APPENDIX A

ATWATER PARK AND EDGEWOOD DEVELOPMENT EROSION CONTROL

APPENDIX A

INTRODUCTION

Two sites outside of the project area were addressed specifically for this project. These sites were Atwater Park on the Lake Michigan shoreline and the Edgewood Development site on the southern border of the Village. The concern at the Atwater Park site is hillslope erosion on the lake bluff. The concern at the Edgewood development is potential construction site erosion.

ATWATER PARK HILLSLOPE EROSION STABILIZATION

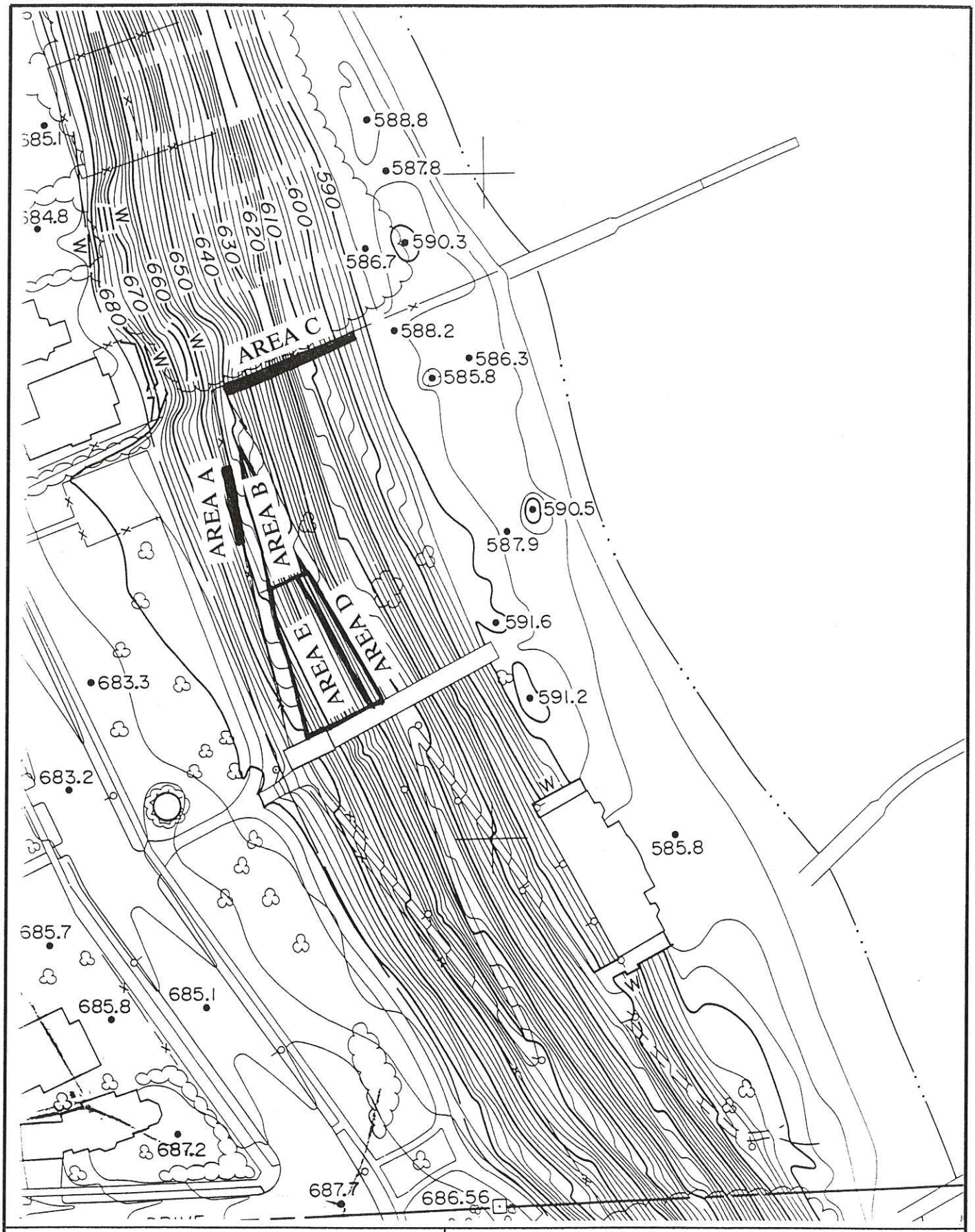
Atwater Park and Beach is located on Lake Drive, north of Capitol Drive. The park has a recreation area on the top of the Bluff and two walkways going down to the beach area. See Figure A-1 for schematic of the area. One walkway is a series of stairs from the top of the bluff to the beach. The other walkway is a sloping path that runs north from the top of the bluff to a landing and then south to a second landing and finally north to the beach. The erosion problem is occurring along the upper part of this bituminous path (Figure A-1). The most severe erosion is occurring near the first or north landing and between the paths.

The first segment of erosion (Area A) is located east of the path before the first landing. It appears that this erosion maybe caused by people entering the park from under the fence. The second area (Area B) is the area along the path by the first landing. The slope in this area is very steep, and although the area is partially vegetated, the amount of exposed soil at the ground level is significant. The third area (Area C) is an eroded gully along the north property line. The fourth area (Area D) is south of Area B and is similar to Area B, except the slope is not as steep. The final area (Area E) is west and upslope of Area D. This area has poor vegetative ground cover but is not eroding as severely as the other areas. These areas are shown on Figure A-1.

Slope Face Stabilization Techniques

1. **Concrete Block Retaining Wall**. Concrete blocks such as Keystone blocks could be used to construct a retaining wall along the bituminous trail. The wall would be backfilled with soil to achieve a 3:1 slope and vegetated. The height of the wall would be dictated by the existing slope with a maximum suggested height of five feet. Two tiers of retaining walls may be necessary for longer slopes. Granular fill with a drain tile would be placed behind the wall. During an on site inspection, it was noted that the shorter Keystone block in place by the landing is beginning to buckle forward. Therefore, the use of a deeper Keystone block for this application is recommended. A prairie seed mix interspersed with trees for a deeper root system is suggested for vegetation. Straw matting should be spread over the area after seeding.

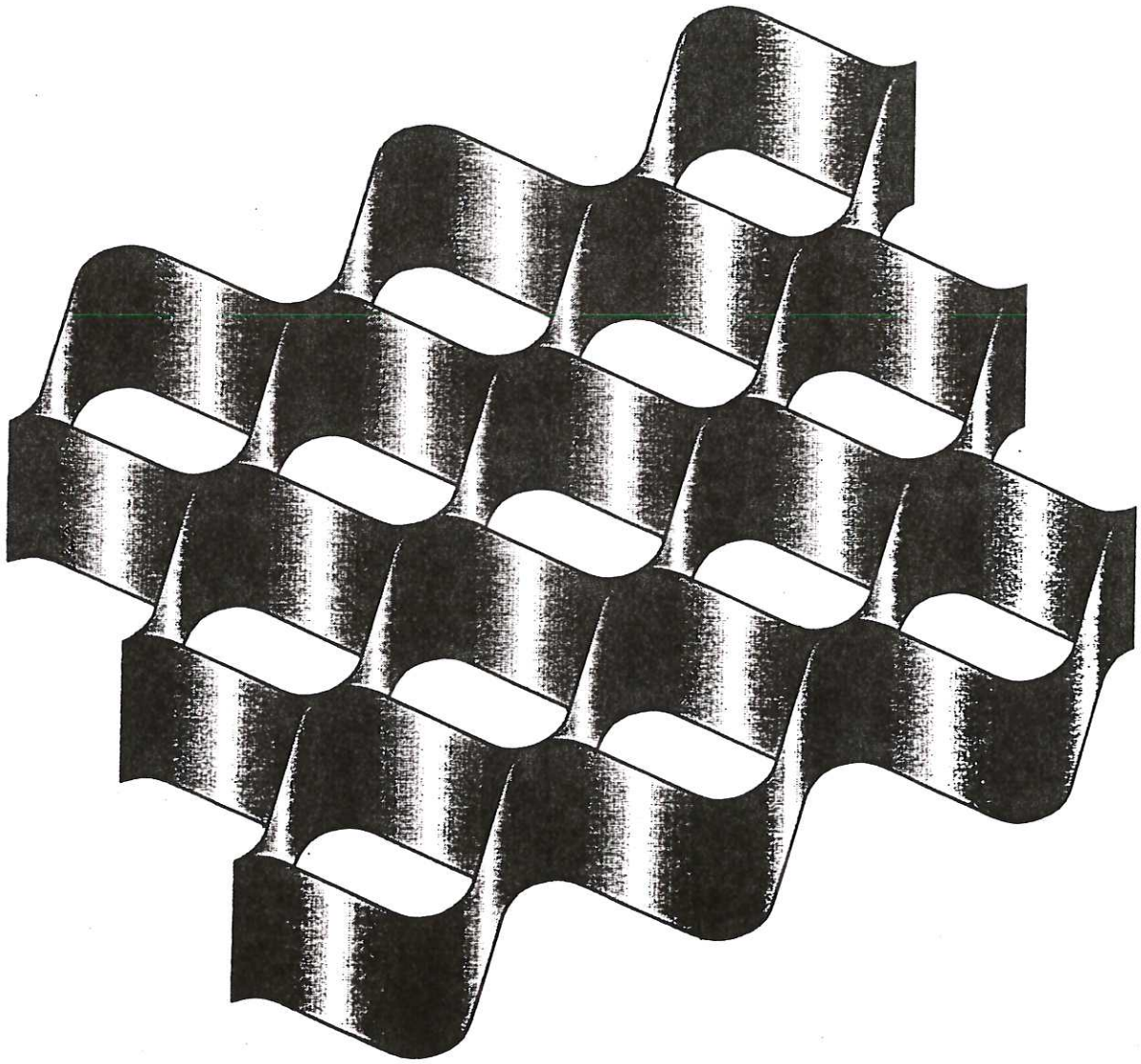
2. **Cellular Confinement System Slope Protection (cellular web mats).** The cellular confinement system (such as Geo-Web) consists of flexible web mats of polyethylene honeycomb cells which are filled with soil backfill (Figure A-2). The cellular web mats which are anchored to a slope with long pins or wooden stakes are filled with soil and vegetated. The cells confine and reinforce the vegetation and soil structure. This system is good for protecting against surface erosion on steep slopes, but does not provide protection against large scale slope failure. The maximum slope is dependent on the soils, but it has been used on slopes as steep as 1:1. It may be possible to use the cellular web mats on this site



RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE A-1

ATWATER PARK
EROSION CONTROL AREAS
VILLAGE OF SHOREWOOD
STORMWATER MANAGEMENT PLAN



RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE A-2

CELLULAR WEB MAT

VILLAGE OF SHOREWOOD
STORMWATER MANAGEMENT PLAN

without changing the slope. Little additional soil would be required on the site. This would limit any additional loadings on the slope.

All topsoil and easily degraded soil should be removed before laying down the cellular sheets. A loamy soil is recommended for the fill. The cellular web mats with notches between cells for drainage are recommended. A bedding layer of sand or a non-woven geo-textile is recommended between the mats and the native soil. The geo-textile may impede rooting of plants. Suggested vegetation would be a prairie mix with a deep rooting system. A few small scale trees or shrubs may be planted in large spaces in the web by cutting the dividers between a couple of cells. After seeding a straw matting should be placed to hold in soil and seed before sprouting. It may be more aesthetically pleasing to dress the bottom edge of the mat along the trail with a row of concrete block or treated timbers.

3. **Vegetation Management.** For some of the shallower slopes it may be feasible to prevent surface erosion by enhancing the ground cover vegetation. Currently the site is well shaded by black locust trees and burdock. If the black locust trees were thinned out and the existing weedy ground cover was removed and treated with herbicide, a thicker and more desirable ground cover could be established. Leaving the larger trees and pruning the lower branches is suggested since the deep root systems are providing slope stability. A prairie seed mix is also suggested for this site. More desirable tree species may be planted in place of the black locust trees.

Site Preparation and Revegetation

Before the construction of any of the structural alternatives (techniques 1 and 2), the vegetation should be removed. The tree stumps and root systems should be left for soil stabilization where possible. The stumps should be treated with herbicides to prevent suckering. Replant trees, shrubs and ground cover vegetation. Planting of trees and shrubs should take place in the fall or in the spring.

The suggested shrubs, common juniper, red cedar, and gray dogwood provide spreading ground cover, similar root depth to black locust, and provide good wild life habitat. They are also well adapted to the harsh conditions prevalent on lake bluffs. The existing under story does not provide very good ground cover. Plants like burdock have only one stem and have large leaves which shade out other plants. Good ground cover plants ideally spread and have many stems. The suggested plants are native open woods and prairie plants which would tolerate the harsh conditions on the site and provide good wildlife habitat. The list in Table A-1 is representative of the types of plants to use and does not include all possibilities. Several nurseries provide seed mixes blended for different conditions. It is recommended that a nursery be contacted for further advice on plant selection. Potential nurseries include: McKay nursery in Waterloo, WI (414) 478-2121, for shrubs; Prairie Nursery in Westfield, WI (608) 296-3679; Prairie Ridge Nursery in Mt. Horeb, WI (608) 437-5245); and Taylor Creek nursery in Brodhead, WI (608) 897-8641.

Table A-1
Suggested Planting List

Woody Species	Partial Sun Ground Cover	Full Sun Ground Cover
Common Juniper	Switch Grass	Big Bluestem Grass
Red Cedar	Bird's Foot Trefoil	Indian Grass
Gray Dogwood	Northern Bedstraw	Little Bluestem
Black Willow	Pussy Toes	Side Oats Gramma
Honey Locust	Harebell	Lead plant
	Wild Strawberry	Butterfly Milkweed
	Downy Phlox	Pale Purple Cone flower
	Cynthia	Ox eye sunflower
	Common Wood Violet	Prairie Dock

ATWATER PARK RECOMMENDED AND ALTERNATE SOLUTIONS

A solution was recommended for each area. An alternate solution is discussed for each area except for Area A which had one clear solution. Cost estimates for the recommended and alternate solutions are shown in Table A-2.

Area A

This area is experiencing erosion along the chain link fence. The eroding face is relatively short (~ 2 feet high). The cement foundations for the fence posts are exposed. Given the tight confines of the eroded area the recommended solution is to build a short concrete block wall as described above. The area of backfill would be minimal. The fence line would be temporarily removed and then reinstalled, leaving no gaps for people to take a short cut through.

Area B

This area has the steepest slopes and the most erosion. Slopes are approximately 1.5:1. Either the installation of the cellular web mats or a concrete block retaining wall and backfilling to 3:1 slopes may be appropriate. Additional evaluation may be required to determine whether or not the cellular web mats can hold the existing slopes. The total retaining wall total wall height at the south end of the area would be around 11 feet. The wall would probably be in two tiers. The effect of the additional weight of the backfill on slope stability should be considered.

The recommended solution, installing a cellular web mat is less costly and requires the addition of less backfill on the slope, than the alternate solution of constructing a concrete block retaining wall.

Area C Gully Erosion

Area C is an eroded gully along the north property line caused by the runoff coming off of the trail landing and from a 4" PVC drain tile outfall. The drain tile originates at the keystone walls at the first landing. It is recommended that the curb at the landing be rebuilt so that surface runoff does not overtop it. There are two approaches to alleviating the gully erosion. One is to extend the drain tile sub-surface to the sand beach at the base of the hill. The other is to carry the surface flow down a series of terraces constructed out of treated timbers filled with gravel.

The recommended solution, the extension of the drain tile to the bottom of the hill, is less costly and disruptive than the installation of a series of timber terraces.

Area D

The strip of land immediately adjacent to the trail in Area D is steep and prone to erosion. Slopes within 10 feet of the trail are approximately 1.5:1. As in Area B both the use of the cellular web mats and a concrete block wall were considered. The matting could be installed in 8 - 10 foot widths along the trail if the slopes are suitable. A short (1 foot) concrete block wall is used to tie in the bottom edge of the mat. A concrete block wall installed without cellular web matting and backfilled would be approximately three feet high.

The recommended solution, the concrete block wall, is slightly less costly than the cellular web mat. The incremental cost of going from a one foot concrete block wall to three foot wall is more than offset by the cost of the web matting.

Area E

While not as erosion prone as the other sites, this area is still lacking adequate erosion protection. Therefore, it would be beneficial to provide additional protection. Average slopes in this area are approximately 2:1. Installing cellular web mats or taking vegetation management actions to enhance the ground cover were considered.

The recommended solution, vegetation management is less costly and disruptive than the alternate solution of installing the web matting.

Atwater Park Erosion Control Alternatives Cost Estimates

Materials, labor, and planting costs for each of the erosion control alternative were estimated. Design costs were not included.

Table A-2
Atwater Park Erosion Control Cost Estimates

Area	Recommended Solution	Cost Estimate	Alternate Solution	Cost Estimate
Area A	concrete block wall	$4,500	N/A	N/A
Area B	cellular web mat	$9,200	concrete block wall	$14,600
Area C	drain tile extension	$1,800	timber terraces	$4,000
Area D	concrete block wall	$6,300	cellular web mat	$6,400
Area E	vegetation management	$4,000	cellular web mat	$20,000
Total		$25,800		

EDGEWOOD DEVELOPMENT CONSTRUCTION SITE EROSION CONTROL

The Edgewood Development site is the block of land bounded by Edgewood, Prospect, and Maryland Avenues, and Stratford Court. The Village of Shorewood has purchased this land with the intent of constructing residential housing. The site plan has not been determined and construction sequence and timing is not currently known.

Construction site erosion can be a major short term source of sediment in nonpoint source pollution. Due to the lack of undeveloped land in Shorewood, this has not been a major concern. However, the Edgewood site is one of the few parcels of land in Shorewood with new construction planned and, it is important that construction site erosion from this site be minimized.

The Village currently has a construction site erosion control ordinance (Article 3 of Ordinance 1697) which is based upon Wisconsin's model construction site erosion control ordinance. This ordinance applies to redevelopment as well as to new development. If implemented correctly, this ordinance can significantly minimize the amount of construction site sediment coming off of a site. The ordinance requires and erosion control plan in order to receive an erosion control permit.

The erosion control plan is to include a map of erosion control best management practices (BMPs) as required by the ordinance. During the construction period, the site is to be inspected at least once a week and after every rainfall of 0.5 inches or greater. Inspectors are to make requests for needed repairs or to request BMPs as outlined in the erosion control plan. If these requests are not complied with, the Village may post a stop work order or issue a notice of violation. Having the ordinance on the books is by no means a guarantee that it will be complied with. Specific BMPs are described in the "Wisconsin Construction Site Best Management Practice Handbook" (WDNR Publication WR-222 93 REV.). BMPs applicable to this site include:

- tracking pads at site entrances/exits to collect soil from vehicle tires,
- seeding/mulching of disturbed ground which will be exposed for greater than 7 days,
- storm drain inlet protection with filter insert baskets,
- silt fence along down slope edges of graded areas before runoff reaches a street or drainage way,
- clean off-site sediment daily.

EDGEWOOD DEVELOPMENT STORMWATER MANAGEMENT

Alternatives for stormwater management on the site after any potential development were also considered. The costs for these practices, described below, can be borne by the developer.

Direct Rooftop and Parking Lot Runoff onto Pervious Areas. Rather than directly connecting roof drains and parking lot inlets to the combined sewer system, direct the runoff onto grassed areas. This would allow water to infiltrate in the soil or be filtered by the vegetation, improving water quality and reducing runoff volume. Other studies have shown that directing rooftop/parking lot runoff onto pervious areas reduces pollutant loading by approximately 15 percent. Typically, this is unfeasible in currently developed areas of the Village because most yards pitch towards the street and water flowing over the yards could end up icing over the sidewalks in the winter. However, this may be feasible at the Edgewood site if the lot is designed so that overland flow from the landscaped areas does not flow over the sidewalks. Field inlets could be placed to intercept overland flow from grassed areas.

Grass Swale Drainage. The site could be graded so that runoff drains to a grass drainage swale in the center of the block. The grass swale could then drain into a field drain and then into the combined sewer. The grass swale could filter and infiltrate stormwater and slow down peak flows. SLAMM analysis indicates a 42 percent reduction in sediment loading by switching from curb and gutter drainage to grass swale drainage. The site has a number of trees which the development will try to avoid removing. The resulting green space may provide room for the grass swale, which would be configured to blend in with the natural topography of the site.

Parking Lot Bioswales. Runoff from the parking lots could drain to bioswales which are swales with a series of check dams planted with wetland vegetation. Bioswales both enhance infiltration and filter runoff. Water that is not infiltrated flows into a raised overflow into the combined sewer system. A properly designed bioswale can reduce sediment loading from the parking lot by greater than 50 percent. Approximately two feet of length is required from each parking stall for the bioswale.

EDGEWOOD DEVELOPMENT RECOMMENDATIONS

It is recommended that the Village erosion control ordinance be adhered to and enforced during any potential construction. Recommended stormwater practices for the site after construction include directing rooftop and parking lot runoff onto pervious areas, constructing parking lot bioswales, and constructing an interior lot grass drainage swale. The costs for these practices can be born by the developer.

APPENDIX B

REPLACEMENT AND STORAGE ALTERNATIVES

TABLE B-1
REPLACEMENT ALTERNATIVE
10-YEAR RECURRANCE INTERVAL STORM
SHOREWOOD, WISCONSIN

Pipe Id.	Link No.	Length (Ft.)	Size (In.)	Cost ($)
1130-1140	4	229	30	$22,674.00
1140-1200	5	114	30	$11,800.00
1200-1300	6	153	36	$27,237.00
1300-1310	7	199	42	$47,445.00
1310-1400	8	80	42	$10,448.00
1400-1410	9	80	42	$9,945.00
1410-1420	10	35	42	$4,230.00
1420-1430	11	370	42	$40,745.00
2100-2110	12	174	21	$8,343.00
2110-2220	13	58	36	$10,908.00
2200-2220	14	174	30	$14,740.00
2220-2300	15	130	36	$19,093.00
2300-2310	16	35	36	$4,765.00
3400-3410	31	315	30	$39,023.00
3410-3415	32	295	36	$62,605.00
3415-3500	33	51	30	$13,551.00
3610-3620	39	320	30	$33,338.00
3620-3630	40	102	30	$12,933.00
3630-3650	41	106	30	$33,477.00
3500-3510	46	245	54	$89,942.00
3510-3650	47	282	54	$117,074.00
3650-3710	48	627	54	$291,861.00

TABLE B-1 CONTINUED

Pipe Id.	Link No.	Length (Ft.)	Size (In.)	Cost ($)
3260-3300	53	329	30	$33,272.00
3300-3350	54	271	30	$31,011.00
3050-3060	56	300	30	$31,795.00
3060-3100	57	122	30	$12,997.00
3100-3110	58	275	36	$32,835.00
3110-3120	59	40	36	$4,886.00
3120-3160	60	35	36	$3,383.00
3160-3170	61	332	42	$43,938.00
3170-3180	62	385	42	$53,004.00
3180-3190	63	25	42	$3,614.00
3190-3200	64	23	42	$3,349.00
4100-4200	70	323	21	$18,892.00
4200-4300	71	97	30	$9,285.00
4300-4400	72	218	30	$22,104.00
4400-4500	73	133	30	$16,997.00
5000-5010	75	198	24	$16,764.00
5010-5020	76	280	24	$20,753.00

	$1,285,056.00
Manholes and Appurtenances	$128,506.00
Contingency	$321,264.00
Total	$1,734,826.00

TABLE B-2
STORAGE ALTERNATIVE
10-YEAR RECURRANCE INTERVAL STORM
SHOREWOOD, WISCONSIN

Pipe Id.	Length (Ft.)	Volume (cuft)	Box culvert (Ft x Ft)	Cost ($)
1000	178	12,866	12 x 6	$140,118.00
2100	221	15,985	12 x 6	$176,635.00
2200	75	7,253	12 x 8	$64,658.00
3450	287	17,283	12 x 5	$210,002.00
3400	103	9,996	12 x 8	$91,524.00
3600	123	8,919	12 x 6	$98,455.00
3250	87	6,314	12 x 6	$68,183.00
3050	138	10,016	12 x 6	$110,917.00
4000	101	6,114	12 x 5	$73,924.00
5000	256	12,347	12 x 4	$172,234.00
Total		107,093		$1,206,651.00
			Manholes and Appurtenances	$120,655.00
			Contingency	$301,663.00
			Total	$1,628,979.00

APPENDIX C

TABLE C-1
SUB-BASIN LAND USE AREAS
VILLAGE OF SHOREWOOD

Basin i.d.	HDRDC (acres)	MDRDC (acres)	MFRDC (acres)	STRDC (acres)	INSDC (acres)	LINDC (acres)	OPN (acres)	PRK (acres)	Total (acres)
1100	9		0.8		6				15.8
1200	12.1		0.8	0.5					13.4
1300	0.9		3.7	0.8				1	6.4
1390			0.4					2.9	3.3
1400	2.3							1.7	4
2100	1			8.9					9.9
2200	3.7			3.1	10.2				17
2300			1.8	4.2	2	1.8		0.4	10.2
2400			0.3		4.9			0.8	6
3050	10.2			2.8					13
3100	13.8			0.2					14
3150	7.5			0.4					7.9
3200	7.9		0.1	0.5					8.5
3250	0.1	6.2	4.3					0.6	11.2
3300	1	5.3	3.8					0.7	10.8
3350	10.2		3.2		0.5			1.1	15
3400	12.6	2.7							15.3
3450	9.4	9.8		0.9					20.1
3500	7.6	16.2							23.8
3550	3.6	7.8							11.4
3600	9.8			0.8	4.2				14.8
3650	11.8				3.9				15.7
3700	3.4	15.8							19.2
3750	12.9			0.8					13.7
3800	7.2			1.3	4.2				12.7
3850	7.6	0.2							7.8
3900	18.7								18.7
4100	1.1	4.9							6
4200	6.4		6.1					0.5	13
5000			14.2						14.2
6000	1.8			0.1		5.2			7.1
7000			1.3		2.6	2.3	4.9	76	87.1
8000		0.3							0.3
									467.3
TOTALS	**193.6**	**69.2**	**40.8**	**25.3**	**38.5**	**9.3**	**4.9**	**85.7**	**467.3**