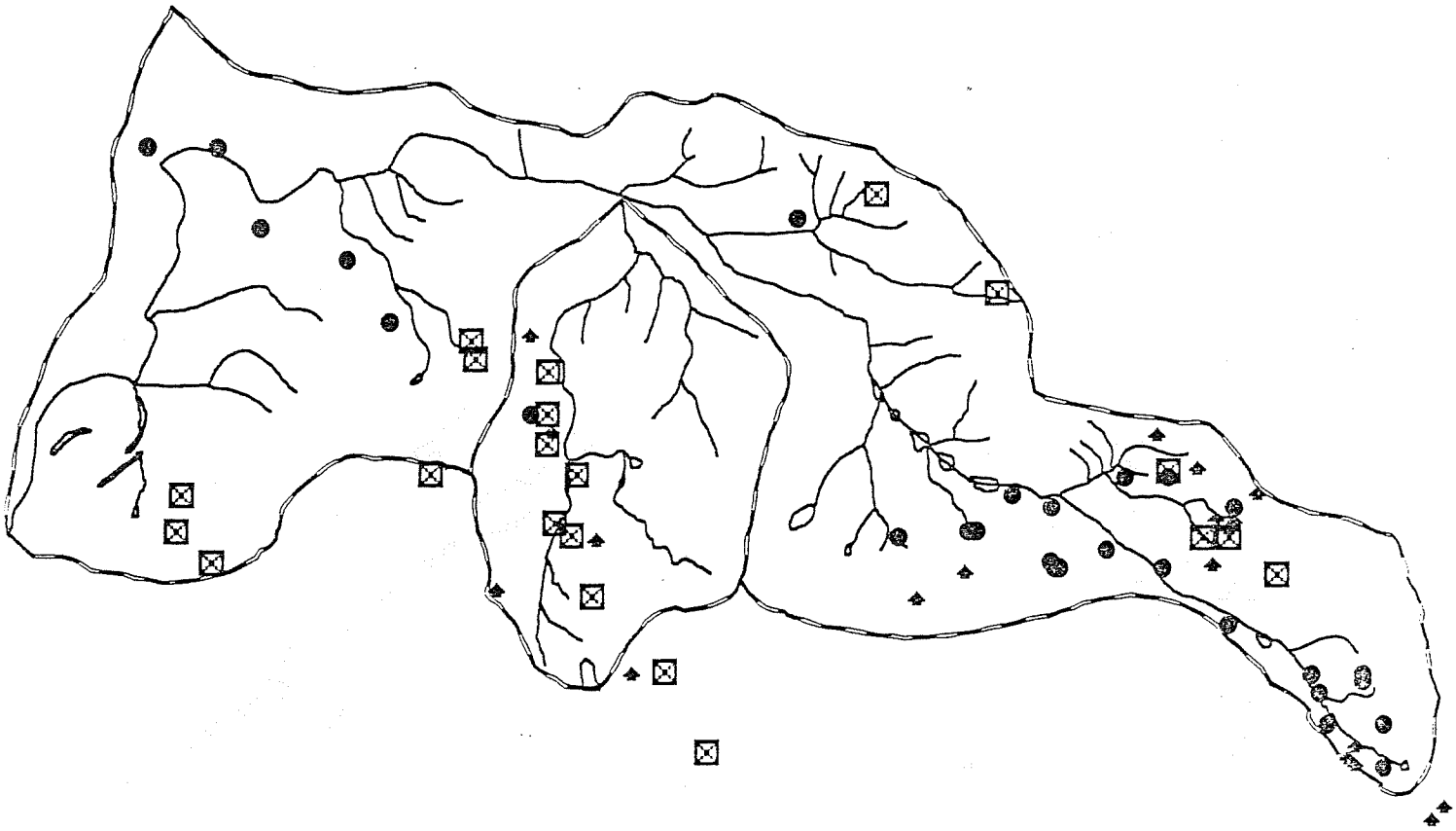


Figure 8.9: Sunderland Brook watershed mapped impervious surface - 1996.

Figure 8.10: Sunderland Brook watershed mapped sewersheds - 1996.

Figure 8.11: Sunderland Brook watershed mapped nonpoint sources. Mapped sources include: nonpoint sources such as eroding banks identified during RCE; stormwater permitted discharges; EPA hot landuses (quik-stops with gas pumps, gas stations).



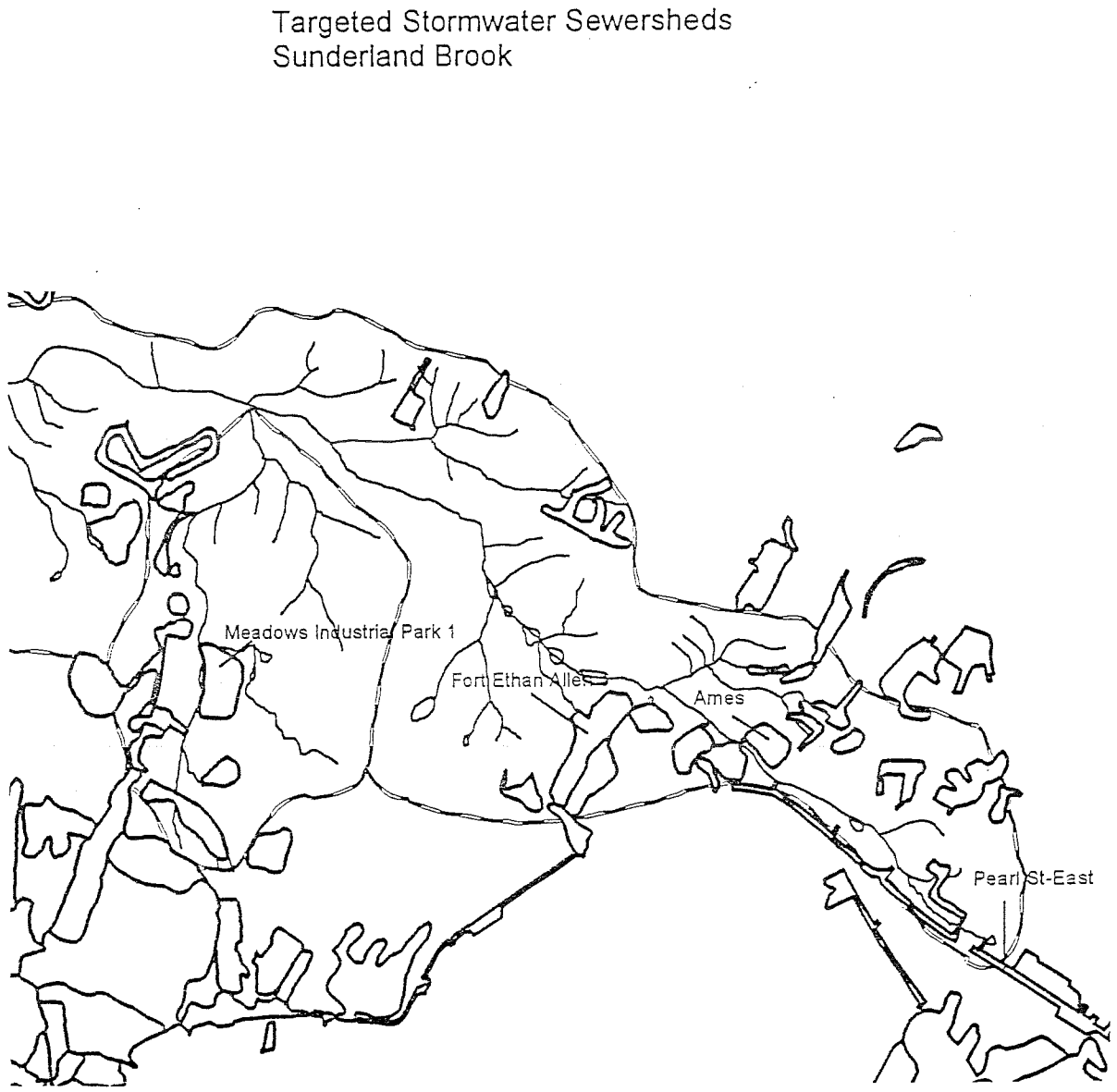
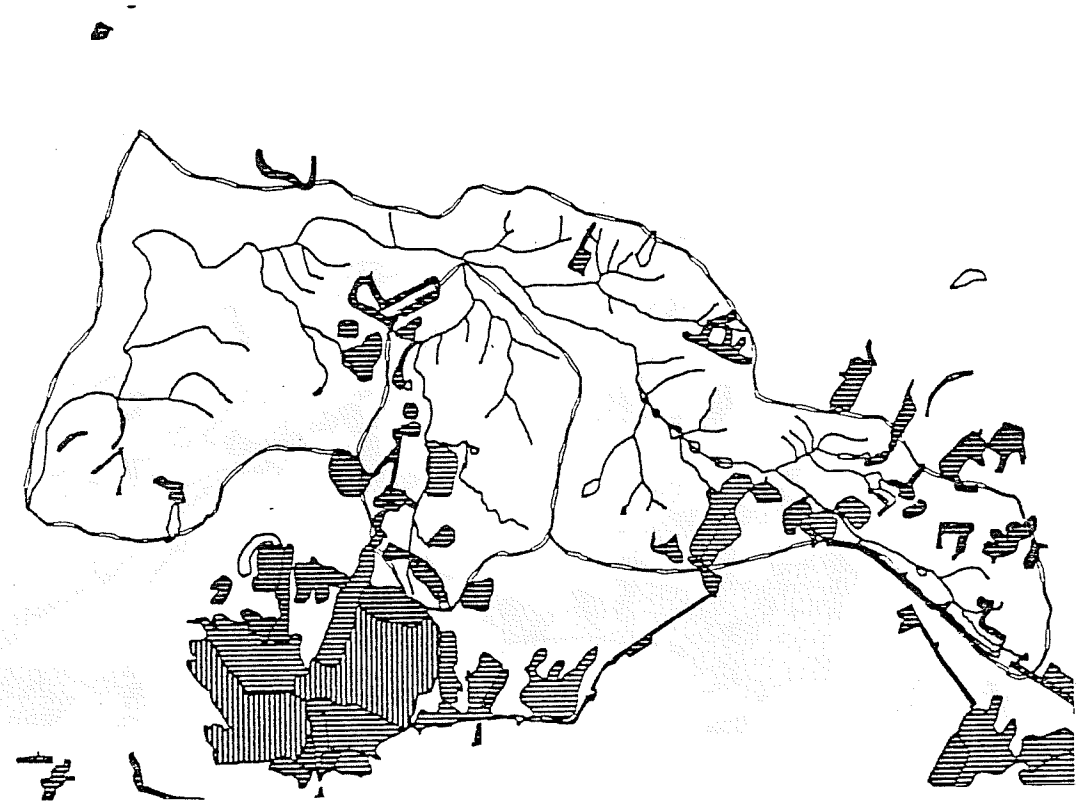


Figure 8.12: Targeted Stormwater Sewersheds in Sunderland Brook Watershed - Sewersheds were targeted based on exceedences of loading thresholds as described in Table 2.2. BMP recommendations are made for each targeted sewershed. Four sewersheds in the Sunderland Brook watershed have been targeted.

Figure 8.13: Estimated total suspended solids loading from sewersheds in the Sunderland Brook watershed.



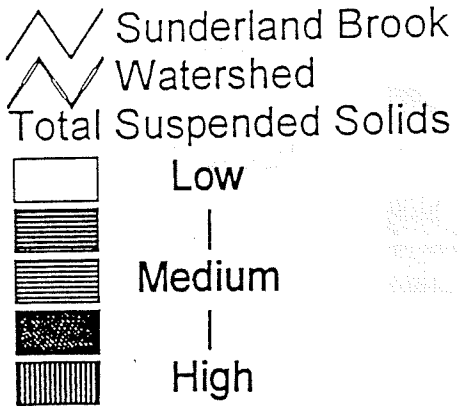


Figure 8.14: Estimated total phosphorus loading from sewersheds in the Sunderland Brook watershed.

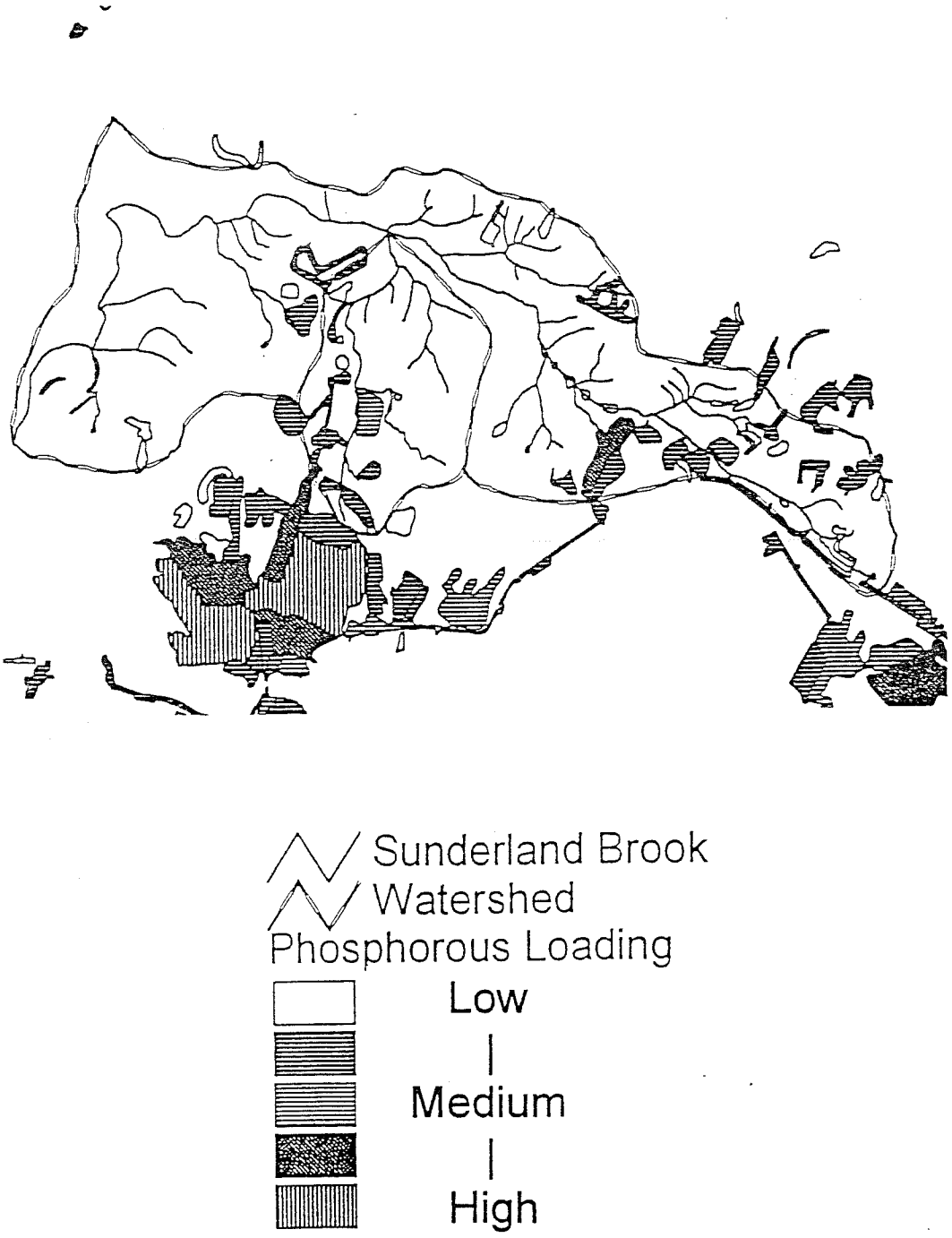
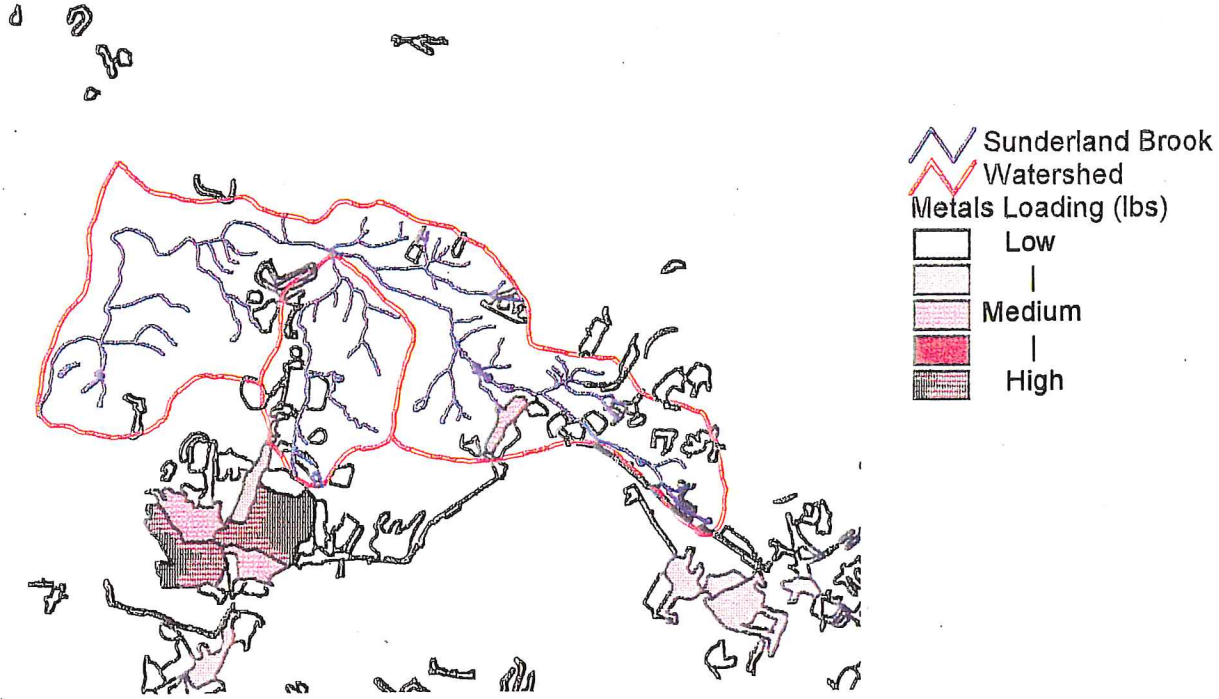
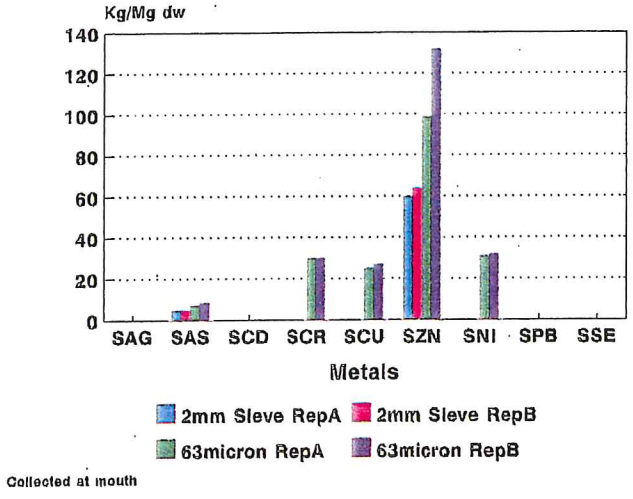


Figure 8.15: Estimated total metals loading from sewersheds in the Sunderland Brook watershed. Graph at bottom shows concentrations of metals in whole (2mm) and fine fraction (63u) sediments at the mouth of the Sunderland watershed. Samples collected in 1995.





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