MOREHOUSE 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.

Morehouse Brook Stormwater Management Evaluation

Watershed Description

It is unknown how Morehouse Brook received its name although it may be named for one of the original New Hampshire grant recipients. The stream was too small to provide water power but may have provided drinking water to early settlers in Winooski. Probably the best evidence of a native American village in Vermont was found near the stream mouth.

Morehouse Brook is a heavily urbanized watershed (1.48 kms2, 14% impervious) divided equally between the City of Winooski and the town of Colchester **(Figure 6.1)**. The stream drains an area from Water Tower Hill in the north, west and south to the Winooski River. The watershed is a rapidly developing suburb of Winooski.

Land Use

The land use in 1995 was approximately 25% industrial park, 60% residential-commercial, 10% agricultural and 5% open space. Future land use is projected to be 80% subregional growth center, 10% urban mixed use and 10% agricultural. The watershed is 14% impervious **(Figure 6.2, Table 6-1)**.

Table 6-1. Morehouse Brook: Current and Projected Land Use as percent watershed area. Projected land use is indicated in terms of zoning or planning categories.

	Open	Ag	Res/Dev	Com/Ind	Urban/ Mixed	Regional Growth Center	*Impervious Surface Area*
1995	5%	10%	60%	25%			*14%*
Projected		10%			10%	80%	

Soils

Highly erodible clays (Vergennes and Covington) exist in the developing Water Tower Hill area and erosion during construction should be avoided. Soils suitable for infiltration of stormwater (Adams) are abundant and should be utilized **(Figures 6.3-5)**.

Riparian Corridor and Biological Evaluation

Riparian habitat has been completely lost in a 100 m section of the lower watershed where an unstable bank (Agawam soil) has slipped into the stream. Habitat quality recovers upstream but is degraded again where the stream is piped under a recreational field and the Highland Industrial Park **(Figure 6.6)**.

Severe sedimentation as a result of a stormwater discharge has degraded the lower reach of the brook. Erosion and bank slumping in an area of steep slopes **(Figure 6.7)** have destroyed biological habitat for macroinvertebrates in this reach. Upstream, this sand plain brook has evidence of embeddedness but not enrichment **(Figure 6.8)**. Both macroinvertebrate density and species richness were low. The brook does not meet the Class B water quality standards for biological community integrity.

Watershed Management Goals

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

5. Establish consistent inter-jurisdictional (Winooski, Colchester) stormwater management and stream protection policies throughout the Morehouse 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 Morehouse Brook watershed.

Existing Zoning

Neither the city of Winooski nor the town of Colchester have a designated conservation buffer zone for Morehouse Brook. The current massive erosion problems are a result of storm water discharges following stormwater separation from the Winooski city sewage system which occurred in the early 1970's.

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 is one targeted storm sewer: W.Spring St-Malletts Bay Ave **(Table 6.2, Figures 6.9-6.12)**. An infiltration BMP is recommended for this site (map 6; Part 1). TSS reduction from this BMP would be 12,472 kg/yr; TP reduction would be 17 kg/yr.

There is one targeted discharge permit: Highland Industrial Park. A wetpond BMP is recommended at this site with a resulting TSS and TP reduction of 2314 kg/yr and 3 kg/yr respectively. Total sediment and phosphorus reduction to the stream for both BMP's would be 51% and 59% respectively of existing load from these two sewersheds. The estimated range of capital costs is $13,655-$107,905 **(Table 6.3)**.

Implementation recommendations, estimated treatment efficiencies and loading reductions, and estimated capital and annualized capital costs are summarized in **Table 6-3.** Estimated annualized capital costs for phosphorus and suspended solids loading reductions at individual sites range from $40 - $805 per kg/yr for phosphorus and $0.05 - $1.04 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. Restoration of Impaired Habitat - The most highly impacted areas in the watershed occurs in the vicinity of Highland Industrial Park and in the lower reaches of the stream below an area of massive streambank erosion. Riparian and aquatic habitat in these areas are impaired. It is likely that measures to reduce the intensity of peak flows and 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 6-3)**, prioritized by estimated Total Suspended Solids loading **(Table 6-2)**, 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 6.1)** or other evaluations, should be pursued. Of critical importance to restoration of the lower stream is the stabilization of eroding and slumping banks below stormwater discharges from Winooski. Opportunities to implement stream and riparian habitat restoration and improvement activities should be fully explored. Programs such as the Youth Conservation Corps and the USFW 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.

3. 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.

4. 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).

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

Table 6-2. Significant Stormwater Discharges in the Morehouse Brook Watershed: Discharges are targeted based on estimated exceedence of annual loading thresholds for: suspended solids (4,536 kg/year); total phosphorus (6.8 kg/year); total metals (5.4 kg/year); total PAHs (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 6.10)**			
Morehouse	W.Spring St-Malletts Bay Ave	CB	32.1	17,817
Morehouse	*Highland Industrial Park*	*CG/GS/RS*	*20.3*	*3,856*
	Highest Total Phosphorus **(Figure 6.11)**			
Morehouse	W.Spring St-Malletts Bay Ave			28
Morehouse	*Highland Industrial Park*			*6*
	Highest Total PAH (Commercial Landuses Only)			
Morehouse	W.Spring St-Malletts Bay Ave			191
Morehouse	*Highland Industrial Park*	*CB/GS/RS*	20.3	41
	Highest Total Metals **(Figure 6.12)**			
Morehouse	W.Spring St-Malletts Bay Ave			22

Table 6-3. Morehouse 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	Capital Cost-Low	Capital Cost-High
Morehouse	WSpring-Malletts	Infiltration	28	11	17	17817	5345	12472	$11,800	$70,802
Morehouse	Highland Park	Wetpond	6	3	3	3856	1542	2314	$1,855	$37,103
		TOTALS	**34**	**14**	**20**	**21673**	**6887**	**14786**	**$13,655**	**$107,905**

	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 dollars/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
WSpring-Malletts	$694	$4,165	$0.95	$6	$45	$271	$0.06	$0.37	$768	$4,606
Highland Park	$618	$12,368	$0.80	$16	$40	$805	$0.05	$1.04	$121	$2,414
AVERAGE	**$683**	**$5,395**	**$0.92**	**$7**	**$44**	**$351**	**$0.06**	**$0.47**	**$888**	**$7,019**

Morehouse Brook

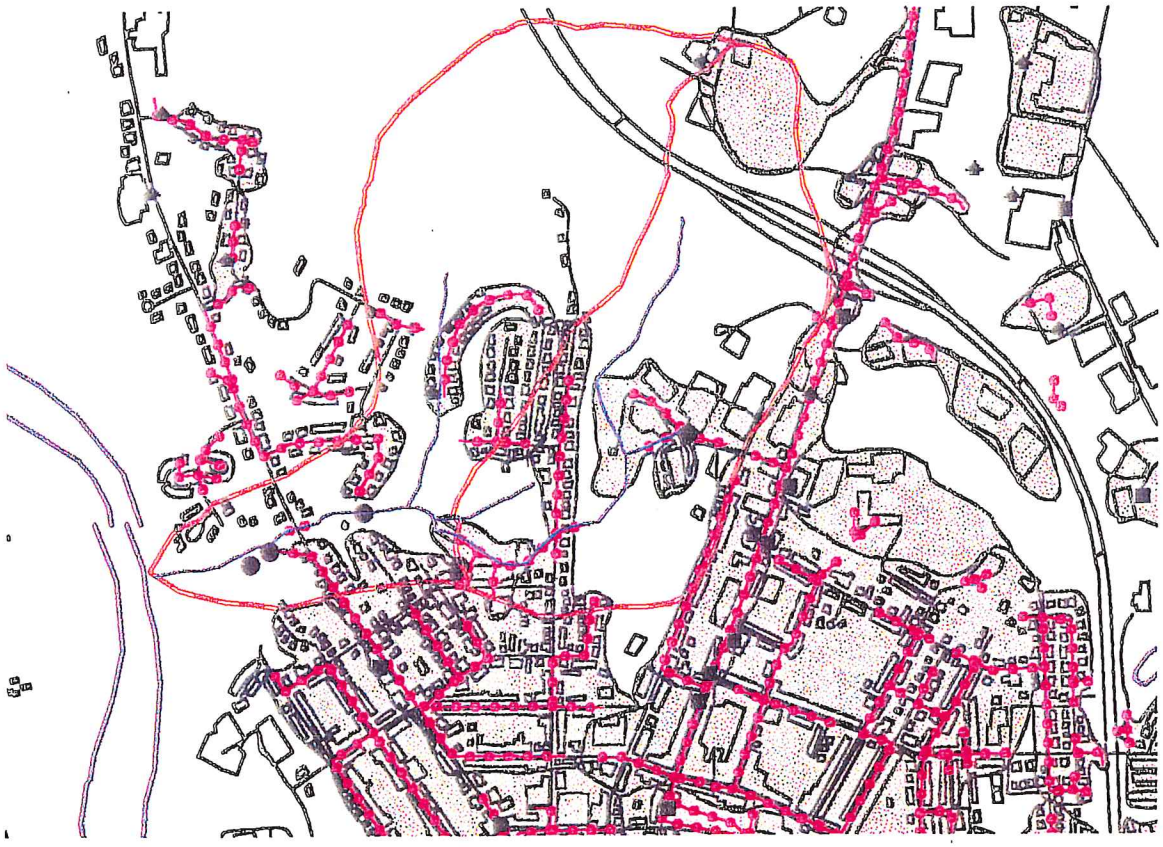


Figure 6.1: Morehouse Brook watershed showing: roads, surface waters, impervious surface areas, permitted wastewater and stormwater discharges, stormwater lines, nonpoint sources such as eroding stream banks, EPA hot land uses (gasoline service areas), underground storage tanks, and biological monitoring sites

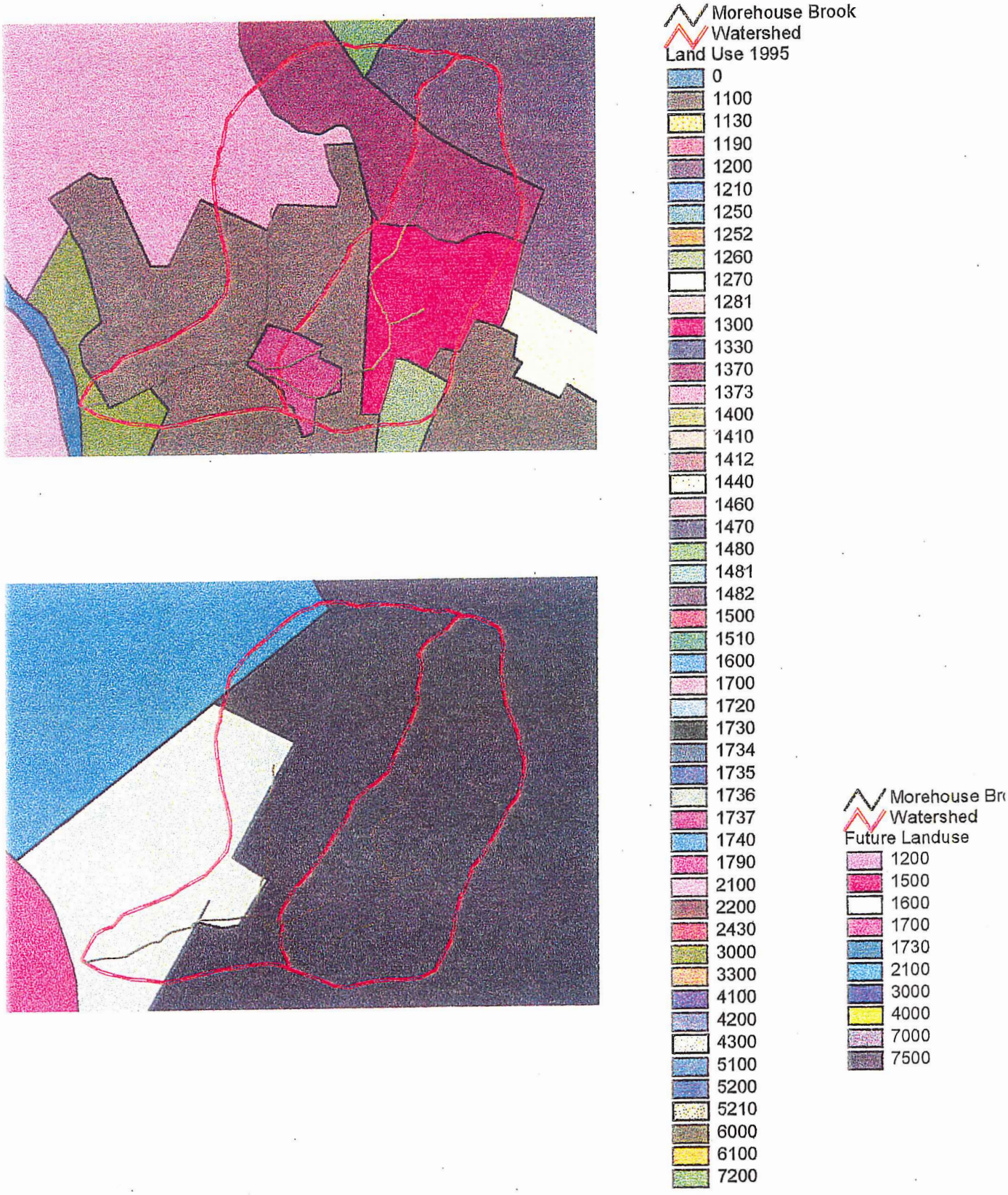


Figure 6.2: Morehouse Brook watershed 1995 actual land use; and future land use as defined by zoning designation.

Figure 6.3: Morehouse Brook generalized soils map.

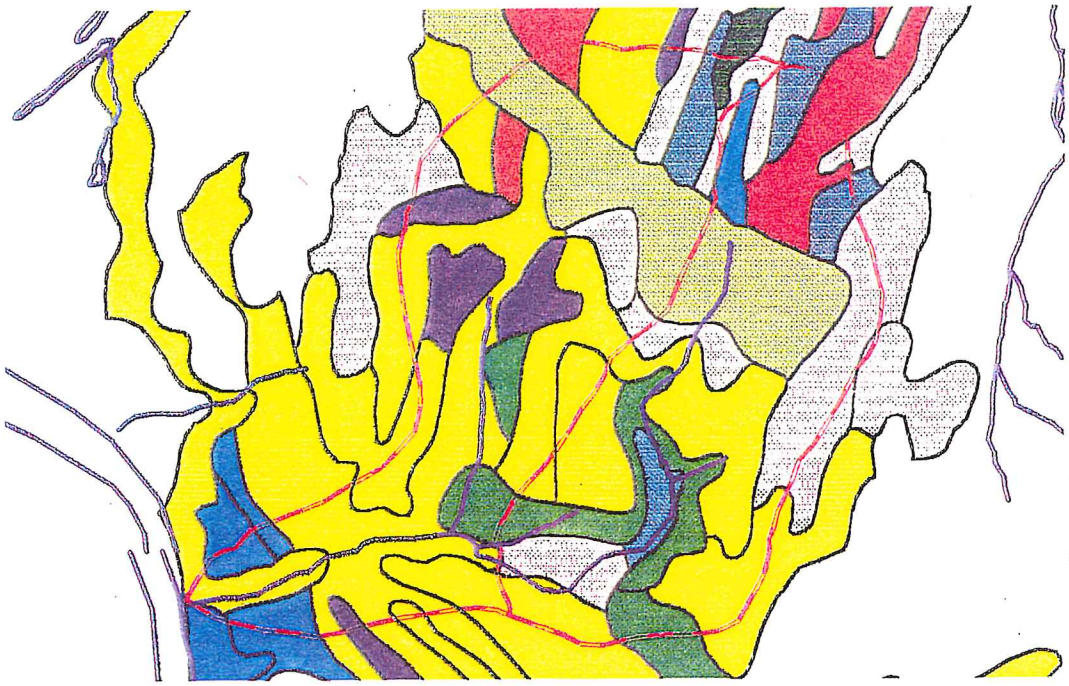
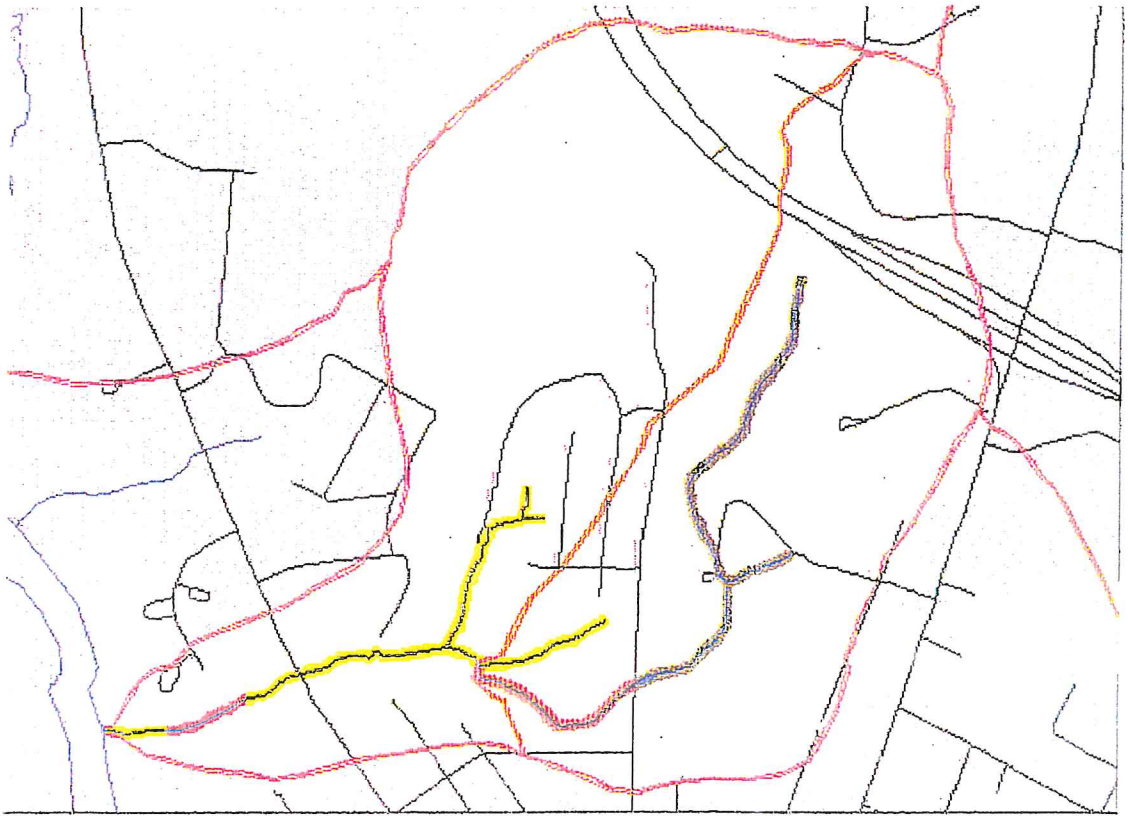


Figure 6.4: Morehouse Brook watershed - areas of highly erodible soils. These soils are easily displaced.

Figure 6.5: Morehouse Brook watershed - wetpond/wetland soils.



Riparian Corridor Evaluation (RCE)
Red=Poor, habitat structure gone
Brown=Fair, major habitat alteration
Yellow=Good, minor habitat alteration
Green=Very Good, monitor for changes
Blue=Excellent, protect existing status

Figure 6.6: Morehouse 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.

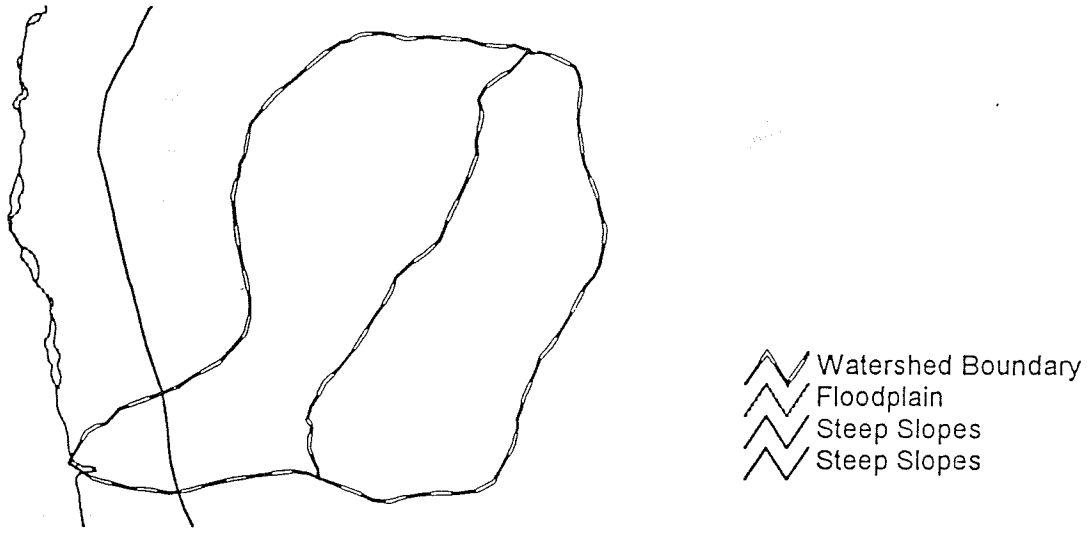
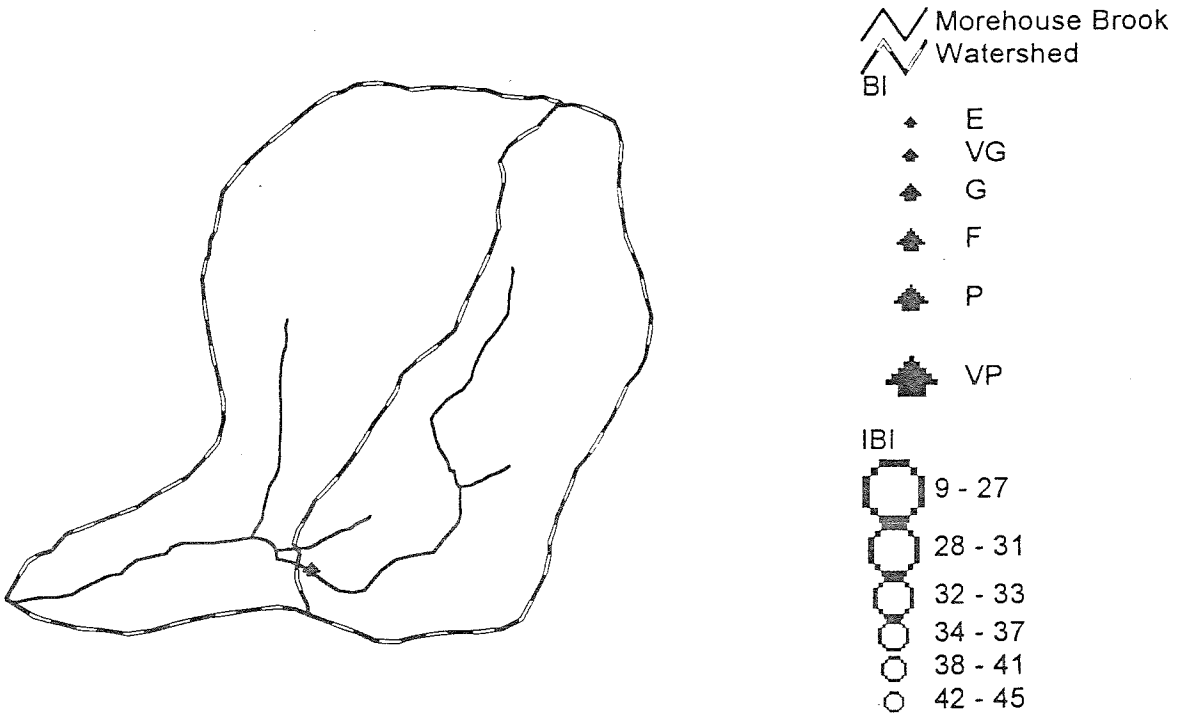
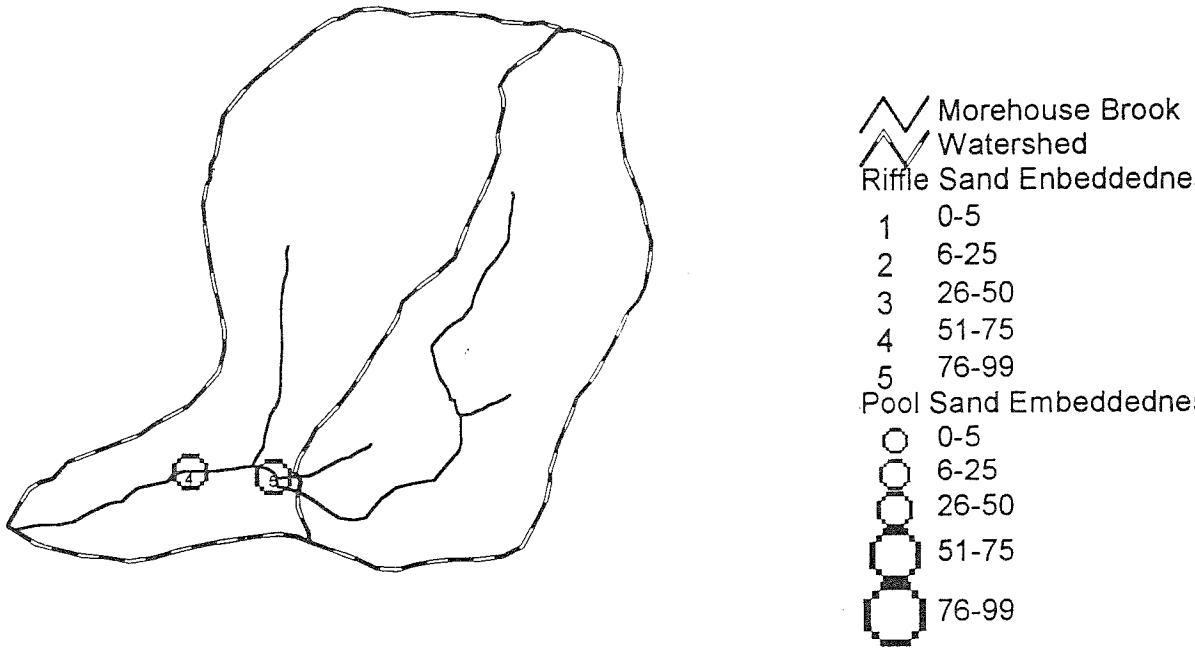


Figure 6.7: Line of steep slopes in the Morehouse watershed. Significant erosion is occurring where the main channel cuts through this slope area.

Figure 6.8: Morehouse 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.

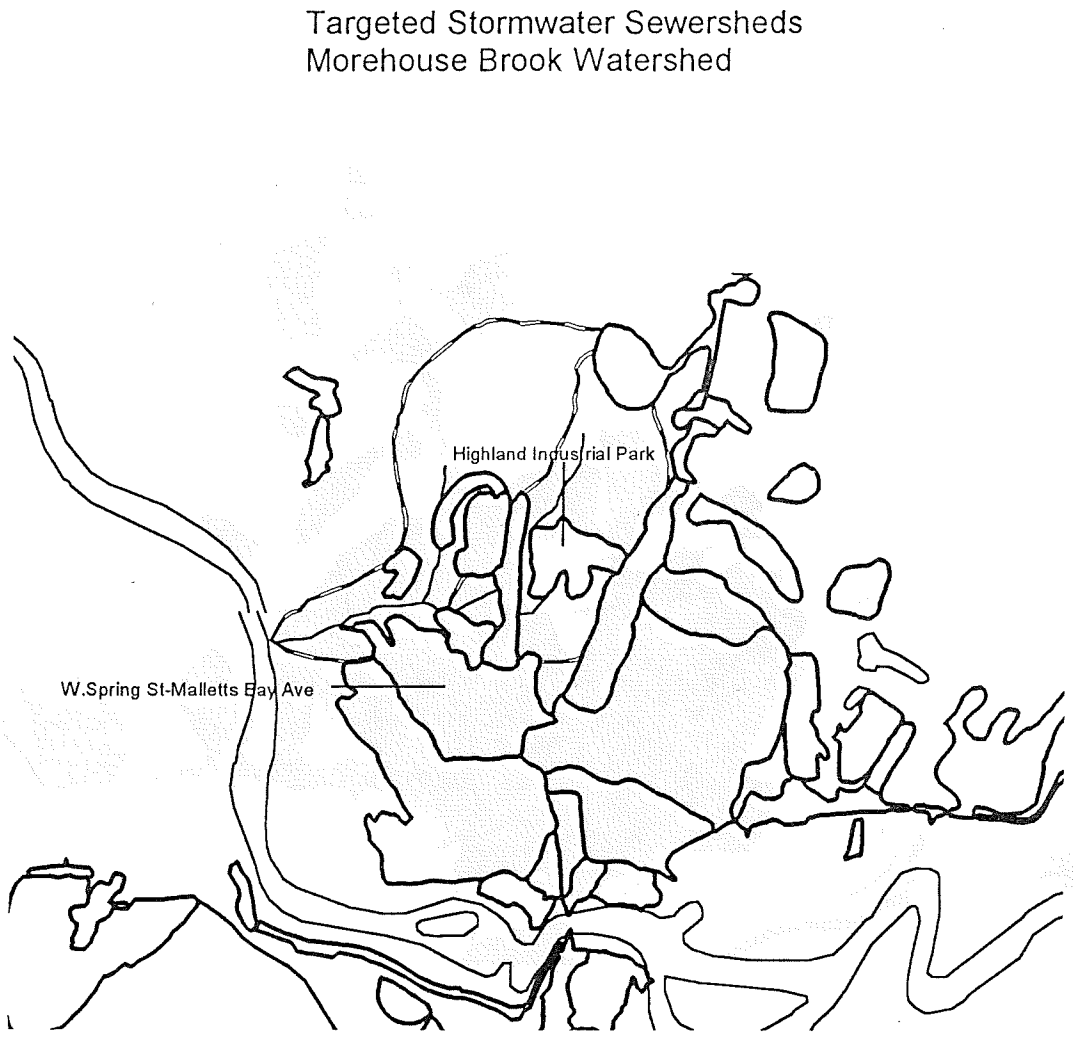


Figure 6.9: Targeted Stormwater Sewersheds in Morehouse Brook Watershed - Sewersheds were targeted based on exceedences of loading thresholds as described in Table 2.2. BMP recommendations are made for each targeted sewershed. One sewershed in the Morehouse Brook watershed has been targeted.

Figure 6.10: Estimated total suspended solids loading from sewersheds in the Morehouse Brook watershed.

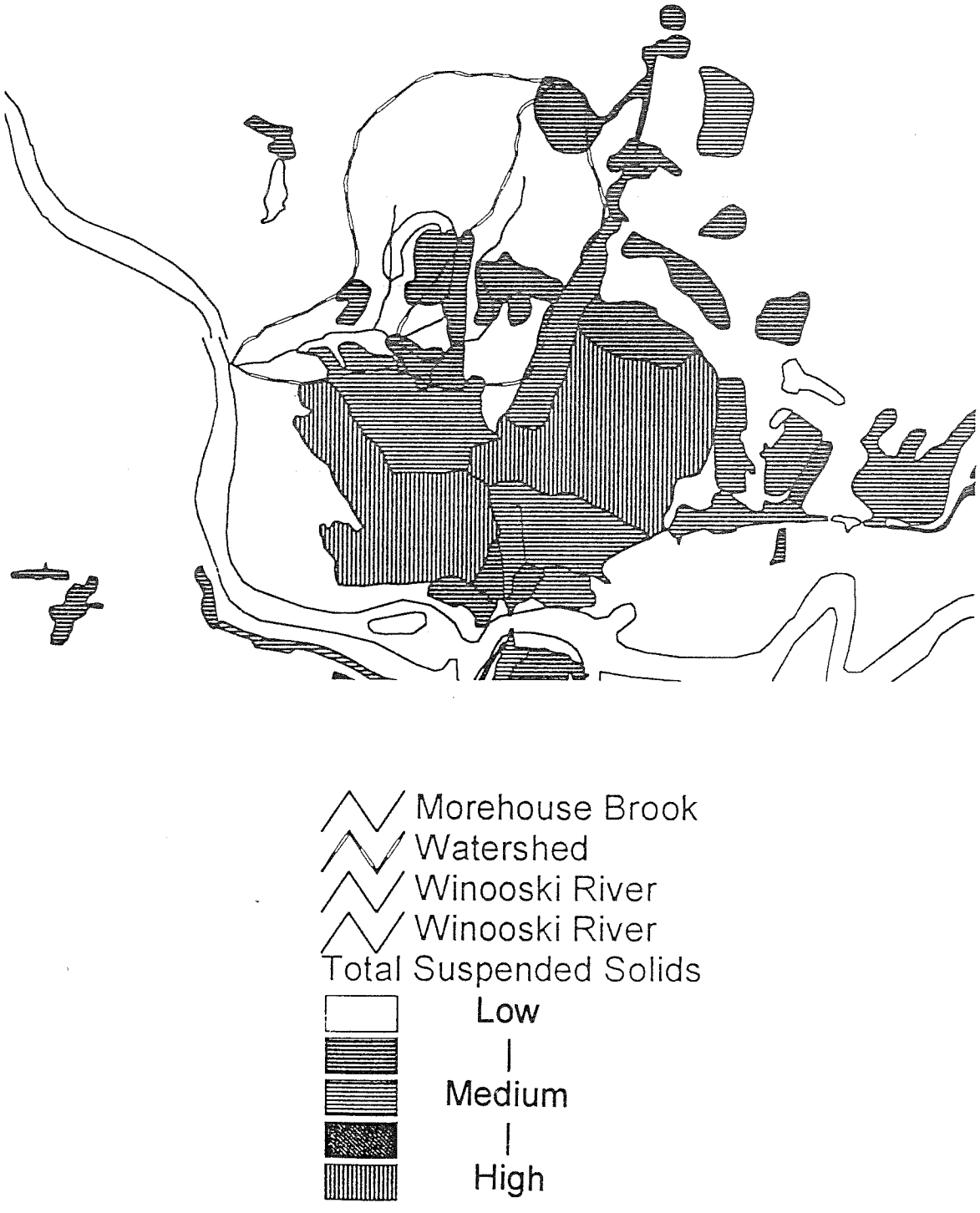


Figure 6.11: Estimated total phosphorus loading from sewersheds in the Morehouse Brook watershed.

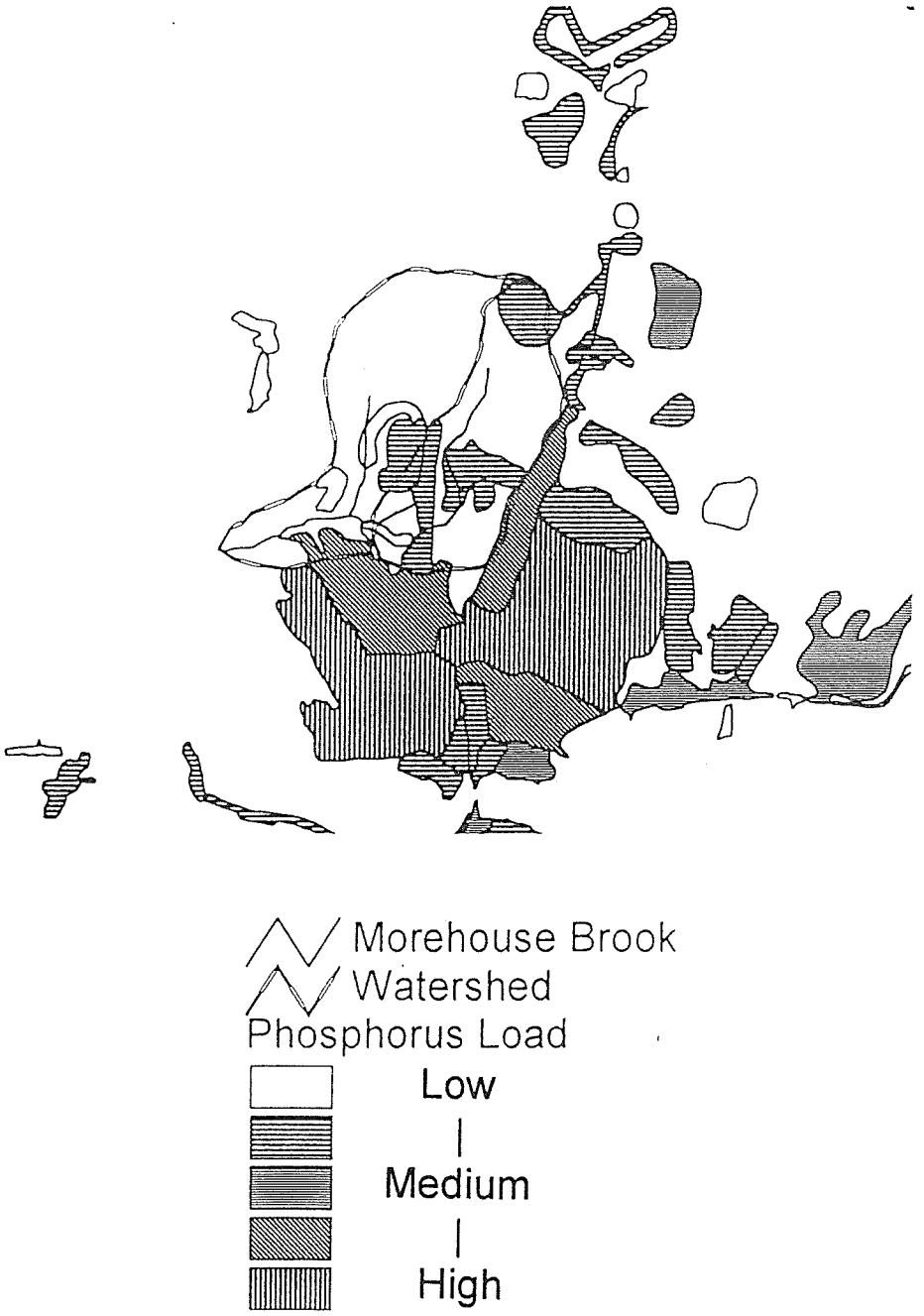


Figure 6.12: Estimated total metals loading from sewersheds in the Morehouse Brook watershed.

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