

Section 6

Water Quality Analysis

6.1 Introduction

A water quality analysis was conducted to estimate the amount of pollutants that are discharged to the major streams within New Berlin via storm water runoff. The water quality analysis was conducted using a unit-area loading model which is based in part on the Source Loading and Management Model (SLAMM) developed by the WDNR.

The type and amount of pollutants carried with storm water depend on the types of land use. Transportation, industrial, and commercial areas are typically major contributors of sediments and metals due to vehicular traffic and outside material storage. Residential areas typically contribute sediment and metals, along with pesticides, fertilizers, and bacteria. The pollutant loading rate for residential areas varies with the density of development. Park and open space areas generally contribute relatively minor amounts of metals and sediment. Park areas typically contribute significant amounts of nutrients due to landscaping practices.

The type of storm water conveyance system affects the quality of the storm water runoff. Grassed swales, when properly designed and maintained, filter out pollutants and reduce runoff quantity through infiltration. Engineered storm sewer systems convey runoff and pollutants to the receiving stream without an opportunity for filtration.

The water quality analysis was conducted for five pollutants: sediment, phosphorous, copper, lead, and zinc. These five pollutants are associated with urban storm water runoff and often cause water quality problems in urban streams as identified in Table 6-1.

Table 6-1: Major Storm Water Pollutants, Sources, and Water Quality Impacts

Pollutant	Typical Sources	Water Quality Impacts
Sediment	Soil, atmospheric deposition (dust), litter and debris, particles from automobiles and tires, deteriorated pavement	Decreases water clarity, covers valuable plants and bottom dwelling organisms, destroys breeding sites, reduces aquatic plant photosynthesis
Phosphorous	Fertilizer, organic matter (leaves, grass clippings), soil	Excessive algal growth, dissolved oxygen reduction, odors
Copper	Automobile brake pads, wire, roof materials	Toxic to aquatic life
Lead	Atmospheric deposition, automobiles, paint, medical equipment	Toxic to aquatic life
Zinc	Galvanized steel roof drains and downspouts, coatings, rubber products	Toxic to aquatic life

A separate industrial pollutant loading analysis was conducted to further evaluate the amount of pollutants discharged to storm water runoff from industries within the City of New Berlin. The analysis was conducted for conventional and toxic pollutants anticipated being discharged in storm water from various types of industries. The objective of the industrial analysis is to determine the pollutants with the highest loading rate from industries within New Berlin, the industries with the greatest potential for contributing significant storm water pollutant loadings, and identification of selected best management practices which, when implemented will reduce the pollutant loading.

6.2 Water Quality Analysis Methodology

6.2.1 Study Area Analysis

The amount of pollutants which are contained in storm water runoff discharging to the major streams within the City of New Berlin were estimated using a unit-area loading rate model. The analysis was based on the following information:

- Land use in accordance with the areal photographs, land use maps, and other information provided by the City of New Berlin. Land use was calculated for the study area under current (1995) and future development conditions as shown on the zoning map. Land use conditions are described in Section 3.2 of this report.
- Pollutant loading rates for each land use category based on previous studies using the Source Loading and Management Model, research results, and professional judgement. The pollutant loading rates utilized in the model are presented in Table 6-2.
- Existing storm water control practices and study area characteristics including use of drainage swales or retention ponds.

Table 6-2: Unit Area Pollutant Loading Rates for the City of New Berlin Study Area

Land Use	Unit Area Loading Rates (lb./ac./yr.)				
	Sediment	Phosphorous	Lead	Copper	Zinc
Wetland, Forest, Preservation	3	0.03	0.01	0.01	0.01
Park	417	2.81	0.01	0.01	0.06
Institutional / Business Park	421	1.80	0.18	0.08	1.09
Low Density Residential	205	0.19	0.13	0.06	0.08
Medium Density Residential	410	0.38	0.26	0.11	0.16
High Density Residential	574	0.52	0.36	0.16	0.22
Commercial	1056	1.07	2.7	0.4	2.10
Industrial	430	0.14	1.2	0.25	3.65
Highway	1003	2.20	5.730	0.62	2.60
Arterial	288	1.12	0.056	0.15	0.56
Agriculture	450	0.86	0.01	0.01	0.01
Construction	6,000	2.2	0.23	0.09	0.3
Extractive, Landfill	3,344	0.09	0.01	0.01	0.01
Open Water	185	0.13	0.04	0.04	0.04

6.2.2 Industrial Analysis

The industrial pollutant loading analysis was conducted to further evaluate the amount of pollutants discharged to storm water runoff from industries within the City of New Berlin. The analysis was based on the following information:

- Industrial facility information including Standard Industrial Classification (SIC) Code, acres, and percent impervious. The industrial facility information was provided by the City of New Berlin through tax records and the New Berlin Industrial Park Directory.
- Pollutant loading rates for specific types of industries based on storm water sampling data collected from 6,500 industrial facilities nationwide as part of the U.S. Environmental Protection Agency's (USEPA's) group industrial storm water permitting program.

6.3 Water Quality Analysis Results

6.3.1 Study Area Analysis

The water quality analysis summarizes the annual anticipated pollutant loadings, in pounds per year, by land use category and by subwatershed / subbasin designation. The results can then be used to target appropriate best management practices (BMPs) to effectively reduce the pollutant loadings in critical areas.

The analysis indicates that construction, extractive, commercial, and highway land use contributes the highest loading of sediment per acre, while parks, highways, and construction land use contributes the highest loading of phosphorous per acre, and commercial, industrial, and highway land use contributes the highest per acre loading of metals. Based on total loadings of pollutants from the City of New Berlin:

- agriculture and residential land use account for 49 and 44 percent of the total sediment loading under existing and future conditions, respectively;
- extractive land use accounts for more than 20 percent of the total sediment loading;
- agriculture and park land use account for 57 and 46 percent of the phosphorous loading under existing and future conditions, respectively;
- commercial, industrial, and highway land use account for 46 to 78 percent of the total metals loadings under existing and future land use conditions; and
- the total sediment and phosphorus loadings are reduced by 12 and 6 percent, respectively from existing to future conditions while metal loadings are increased by more than 30 percent due to development of agricultural lands.

The annual anticipated pollutant loadings, by land use, under the existing and future land use conditions are presented on Table 6-3 and 6-4. The distribution of the annual pollutant loading by land use for existing and future conditions is shown on Figure 6-1. A comparison of the total annual pollutant loadings under existing and future conditions is shown on Figure 6-2.

Tables 6-5 and 6-6 present a summary of the annual anticipated loadings by subwatershed within the City of New Berlin under existing and future conditions. Generally, the subwatersheds which contribute the highest pollutant loading correlate with the land uses discussed above. In order to reduce the influence of the subwatershed size on the pollutant loadings, a pound per acre per year loading was evaluated for each subwatershed. The sediment and metals pollutant loading, based on pounds per acre per year, varies in accordance with the percentage of urban land use. The phosphorous pollutant loading, based on pounds per acre per year, does not vary significantly between subwatershed. A comparison of pollutant loadings based on pounds per acre per year is presented in Figure 6-3.

The water quality model results are presented in Appendix E.

**Table 6-3: Existing Annual Pollutant Loadings By Land Use
City of New Berlin - Storm Water Management Study**

Land Use	Area (acres)	Pollutant														
		Sediment			Phosphorous			Lead			Copper			Zinc		
		(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)
Wetland, Forest, Preservation	5,147	15,442	3	0%	154	0.0	1%	51	0.01	1%	51	0.01	4%	51	0.01	1%
Agriculture	7,152	3,218,257	450	30%	6,150	0.9	47%	72	0.01	1%	72	0.01	5%	72	0.01	1%
Park	478	199,488	417	2%	1,344	2.8	10%	5	0.01	0%	5	0.01	0%	29	0.06	0%
Institutional	625	262,960	421	2%	1,124	1.8	9%	115	0.18	2%	50	0.08	3%	681	1.09	9%
Low Density Residential	4,366	894,984	205	8%	838	0.2	6%	559	0.13	9%	244	0.06	17%	349	0.08	5%
Medium Density Residential	2,282	935,600	410	9%	858	0.4	7%	584	0.26	9%	256	0.11	17%	365	0.16	5%
High Density Residential	301	172,523	574	2%	156	0.5	1%	108	0.36	2%	48	0.16	3%	67	0.22	1%
Commercial	567	598,511	1,056	6%	606	1.1	5%	1,530	2.70	24%	227	0.40	15%	1,190	2.10	16%
Industrial	850	365,637	430	3%	119	0.1	1%	1,020	1.20	16%	213	0.25	15%	3,104	3.65	43%
Highway	369	370,559	1,003	3%	813	2.2	6%	2,117	5.73	33%	229	0.62	16%	961	2.60	13%
Arterial	198	56,958	288	1%	222	1.1	2%	111	0.56	2%	30	0.15	2%	111	0.56	2%
Open Water	358	66,311	185	1%	47	0.1	0%	14	0.04	0%	14	0.04	1%	14	0.04	0%
Extractive, Landfill	668	2,233,227	3,344	21%	59	0.1	0%	7	0.01	0%	7	0.01	0%	7	0.01	0%
Railroad	83	44,880	540	0%	37	0.4	0%	35	0.42	1%	0	0.00	0%	166	2.00	2%
Construction	200	1,200,000	6,000	11%	440	2.2	3%	46	0.23	1%	18	0.09	1%	60	0.30	1%
<i>Total</i>	<i>23,644</i>	<i>10,635,300</i>	<i>450</i>	<i>100%</i>	<i>12,968</i>	<i>0.5</i>	<i>100%</i>	<i>6,374</i>	<i>0.27</i>	<i>100%</i>	<i>1,463</i>	<i>0.06</i>	<i>100%</i>	<i>7,227</i>	<i>0.31</i>	<i>100%</i>

**Table 6-4: Existing Annual Pollutant Loadings By Drainage Area
City of New Berlin - Storm Water Management Plan**

Drainage Areas	Area (acres)	Pollutant														
		Sediment			Phosphorous			Lead			Copper			Zinc		
		(lb./yr.)	(lb./ac./yr)	(% Total)	(lb./yr.)	(lb./ac./yr)	(% Total)	(lb./yr.)	(lb./ac./yr)	(% Total)	(lb./yr.)	(lb./ac./yr)	(% Total)	(lb./yr.)	(lb./ac./yr)	(% Total)
Calhoun Creek	4,135	2,518,962	609	24	2,534	0.6	20	1,975	0.48	31	316	0.08	22	1,179	0.29	16
Upper Root River	4,106	1,636,176	399	15	2,485	0.6	19	1,191	0.29	19	312	0.08	21	971	0.24	13
Tess Corners Creek	1,707	553,124	324	5	1,008	0.6	8	266	0.16	4	63	0.04	4	247	0.14	3
Underwood Creek	462	184,459	399	2	284	0.6	2	133	0.29	2	47	0.10	3	168	0.36	2
Deer Creek	2,769	1,211,690	438	11	1,347	0.5	10	1,382	0.50	22	319	0.12	22	2,582	0.93	36
Poplar Creek	8,075	3,125,361	387	29	3,989	0.5	31	1,162	0.14	18	337	0.04	23	1,907	0.24	26
Mill Creek	2,391	1,405,565	588	13	1,316	0.6	10	265	0.11	4	69	0.03	5	173	0.07	2
<i>Total</i>	<i>23,644</i>	<i>10,635,300</i>	<i>450</i>	<i>100</i>	<i>12,962</i>	<i>0.5</i>	<i>100</i>	<i>6,374</i>	<i>0.27</i>	<i>100</i>	<i>1,463</i>	<i>0.06</i>	<i>100</i>	<i>7,227</i>	<i>0.31</i>	<i>100</i>

**Table 6-5: Future Annual Pollutant Loadings By Land Use
City of New Berlin - Storm Water Management Study**

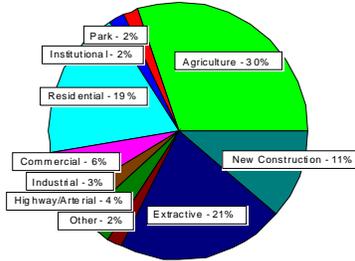
Land Uses	Area (acres)	Pollutant														
		Sediment			Phosphorous			Lead			Copper			Zinc		
		(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)
Wetland, Forest, Preservation	4,596	13,789	3	0	138	0.0	1	46	0.01	1	46	0.01	2	46	0.01	0
Agriculture	2,925	1,316,077	450	14	2,515	0.9	21	29	0.01	0	29	0.01	1	29	0.01	0
Park	1,090	454,693	417	5	3,064	2.8	25	11	0.01	0	11	0.01	1	65	0.06	1
Institutional	867	365,150	421	4	1,561	1.8	13	160	0.18	2	69	0.08	4	945	1.09	8
Low Density Residential	6,525	1,337,571	205	14	1,253	0.2	10	835	0.13	10	365	0.06	19	522	0.08	5
Medium Density Residential	2,820	1,156,363	410	12	1,060	0.4	9	722	0.26	8	316	0.11	16	451	0.16	4
High Density Residential	673	386,065	574	4	350	0.5	3	242	0.36	3	108	0.16	5	151	0.22	1
Commercial	809	854,680	1,056	9	866	1.1	7	2,185	2.70	26	324	0.40	16	1700	2.10	15
Industrial	1,662	714,777	430	8	224	0.1	2	1,995	1.20	23	416	0.25	21	6067	3.65	54
Highway	370	371,522	1,003	4	815	2.2	7	2,122	5.73	25	230	0.62	12	963	2.60	9
Arterial	199	57,404	288	1	223	1.1	2	112	0.56	1	30	0.15	2	112	0.56	1
Open Water	358	66,196	185	1	47	0.1	0	14	0.04	0	14	0.04	1	14	0.04	0
Extractive, Landfill	665	2,225,368	3,344	24	60	0.1	0	7	0.01	0	7	0.01	0	7	0.01	0
Railroad	83	44,761	540	0	36	0.4	0	35	0.42	0	0	0.00	0	166	2.00	1
Total	23,644	9,364,400	396	100	12,213	1	100	8,515	0	100	1,964	0	100	11,238	0	100

**Table 6-6: Future Annual Pollutant Loadings By Drainage Area
City of New Berlin - Storm Water Management Study**

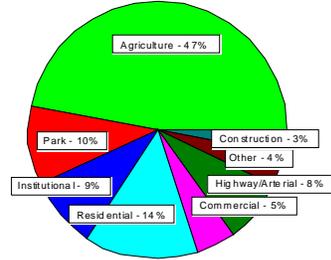
Drainage Areas	Area (acres)	Pollutant Type														
		Sediment			Phosphorous			Lead			Copper			Zinc		
		(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)	(lb./yr.)	(lb./ac./yr.)	(% Total)
Calhoun Creek	4,135	2,442,797	591	26	2,354	0.57	19	2,774	0.67	33	459	0.11	23	2,579	0.62	23
Upper Root River	4,106	1,505,222	367	16	2,376	0.58	19	1,574	0.38	18	425	0.10	22	1,208	0.29	11
Tess Corners Creek	1,707	526,783	309	6	973	0.57	8	315	0.18	4	80	0.05	4	495	0.29	4
Underwood Creek	462	186,176	403	2	288	0.62	2	140	0.30	2	48	0.10	2	175	0.38	2
Deer Creek	2,769	1,203,665	435	13	1,325	0.48	11	1,713	0.62	20	401	0.14	20	3,507	1.27	31
Poplar Creek	8,075	2,394,781	297	26	3,453	0.43	28	1,676	0.21	20	460	0.06	23	3,062	0.38	27
Mill Creek	2,391	1,104,991	462	12	1,443	0.60	12	323	0.14	4	92	0.04	5	212	0.09	2
<i>Total</i>	<i>23,644</i>	<i>9,364,416</i>	<i>396</i>	<i>100</i>	<i>12,213</i>	<i>0.52</i>	<i>100</i>	<i>8,515</i>	<i>0.36</i>	<i>100</i>	<i>1,964</i>	<i>0.08</i>	<i>100</i>	<i>11,238</i>	<i>0.48</i>	<i>100</i>

Existing Conditions

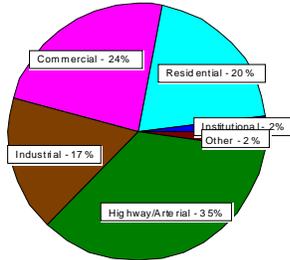
Sediment



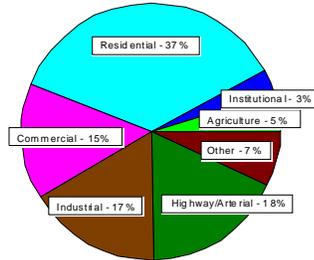
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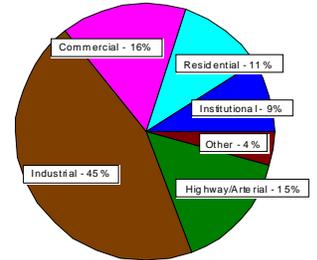
Lead



Copper

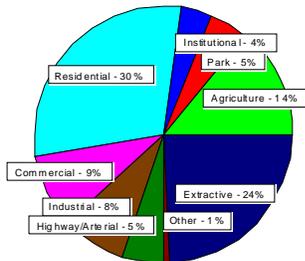


Zinc

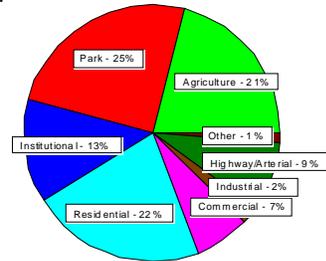


Future Conditions

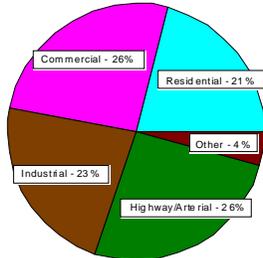
Sediment



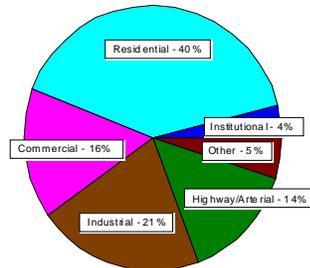
Phosphorous



Lead



Copper



Zinc

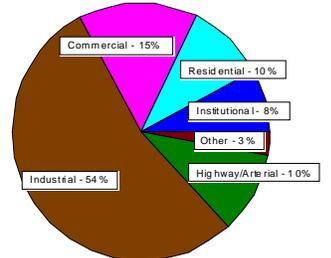
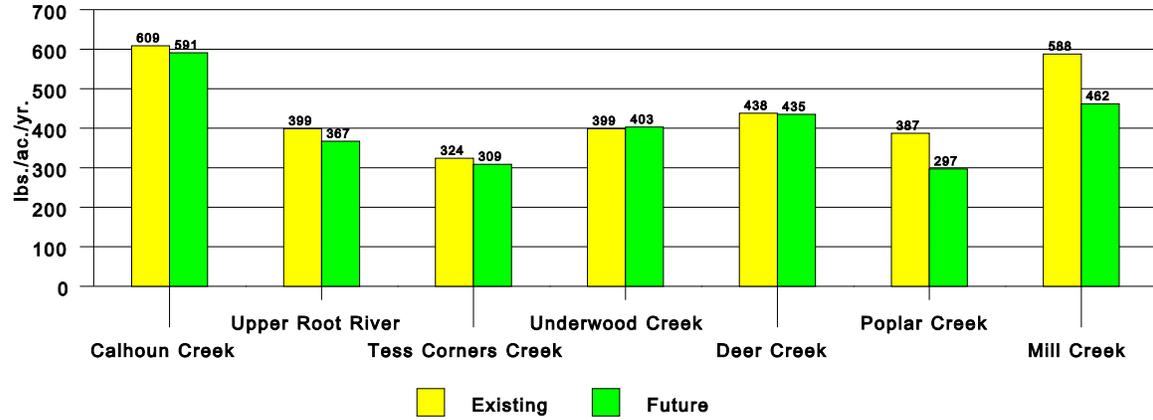
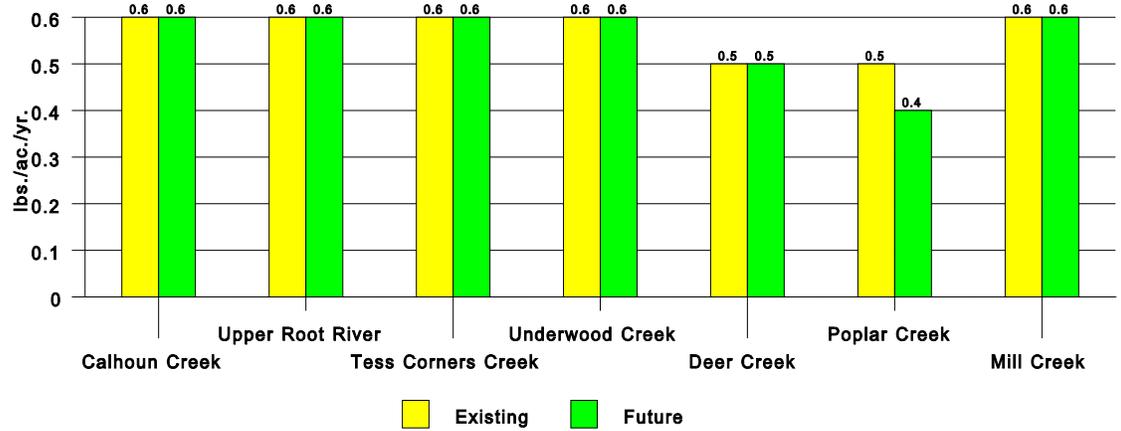


Figure 6-3: Comparison of Subwatershed Pollutant Loadings

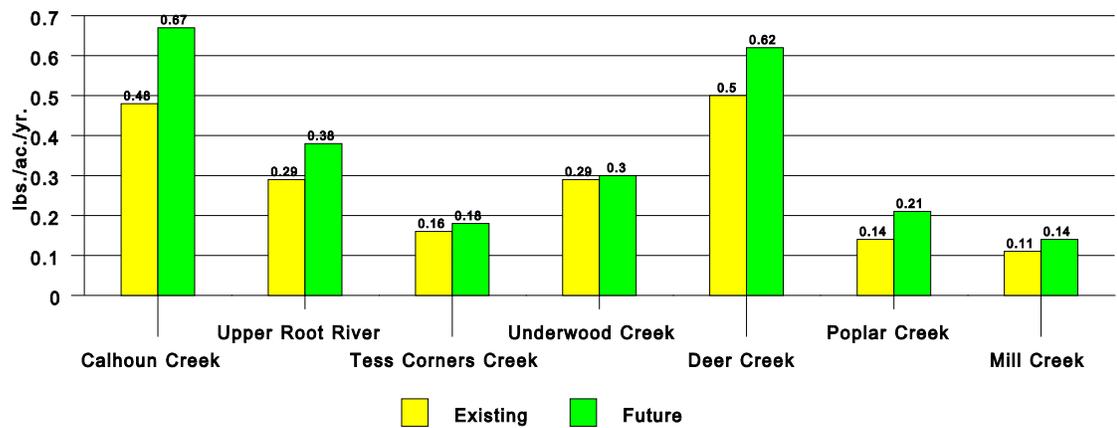
Sediment



Phosphorous



Lead



Note: The pollutant loadings for copper and zinc are not shown because the variation between the subwatersheds is similar to that shown for lead.

6.3.2 Industrial Analysis

The industrial analysis estimated storm water pollutant loadings from 182 industries within the City of New Berlin. The water quality analysis summarizes the annual anticipated pollutant loading, in pounds per year, by industrial category. The results can then be used to identify those industries that have the greatest potential for contributing significant storm water pollutant loadings and to identify appropriate best management practices for those industries.

The industries included in the analysis, are industries which, based on their SIC code, are likely required to obtain a Wisconsin Industrial Storm Water Permit. The industries are grouped into 13 different categories based on the general type of manufacturing facility. A majority of the industries included in the analysis are grouped in the categories of fabricated metal products, transportation equipment, electronics, land transportation, or printing and publishing. These industrial categories also occupy a majority of the total acres included in the analysis. A description of the industrial categories included in the analysis is presented in Table 6-7.

Table 6-7: Summary of Industrial Facilities in New Berlin

Industrial Category	Number of Facilities	Total Acres Occupied	Percent of Total Industrial Acres	Average Percent Impervious
Timber Products	6	16	4	45
Fabricated Metal Products	23	57	13	46
Transportation Equipment, Industrial & Commercial	52	101	24	54
Electronic, Electrical, Photographic and Optical	25	90	21	42
Paper & Allied Products	3	5	1	54
Chemical and Allied Products	5	5	1	46
Asphalt Paving and Roofing Materials Manufacturers and Lubricant manufacturers	1	2	1	30
Glass, Clay, Cement, Concrete, and Gypsum	2	4	1	44
Land Transportation	25	49	12	57
Food and Kindred Products	10	27	6	43
Textile Mill, Apparel and Other Fabric Products	3	10	2	69
Printing and Publishing	21	53	12	52
Rubber, Misc. Plastic Products	6	9	2	75
<i>TOTAL</i>	182	428	100	---

The industries included in the analysis are based on information provided by the City of New Berlin through tax key records and the *New Berlin Industrial Park Directory*. It should be noted that the quarries located within the City of New Berlin were not included in the industrial water quality analysis because specific information regarding these facilities was not provided. The quarries are included in the study area analysis as extractive land use areas.

The analysis indicates that five of the industrial categories, fabricated metal products, transportation equipment, electronics, land transportation, and printing and publishing, contribute over one-half of the total industrial loading of all pollutants. The industrial facilities in these five categories occupy approximately 350 acres, or more than 80 percent of the industrial areas evaluated. Based on the total loading calculated by the industrial water quality analysis:

- A majority of the industrial metals loading is contributed by fabricated metal products, transportation equipment, electronics, land transportation, and printing and publishing facilities.
- A majority of the industrial sediment loading is contributed by Timber Products and Land Transportation facilities.
- A majority of the industrial nutrient loading is contributed by transportation equipment and land transportation facilities.

The unit area pollutant loading contributed by the different types of industries vary greatly. Pollutants of Concern and the industrial category with the highest unit area loading are presented in Table 6-8.

Table 6-8: Highest Industrial Unit Area Loadings

Pollutant of Concern	Industry with the Highest Unit Area Loading
Total Suspended Solids	Timber Products
Phosphorous	Timber Products
Biochemical Oxygen Demand	Timber Products
Copper	Rubber and Misc. Plastic Products
Lead	Paper and Allied Products
Zinc	Paper and Allied Products

The annual anticipated pollutant loading, by industrial category, is presented on Table 6-9.

Table 6-9: Summary of Industrial Storm Water Pollutant Loadings

Industry Sector	Number of Facilities	Acres		Average Percent Impervious	Annual Pollutant Loading (lbs.)																					
		Total Acres	% of Total		Lead		Zinc		Cadmium		Chromium		Copper		Nickel		Total Suspended Solids		Total Phosphorous		Total Kjeldahl Nitrogen		Chemical Oxygen Demand		Biochemical Oxygen Demand	
					(lbs.)	(% of total)	(lbs.)	(% of total)	(lbs.)	(% of total)	(lbs.)	(% of total)	(lbs.)	(% of total)	(lbs.)	(% of total)	(lbs.)	(% of total)	(lbs.)	(% of total)	(lbs.)	(% of total)	(lbs.)	(% of total)	(lbs.)	(% of total)
Timber Products	6	16	4%	45%	--	--	15.5	5%	--	--	0.8	3%	2.1	6%	--	--	14554	21%	19.6	7%	87.8	5%	6609.0	10%	877.8	9%
Fabricated Metal Products	23	57	13%	46%	4.7	12%	80.7	24%	1.0	6%	1.8	7%	3.7	11%	3.4	17%	9710	14%	36.6	13%	256.4	15%	11541.4	17%	1465.5	15%
Transportation Equipment, Industrial or Commercial	52	101	24%	54%	10.2	27%	55.3	16%	2.3	15%	10.1	41%	10.1	30%	7.9	39%	7514	11%	51.3	19%	395.7	23%	12062.4	18%	1977.6	20%
Electronic, Electrical, Photographic and Optical Goods	25	90	21%	42%	6.9	18%	24.3	7%	6.9	44%	5.4	22%	4.2	13%	5.4	27%	3782	5%	43.1	16%	273.1	16%	6484.4	10%	1378.0	14%
Paper & Allied Products Manufacturing	3	5	1%	54%	0.7	2%	13.4	4%	--	--	--	--	--	--	--	--	330	0%	0.5	0%	4.4	0%	178.8	0%	35.9	0%
Chemical & Allied Products Manufacturing	5	5	1%	56%	0.2	1%	5.2	2%	0.2	1%	0.1	1%	0.3	1%	0.2	1%	600	1%	1.6	1%	31.7	2%	803.9	1%	149.4	2%
Asphalt Paving and Roofing Materials Manufacturers and Lubricant Manufacturers	1	2	1%	30%	--	--	--	--	--	--	--	--	--	--	--	--	158	0%	0.8	0%	6.2	0%	310.1	0%	22.5	0%
Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing	2	4	1%	44%	0.1	0%	2.5	1%	0.1	0%	0.1	0%	0.5	2%	0.1	0%	2101	3%	3.1	1%	12.4	1%	540.1	1%	42.0	0%
Land Transportation	25	49	12%	57%	4.9	13%	15.6	5%	4.9	31%	1.1	4%	1.6	5%	2.0	10%	17568	25%	56.6	20%	214.7	12%	9857.6	15%	1073.6	11%
Food & Kindred Products	10	27	6%	43%	2.4	6%	6.4	2%	0.3	2%	0.5	2%	2.7	8%	0.9	5%	6240	9%	25.6	9%	146.8	8%	6606.9	10%	844.2	9%
Textile Mills, Apparel and Other Fabric Products	3	10	2%	69%	1.3	3%	9.8	3%	--	--	0.9	4%	0.8	2%	0.5	2%	938	1%	5.1	2%	70.3	4%	1687.5	3%	330.5	3%
Printing & Publishing	21	53	12%	52%	6.0	16%	100.1	29%	--	--	3.6	14%	5.5	16%	--	--	5003	7%	25.0	9%	188.4	11%	7696.3	11%	1231.5	13%
Rubber, Misc. Plastic Products, and Misc. Manufacturing	6	9	2%	75%	0.5	1%	11.7	3%	--	--	0.3	1%	2.3	7%	--	--	2055	3%	7.9	3%	51.4	3%	2943.0	4%	369.0	4%
Total	182	428	100%	--	37.9	--	340.4	--	15.7	--	24.7	--	33.8	--	20.3	--	70552	--	276.8	--	1739.2	--	67321.4	--	9797.6	--