BAY SHORE POWER PLANT
COOLING WATER INTAKE STRUCTURE
INFORMATION
AND
I&E SAMPLING DATA

Kinectrics Report: 112026-005-RA-0002-R00

January, 2008

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EXECUTIVE SUMMARY

Section 316(b) of the Clean Water Act (CWA) requires that cooling water intake structures reflect the best technology available for minimizing adverse environmental impact to aquatic organisms that are impinged (being pinned against screens or outer part of a cooling water intake structure) or entrained (being drawn into and through cooling water systems). Phase II of the 316(b) rule for existing electric generating plants was designed to reduce impingement mortality by 80-95% and, if applicable, entrainment by 60-90%.

In January 2007, the Second U.S. Circuit Court of Appeals remanded several provisions of the Phase II rule on various grounds. The provisions remanded included:

- EPA's determination of the Best Technology Available under Section 316(b);
- The rule's performance standard ranges;
- The cost-cost and cost-benefit compliance alternatives;
- The Technology Installation and Operation Plan provision;
- The restoration provisions; and
- The "independent supplier" provision.

With so many provisions of the Phase II rule affected by the decision, the USEPA suspended the Phase II rule in July 2007.

This report provides of a summary of information pertaining to Bay Shore Power Plant's Cooling Water Intake Structure (CWIS):

- Source Water Physical Data [40 CFR 122.21(r)(2)];
- Cooling Water Intake Structure Data [40 CFR 122.21(r)(3)];
- Cooling Water System Data [40 CFR 122.21(r)(5)]
- Rates of Impingement and Entrainment of Fish at Bay Shore Power Plant's CWIS.

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GLOSSARY OF TERMS

MGD	million gallons per day
YOY	young-of-the-year
YSL	yolk-sac larvae
PYSL	post-yolk-sac larvae
JUV	juvenile
TL	total length

BAY SHORE POWER PLANT
COOLING WATER INTAKE STRUCTURE

1.0 INTRODUCTION

1.1 Site Location

The Bay Shore Power Plant is located on the southern shore of Maumee Bay, near the mouth of the Maumee River, at the western end of Lake Erie, near Oregon, Ohio. Cooling water for Bay Shore is obtained from the Maumee River/Maumee Bay via an open intake channel and after traversing the condensers, is discharged to Maumee Bay (Figure 1.1).

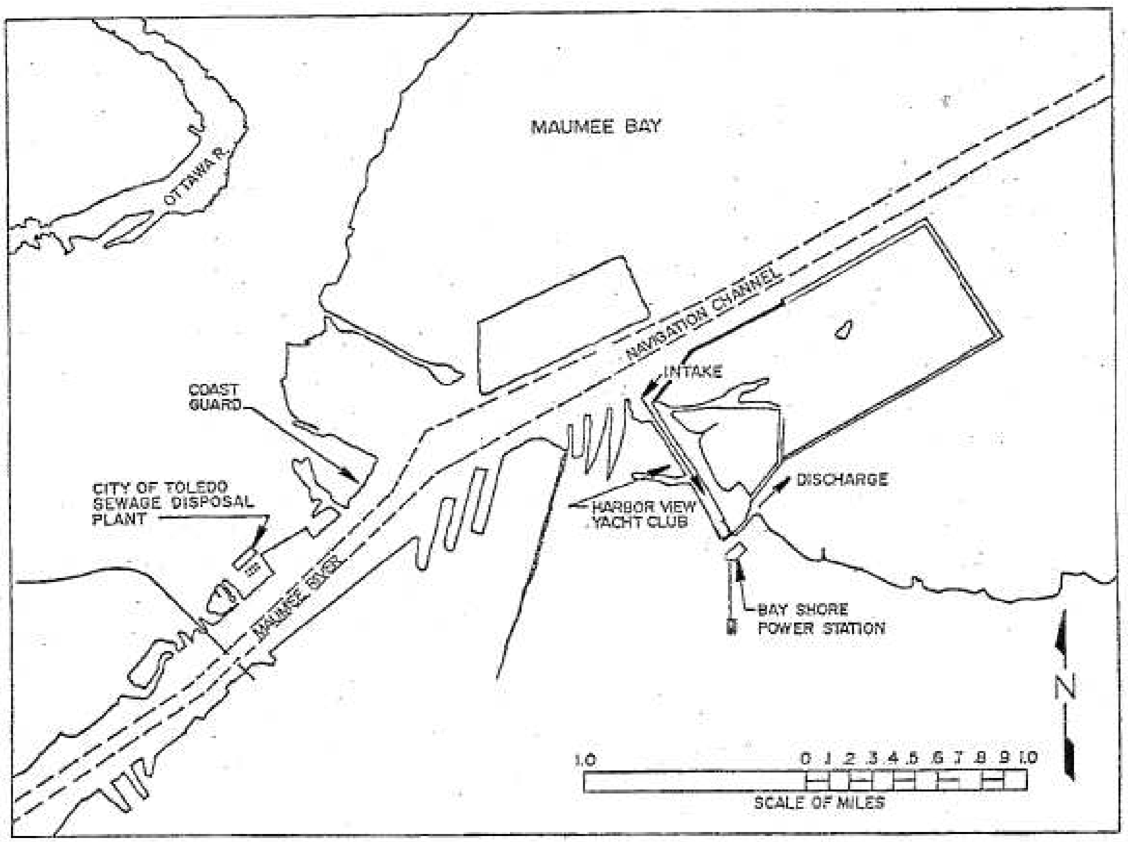


Figure 1.1 General Area Near the Bay Shore Power Plant (Reutter et al., 1978)

1.2 Facility Description

Bay Shore is a 4-unit, coal-fired facility with a total capacity of 631 MW. The operating capacity for Bay Shore is summarized in Table 1.1.

Table 1.1 Capacity of Bay Shore Generating Units

Unit	Generating Capacity (MWe)
1	136
2	138
3	142
4	215
Total	**631**

A photograph of the Bay Shore intake is presented in Figure 1.2. Bay Shore has a surface cooling water intake structure which is described in Section 3.0.

Figure 1.2 Intake at the Bay Shore Power Plant

2.0 SOURCE WATER PHYSICAL DATA

2.1 Maumee River

Bay Shore draws water from the Maumee River/Maumee Bay via an open intake channel which is approximately 3,700 feet in length. The Maumee River is formed in Fort Wayne, Indiana by the merging of the St. Joseph River and St. Marys River. The St. Joseph River forms in Hillsdale County, Michigan and flows southwest into Indiana. The St. Marys River starts in Shelby County, Ohio and flows northwest into Indiana. The Maumee River then flows from Fort Wayne to Toledo, where it empties into Lake Erie. (Smith and Cooper, 1976).

The drainage basin has an area of 6,586 square miles; 1,260 square miles in Indiana, 470 square miles in Michigan and 4,856 square miles in Ohio (Figure 2.1). The diameter of the drainage basin is approximately 100 miles. The average gradient of the Maumee River is 1.3 ft/mile. The St. Marys River averages 2.8 ft/mile and the St. Joseph River averages 1.6 ft/mile. (Smith and Cooper, 1976).

The Maumee River empties into Maumee Bay, at the southwestern end of Lake Erie. The Maumee River has a great range in flows from a low of 400 c.f.s to a high of 10,000, with a median discharge of 5,000 (Figure 2.2). Monthly and yearly mean streamflow for water year 2005 are presented in Figure 2.3. The annual mean discharge for water year 2005 was estimated to be 6,558 cubic feet per second (USGS 04193500 – Maumee River at Waterville OH).[1]

The Maumee is not a large river, but is the largest tributary to Lake Erie. The Maumee River amounts to only 3% of the flow into Lake Erie. Low relief, gentle gradient and fine-grained sediments account for the river's low velocity, muddiness and sediment clogged beds. (Smith and Cooper, 1976).

2.2 Estuary Characteristics

A detailed summary of estuary characteristics has been presented by Smith and Cooper (1976). Relevant information from this report is presented below.

The lower 15 miles of the Maumee River can be considered a freshwater estuary. The formation of this estuary in Lake Erie was caused by a series of geologic events related to Pleistocene glaciation. The flow of the Maumee River was reversed from its south-westerly direction when the glacial lakes drained from the Lake Erie Basin as the ice sheet melted, exposing the outlet to the Niagara River. The lowering of the base level accelerated river velocity and the Maumee valley was cut deeply into lacustrine deposits, glacial tills and bedrock. Removal of the weight of glacial ice allowed the outlet to rebound, raising the water level in the lake. This increase in water level drowned the river mouth. Due to this configuration, the mouth of the Maumee River has been compared to a marine estuary. Most of the south shore tributaries to the lake have estuarine-like lower reaches where the lake water masses affect water level and quality several miles upstream from the traditional mouths.

[1] USGS Surface-Water Annual Statisics for Ohio. National Water Information System. http://waterdata.usgs.gov/usa/nwis/uv?site_no=04193500

The estuary of the Maumee River begins just above the Maumee-Perrysburg Bridge where the bedrock riffles end. Lake effects (flow reversal, sudden change in stage and volume, stagnation, and extreme instability of flow) are felt from the lake up to the riffles.

Figure 2.1 Map of the Maumee River Watershed

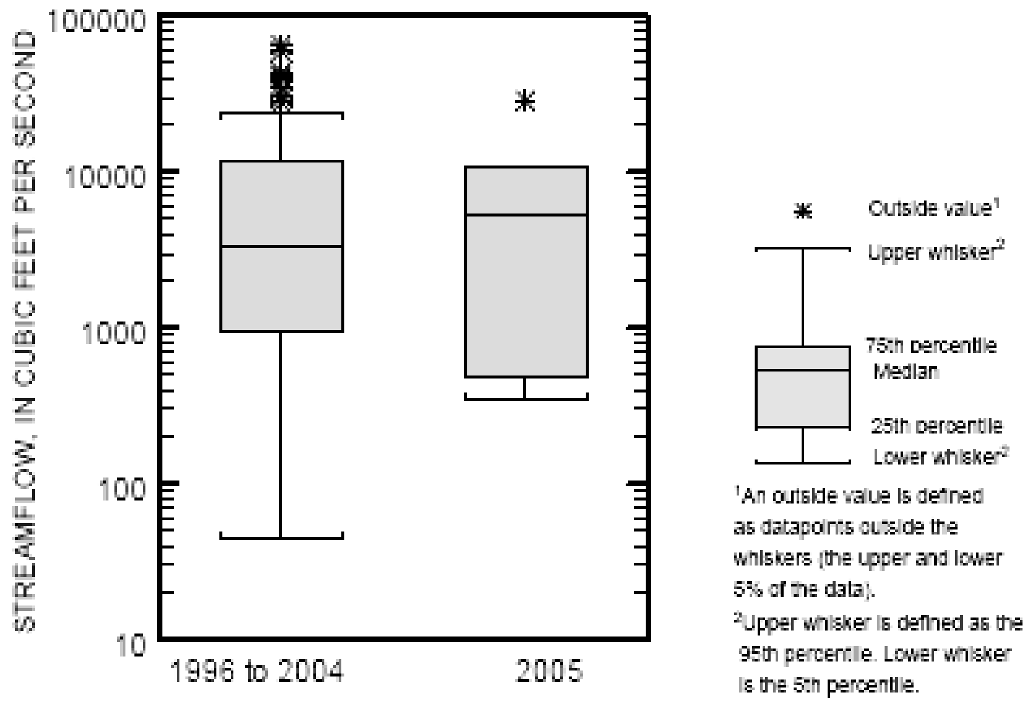


Figure 2.2 Streamflow Measured in Water Year 2005 and the Distribution of Streamflow Measurements made During Water Years 1996-2004, Maumee River at Waterville, Ohio. (Mangus and Frum, 2005)

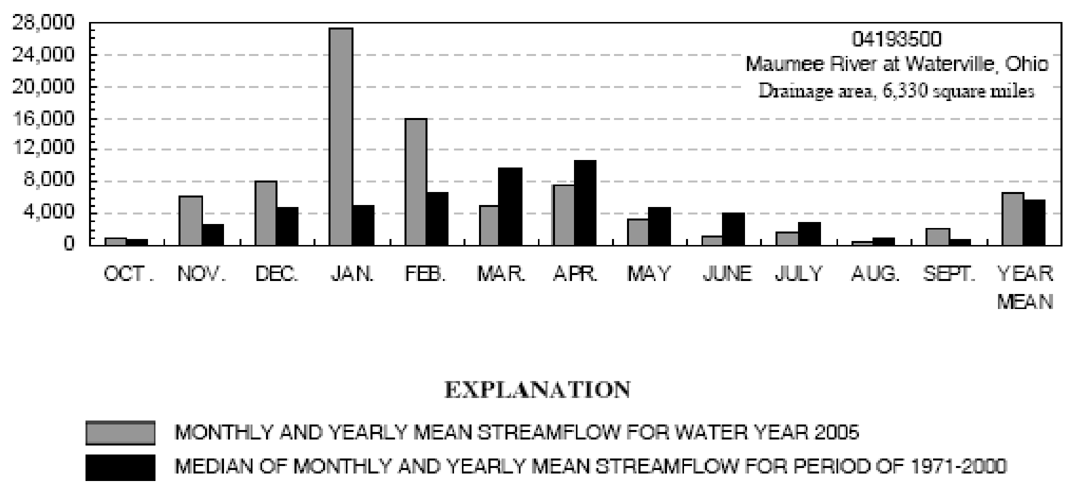


Figure 2.3 Streamflow (cubic feet per second) During Water Year 2005 Compared with Median Streamflow for Period 1971-2000, Maumee River at Waterville, Ohio. (Mangus and Frum, 2005)

At low flow, the Maumee River has little to do with the quantity or exchange rate of water in the estuary. The Maumee estuary is controlled by the level of western Lake Erie and by winds. When the winds blow steadily out of the southwest, the lake falls at Toledo and the water stored in the estuary spills out; when the winds blow out of the north-east, the lake rises at Toledo and the resulting estuarine backflow may drown the lower end of the riffle above the Perrysburg Bridge. In effect, the estuary is a huge, flat lagoon which receives the waters of the free-flowing Maumee and great volumes of Lake Erie water that enter it when backflow is induced by rising lake levels. Obviously, this great "slosh basin" cannot be treated as a free-flowing stream. In fact, the flow which enters the upper end of the estuary is seldom an important hydraulic factor.

The currents in the estuary are basically reversing in nature. The primary generating forces are short-period water-level oscillations (wind tides, surges, and seiches) in Lake Erie, and discharge from the Maumee River. The highest current speeds occur during the formation of a wind tide due to strong southwest winds (causing a rapid fall in water level) along with a significant discharge from the Maumee River.

Large water-level rises in the estuary are not as frequent as at the eastern end of the lake because southwest winds predominate over northeast winds. The frequency of occurrence of various water level rises above mean lake level due to any cause indicates that water level rises increase rapidly to about 4.0 feet (1.2-1.4 meters). A wind tide in excess of 5.0 feet (1.4-1.5 meters) would be an exceptional event.

Currents produced by these water level changes as well as by the flow from the estuary are similar to tidal currents, i.e., the direction of the flow periodically reverses. The current maintains its reversing characteristics when the river discharge is below 7,000 c.f.s. and the effect that the river discharge has on current speed is difficult to determine. Only during periods of rapid rise in lake level does the current change direction from its downstream course (river discharge above 7,000 c.f.s.).

At discharge rates of 20,000 c.f.s or greater, periods of rapid rise in lake level have little effect on the dominant downstream current direction. The latter rate of flow is very infrequent and normally of short duration (Figure 2.2).

Within the shipping channel, outgoing currents range from 0 to 1.5 ft/sec. When the river discharge is moderate (7,000 c.f.s.), the mean velocity at the mouth of the Maumee River ranges from 0.3-0.5 ft/sec. At low discharge (under 350 c.f.s.) the current is aimless. A downstream current at the mouth is persistent about 75 percent of the time. In general, currents in the bay flow outward along the navigation channel about 60 percent of the time.

3.0 COOLING WATER INTAKE STRUCTURE DATA

The Bay Shore Power Plant is located on the southern shore of Maumee Bay at approximately 41^o 41' 00" N latitude and 83^o 26' 00" W longitude, near the mouth of the Maumee River, at the western end of Lake Erie, near Oregon, Ohio. Cooling water for Bay Shore is obtained from the Maumee River/Maumee Bay via an open intake channel and after traversing the condensers, is discharged to the Maumee Bay (Figure 1.1).

Bay Shore draws water from the Maumee River/Maumee Bay via an open intake channel which is approximately 3,700 feet in length. During dry periods of the year (summer), the required plant intake flow may exceed river flow although a grassy island splits the river at this location. In this period, an additional source of intake water is derived from Maumee Bay and Lake Erie.

Bay Shore has nine vertical traveling screens (3/8 in openings), each of which has a bar rack (Figure 3.1). Screen #4 runs only for 15 minutes per day and screen #7 runs for 30 minutes per 12-hr shift. Screen #9 has a small gap between the bottom of the screen and the support structure which does allow for debris to enter the plant. Water is drawn at a depth of approximately 12 feet. The design intake capacity is 810 MGD. Collected fish and debris are sprayed and washed in a sluiceway which discharges into Maumee Bay.

The design-through-screen velocity varies but has been estimated at 2.58 ft/s but approach velocity can be lower.

Heated discharge water is recirculated into the intake area in winter when the intake temperature drops below 35^{o}F. A gate between the intake and discharge canals is opened and remains open until spring (December to late March) when water temperatures rise. Approximately 10% of the total plant cooling water is recirculated at these times. Most of the recirculated water enters the Unit 1 condenser where the Maximum ΔT attributable to recirculated water is 2-3^{o}F (Reutter et al., 1978).

The Bay Shore Station uses water from the Maumee River/Maumee Bay predominantly for cooling of the condensers. It uses city water for several plant processes including sanitary and boiler make-up water. The maximum pumping capacity for the intake structure is 810 MGD. The annual average used is 638.3 MGD. Refer to Figure 3.2 for a more comprehensive Flow Distribution/Water Balance Diagram for Bay Shore Plant.

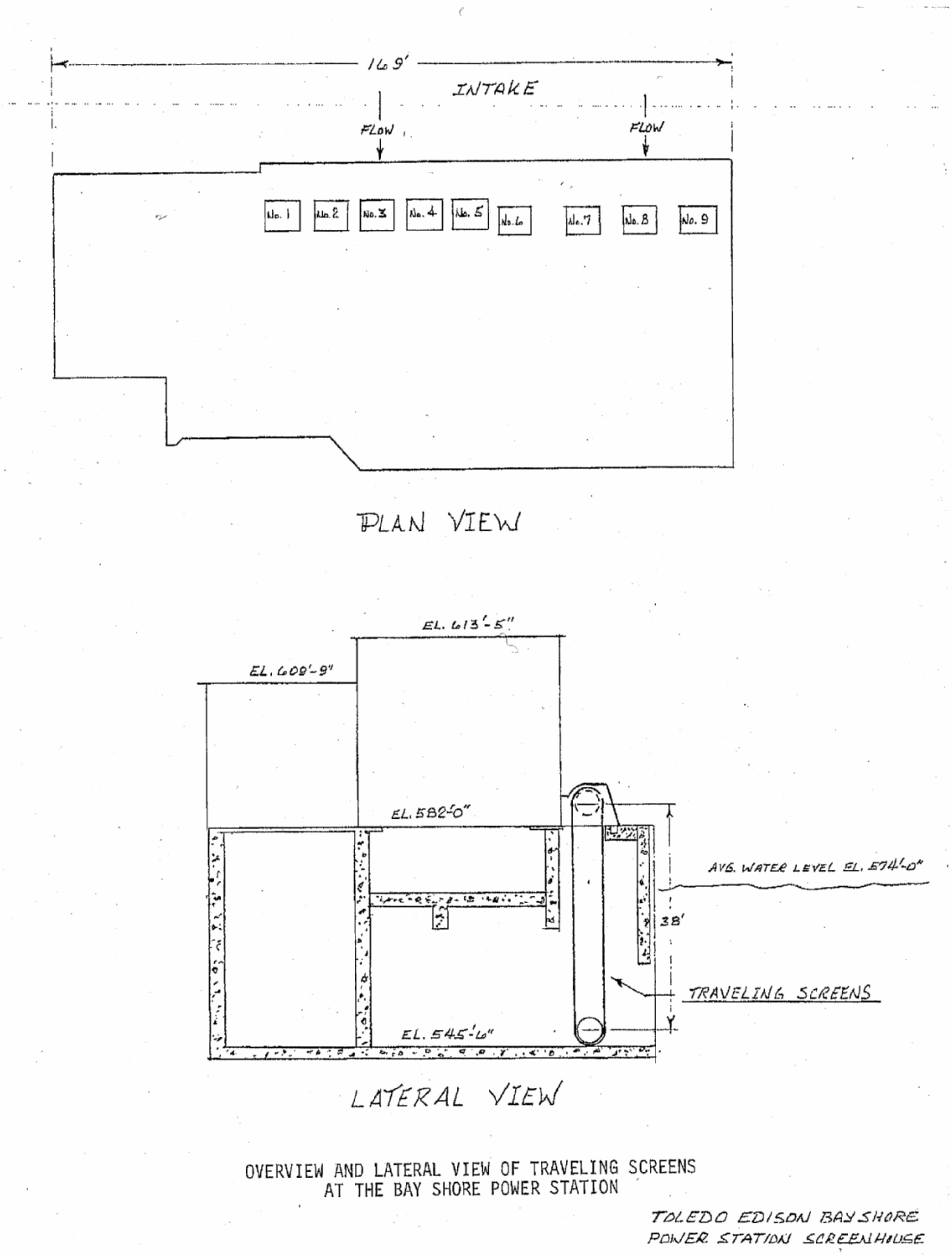


Figure 3.1 Overview and Lateral View of Traveling Screens at the Bay Shore Power Plant (Reutter et al., 1978)

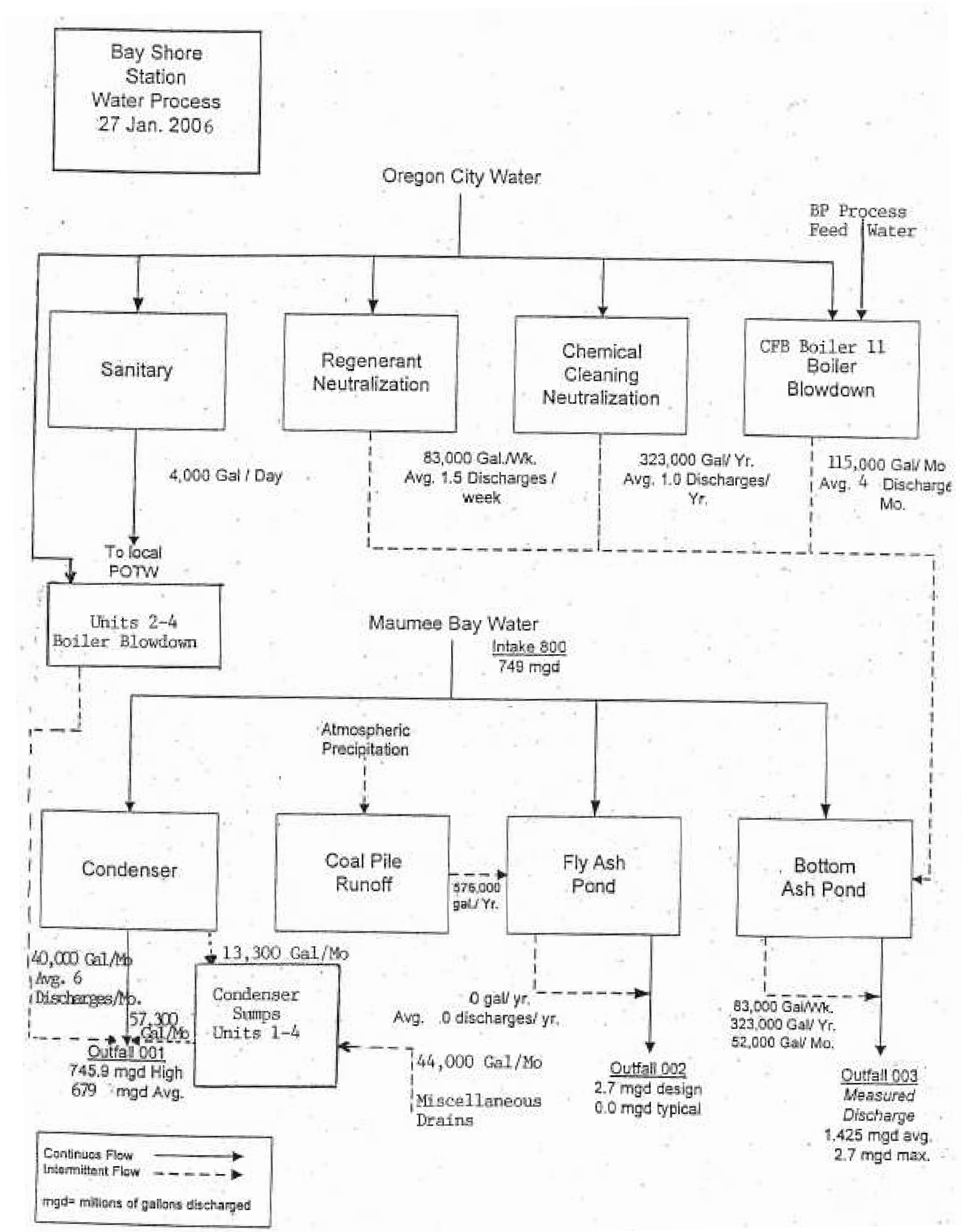


Figure 3.2 Flow Distribution/Water Balance Diagram for Bay Shore Plant

4.0 COOLING WATER SYSTEM DATA

The maximum pumping capacity for Bay Shore is 810 MGD. Daily cooling water flow volumes for the time period April 2005 to December 2006 are summarized in Appendix 1. Over the duration of this study, the monthly cooling water volume ranged between 20,727 and 23,123 million gallons with a mean monthly volume of 22,546 ± 704 million gallons (Table 4.1).

Table 4.1
Monthly Cooling Water Volumes (April 2005 – December 2006)

Month	Million Gallons
Apr-05	22,377
May-05	20,727
Jun-05	22,377
Jul-05	22,386
Aug-05	22,178
Sep-05	22,377
Oct-05	23,123
Nov-05	22,377
Dec-05	23,123
Jan-06	23,123
Feb-06	20,885
Mar-06	23,123
Apr-06	22,377
May-06	23,123
Jun-06	22,377
Jul-06	23,123
Aug-06	23,123
Oct-06	23,123
Nov-06	22,377
Dec-06	23,123
Average	**22,546**
S.D.	**704**
Min	**20,727**
Max	**23,123**

5.0 ENTRAINMENT

Entrainment sampling was conducted at Bay Shore between May 12, 2005 and May 12, 2006. Detailed summaries of the entrainment data and associated analyses are presented in Kinectrics Report No. 112026-005-RA-0001-R00.

5.1 Egg Entrainment

A total of 9,967 fish eggs were collected during the 2005-2006 entrainment sampling program. The majority of fish eggs (99.7%) were categorized as dead/long dead. On an annual basis, it is estimated that a total of 208,565,490 fish eggs were entrained at Bay Shore (Table 5.1). The majority of fish eggs entrained were freshwater drum (97.5%).

Freshwater drum (also known as sheephead) are commonly considered an undesirable rough fish (i.e., undesirable as a food or sport fish and often viewed as a competitor of more desirable fishes).

5.1.1 Historical Levels of Fish Egg Entrainment

A comparison of fish egg entrainment data for 2005-2006 versus 1976-1977 is presented in Table 5.2 and Figure 5.1. The annual number of eggs entrained at Bay Shore between September 1976 and September 1977 was estimated to be 426 million. This value is approximately twice that estimated for 2005-2006 (208 million fish eggs). For both sampling programs, the most abundant species entrained was freshwater drum (>97%) (Reutter et al., 1978).

Although estimated numbers of fish eggs entrained at this plant are large, they may not be particularly significant. For example, the population of fish eggs in the Maumee River was estimated to be approximately 2.4 billion in 1977 (Reutter et al., 1978). For 1976-1977, 17.3% of the river population was estimated to be entrained at Bay Shore.

River sampling was not conducted during the 2005-2006 sampling program. However, it may be assumed that the density of fish eggs in the intake canal of Bay Shore is comparable to the river density. However, variability from year to year can be expected. Based on 2005 discharge information for the Maumee River (USGS 04193500 – Maumee river at Waterville OH)[2], the river population of larval fish is estimated to be approximately 1.8 billion in 2005. For 2005-2006, 11.4% of the river population was estimated to be entrained at Bay Shore.

[2] USGS Surface-Water Annual Statisics for Ohio. National Water Information System.

Table 5.1
Annual Estimate of Fish Eggs Entrained at Bay Shore Power Plant
(May 2005 – May 2006)

Species	Bay Shore - Annual Number of Entrained Eggs								
	May-05/06	**Jun-05**	**Jul-05**	**Aug-05**	**Sep-05**	**Mar-06**	**Apr-06**	**Estimated Total**	**% of Total**
Freshwater drum	12,324,211	191,114,437	0	0	0	0	0	203,438,647	97.54%
Unidentifiable	3,377,760	1,490,751	0	0	0	0	0	4,868,510	2.33%
Catostomidae	36,890	179,419	0	0	0	0	0	216,309	0.10%
Morone spp.	42,023		0	0	0	0	0	42,023	0.02%
Total	**15,780,884**	**192,784,606**	**0**	**0**	**0**	**0**	**0**	**208,565,490**	**100.00%**

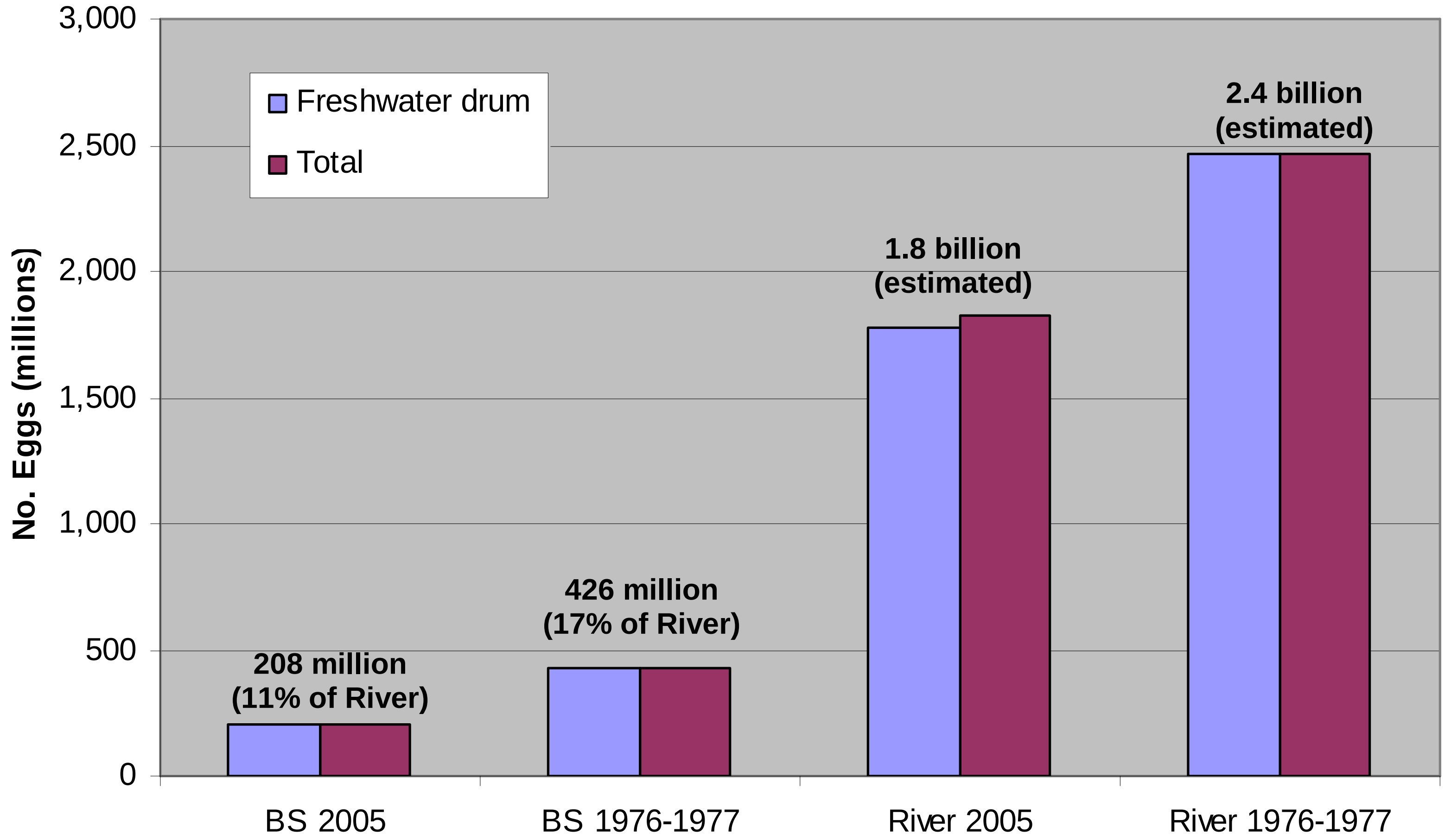
Individual estimates may not add to totals due to rounding.
No fish eggs were entrained in July, August, September 2005 or March and April 2006.

Table 5.2
Comparision of Fish Egg Entrainment at Bay Shore
(2005-2006 versus 1976-1977)*

Taxa	Egg Density at Intake (Eggs per 100 m^3)		Annual Number of Eggs Entrained		Estimated River Population		% of River Population	
	2005	**1976-1977**	**2005**	**1976-1977**	**2005**	**1976-1977**	**2005**	**1976-1977**
Catostomidae	0.05		216,309		1,834,162		11.8%	
Freshwater drum	45.3	NA	203,438,647	425,804,075	1,779,346,087	2,463,574,487	11.4%	17.3%
Morone spp.	0.01		42,023		366,832		11.5%	
Unidentifiable	1.2	NA	4,868,510	346,034	46,587,710	153,818	10.5%	225.0%
TOTAL	**46.5**		**208,565,490**	**426,150,109**	**1,828,134,792**	**2,463,728,305**	**11.4%**	**17.3%**

- 1976-1977 data obtained from Reutter et al., 1978.
- Note: typical survival rates to age 1 of freshwater drum eggs is 1in 25,000.

Figure 5.1
Bay Shore Estimated Fish Egg Entrainment: 2005-2006 versus 1976-1977



5.2 Larval Fish Entrainment

A total of 118,287 larval fish were collected during the 2005-2006 entrainment sampling program.[3] On an annual basis, it is estimated that a total of 2,247,249,020 larval fish were entrained at Bay Shore (Table 5.3). The most abundant taxa were Freshwater drum (43.5%), Rainbow smelt/Cluepeidae (23.9%) and Morone spp. (6.1%). The "success rate" for eggs and larvae can be expressed as survival to age 1. The majority of eggs and larvae entrained at Bay Shore were freshwater drum. Survival is highly dependent on species, but for freshwater drum, approximately 1 in 25,000 eggs survive to age 1 (0.004%). Approximately 1 in 2,500 larvae survive to age 1 (0.04%). Survival for rainbow smelt eggs is even lower, approximately 1 in 33,000,000 survive to age 1 (0.00003%). Approximately 1 in 303 rainbow smelt larvae survive to age 1 (0.3%)

The initial condition of the larval fish was recorded as part of the entrainment abundance study. Recently dead larva are considered to represent those larva damaged during sample collection and/or recent natural mortality. The majority of larval fish (79.3%) were categorized as recently dead. Criteria for recently dead include:

- non-motile,
- body transparent or translucent,
- gut defined,
- myomeres well defined,
- fins or fin buds well defined, and
- body tissue or outline well defined.

Long dead larva are considered to represent those larva that were dead prior to being entrained at Bay Shore. Approximately 21% of larval fish were categorized as long dead. Criteria for long dead include:

- non-motile, opaque,
- fins or fin buds not definable,
- myomeres not definable,
- gut absent, and
- body tissue or outline not well defined.

On an annual basis, it is estimated that a total of 1,745,126,022 live and recently dead larval fish were entrained at Bay Shore (Table 5.4). The most abundant taxa were Freshwater drum (53.9%), Rainbow smelt/Cluepeidae (22.1%) and Morone spp. (7.2%).

Freshwater drum (also known as sheephead) are commonly considered an undesirable rough fish (i.e., undesirable as a food or sport fish and often viewed as a competitor of more desirable fishes).

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[3] Certain species do not exhibit a free-swimming larval life stage. Round goby transition within the egg and hatch as juveniles with a full complement of fin rays. Regardless of overall length, round goby have been classified as juvenile fish.

Table 5.3
Annual Estimate of Fish Larvae Entrained at Bay Shore Power Plant
(May 2005 – May 2006)

Species	Bay Shore - Annual Number of Entrained Larvae								
	May 05/06	**Jun-05**	**Jul-05**	**Aug-05**	**Sep-05**	**Mar-06**	**Apr-06**	**Total**	**% of Total**
Freshwater drum		977,312,351	79,788	34,772				977,426,912	43.5%
Rainbow smelt/Clupeidae	119,920,367	415,780,097	519,964				45,406	536,265,835	23.9%
Unidentifiable	38,613,971	426,336,716	165,664	66,103			762,596	465,945,050	20.7%
Morone spp.	100,211,180	37,242,661	95,920					137,549,760	6.1%
Logperch	21,814,479	8,600,492					2,348,669	32,763,640	1.5%
White sucker	232,238	28,964,338						29,196,575	1.3%
Emerald shiner		18,826,286	175,288					19,001,574	0.8%
White bass		17,816,675	23,581					17,840,256	0.8%
Walleye	5,820,753	793,968					1,543,107	8,157,828	0.4%
Cyprinidae	449,942	7,010,821	23,581					7,484,343	0.3%
Notropis spp.		4,707,966						4,707,966	0.2%
Yellow perch	919,867	1,258,759	63,356	62,662			875,848	3,180,492	0.1%
Percidae	568,882						1,731,756	2,300,638	0.1%
Common carp/Goldfish	36,890	2,018,974	87,326					2,143,190	0.1%
Catostomidae	638,744							638,744	0.03%
Trout-perch		655,666						655,666	0.03%
Walleye/Yellow perch							616,543	616,543	0.03%
White perch		488,198	23,581					511,779	0.02%
Lepomis spp.		17,436		250,649				268,084	0.01%
Grass pickerel	92,453						45,328	137,782	0.01%
Pomoxis spp.		180,015						180,015	0.01%
Burbot	84,256							84,256	0.004%
Spottail shiner		56,596	23,228					79,825	0.004%
Channel catfish			70,390					70,390	0.003%
Centrarchidae	21,064							21,064	0.001%
Lake whitefish							20,814	20,814	0.001%
Total	**289,425,086**	**1,948,068,015**	**1,351,666**	**414,186**	**0**	**0**	**7,990,066**	**2,247,249,020**	**100.0%**

Individual estimates may not add to totals due to rounding.
Note: typical survival to age 1 of freshwater drum is 1 in 2500, typical survival to age 1 of rainbow smelt is 1 in 303

Table 5.4
Annual Estimate of Fish Larvae (Excluding Long Dead Larvae) Entrained at Bay Shore Power Plant
(May 2005 – May 2006)

Species	Bay Shore - Annual Number of Entrained Larvae (Excluding Long Dead Larvae)								
	May 05/06	**Jun-05**	**Jul-05**	**Aug-05**	**Sep-05**	**Mar-06**	**Apr-06**	**TOTAL**	**% of Total**
Freshwater drum		939,780,338	47,399	34,772				939,862,509	53.9%
Rainbow smelt/Clupeidae	109,399,307	275,183,963	519,964				45,406	385,148,641	22.1%
Morone spp.	96,284,784	30,041,339	47,841					126,373,963	7.2%
Unidentifiable	33,598,188	151,582,534	94,798	31,331			762,596	186,069,447	10.7%
Logperch	20,196,703	7,882,519					2,348,669	30,427,890	1.7%
White sucker	232,238	28,964,338						29,196,575	1.7%
White bass		16,435,601	23,581					16,459,181	0.9%
Walleye	4,790,288	703,960					1,543,107	7,037,356	0.4%
Emerald shiner		9,633,376	175,288					9,808,664	0.6%
Cyprinidae	394,606	3,375,220	23,581					3,793,407	0.2%
Yellow perch	901,422	1,258,759	47,161				875,848	3,083,190	0.2%
Percidae	482,662						1,731,756	2,214,418	0.1%
Notropis spp.		1,308,013						1,308,013	0.1%
Catostomidae	638,744							638,744	0.0%
Common carp/Goldfish		1,182,063	87,326					1,269,389	0.1%
Trout-perch		655,666						655,666	0.04%
Walleye/Yellow perch							616,543	616,543	0.04%
White perch		470,763	23,581					494,343	0.03%
Lepomis spp.		17,436		250,649				268,084	0.02%
Pomoxis spp.		180,015						180,015	0.01%
Channel catfish			70,390					70,390	0.004%
Spottail shiner		39,161	23,228					62,389	0.004%
Grass pickerel							45,328	45,328	0.003%
Centrarchidae	21,064							21,064	0.001%
Lake whitefish							20,814	20,814	0.001%
Burbot								0	0.000%
Total	**266,940,005**	**1,468,695,061**	**1,184,139**	**316,752**	**0**	**0**	**7,990,066**	**1,745,126,022**	**100.0%**

5.2.1 Historical Levels of Larval Fish Entrainment

A comparison of larval entrainment data for 2005-2006 versus 1976-1977 is presented in Table 5.5 and Figure 5.2. The annual number of larvae entrained at Bay Shore between September 1976 and September 1977 was estimated to be 284 million. The most abundant species entrained were gizzard shad (78.4%), white bass (11.6%) and freshwater drum (4.7%) (Reutter et al., 1978). A comparison of the most prominent species in the 1976-1977 versus 2005-2006 sampling programs is presented in Figure 5.3.

The number of larval fish estimated to be entrained at Bay Shore between May 2005 and May 2006 is approximately 8 times greater than that estimated for the time period between September 1976 and September 1977. The increase in entrainment appears to be related to an increase in larval fish densities in the Maumee River/Maumee Bay and thus, at the Bay Shore intake (Table 5.5). The average density of larval fish for the 1976-1977 sampling program was estimated to be 86 larvae per 100 m^3. For the 2005-2006 sampling program, the density of larval fish was estimated to be 552 larvae per 100 m^3. The increase in larval fish densities may be associated with beneficial changes in landuse practices in the Maumee watershed since the 1970s which have led to improvements in water quality and habitat conditions for fish spawning and nursery areas (Roseman et al., 2002).

Although estimated numbers of larvae entrained at this plant are large, they may not be particularly significant. For example, the population of larval fish in the Maumee River was estimated to be approximately 7.3 billion in 1977. For 1976-1977, 3.9% of the river population was estimated to be entrained at Bay Shore. (These estimates are based on river flow rates which may not be appropriate for all species, as several species were shown to be more prevalent when the intake water was of lake or bay origin. This estimate does not account for this phenomenon. Reutter et al., 1978)

River sampling was not conducted during the 2005-2006 sampling program. However, it may be conservatively assumed that the density of larval fish in the intake canal of Bay Shore is comparable to the river density[4]. Based on 2005 discharge information for the Maumee River (USGS 04193500 – Maumee river at Waterville OH), the river population of larval fish is estimated to be approximately 21.7 billion in 2005. For 2005-2006, 10.4% of the river population was estimated to be entrained at Bay Shore. This is a preliminary estimate only and not subjected to statistical analysis. Unfortunately, there is a general lack of data on river populations of different larval fish species for 2005-2006. The above discussion represents a “qualitative” comparison the number of organisms entrained relative to river populations.

[4] Reutter et al. (1978) observed that larval fish densities in the Maumee river exceed those observed in the intake canal of Bay Shore. Mean larval fish concentrations in the Maumee River from April 9 to September 1, 1997 (520.7 larvae per 100 m^3) were approximately 6x greater than that observed in the intake canal of Bay Shore (86.2 per 100 m^3).

Table 5.5
Comparison of Larval Entrainment at Bay Shore
(2005-2006 versus 1976-1977)

Species	Larval Density at Intake (Larvae per 100 m^3)		Annual Number of Larvae Entrained		Estimated River Population		% of River Population	
	2005	1976-1977	2005	1976-1977	2005	1976-1977	2005	1976-1977
Bluegill				28,201		0		
Burbot	0.02		84,256		733,665		11.5%	
Catostomidae	0.2		638,744		7,162,070		8.9%	
Centrarchidae	0.005		21,064		183,416		11.5%	
Channel catfish	0.01		70,390	564,532	550,249	0	12.8%	
Common carp/Goldfish	0.5	1.9	2,300,638	8,251,539	21,459,693	12,590,973	10.7%	65.5%
Crappie				28,778		3,027,329		1.0%
Cyprinidae	1.9		7,484,343		73,733,305		10.2%	
Emerald shiner	5.0		19,001,574	142,572	197,539,229	5,172,246	9.6%	2.8%
Freshwater drum	246.9	3.4	977,426,912	13,479,134	9,704,476,157	139,656,878	10.1%	9.7%
Grass pickerel	0.03		180,015		1,100,497		16.4%	
Green sunfish						27,771		0.0%
Lake whitefish	0.005		20,814		183,416		11.3%	
Lepomis spp.	0.04		268,084		1,650,746		16.2%	
Logperch	6.8		29,196,575	28,778	266,136,881	285,804	11.0%	10.1%
Morone spp.	32.3		137,549,760		1,271,449,818		10.8%	
Notropis spp.	1.2		4,707,966		48,055,040		9.8%	
Percidae	0.5		2,143,190		19,808,948		10.8%	
Pomoxis spp.	0.04		137,782		1,467,329		9.4%	
Quillback carpsucker						28,358		0.0%
Rainbow smelt/Clupeidae	124.7	55.9	536,265,835	224,187,505	4,900,513,140	6,522,661,227	10.9%	3.4%
Spottail shiner	0.02		79,825	238,132	733,665	1,937,219	10.9%	12.3%
Trout-perch	0.1		655,666	12,747	5,869,318	0	11.2%	
Unidentifiable	116.7		465,945,050	88,078	4,586,878,226	2,610,012	10.2%	3.4%
Unidentified shiner				166,784		276,446		60.3%
Unidentified sucker				357,889		357,167		100.2%
Unidentified sunfish				493,434		16,540,804		3.0%
Walleye	2.1	0.1	8,157,828	441,614	83,087,531	6,049,074	9.8%	7.3%
Walleye/Yellow perch	0.1	0.7	511,779		5,135,653		10.0%	
White bass	4.5	13.4	17,840,256	33,107,855	177,188,987	560,518,850	10.1%	5.9%
White crappie						27,771		0.0%
White perch	0.1		616,543		5,319,069		11.6%	
White sucker	7.4		32,763,640	637,614	289,448,768	1,857,758	11.3%	34.3%
Yellow perch	0.7		3,180,492	2,426,431	25,861,682	29,630,704	12.3%	8.2%
Total	**551.9**	**86.2**	**2,247,249,020**	**284,681,617**	**21,695,726,497**	**7,303,256,391**	**10.4%**	**3.9%**

Figure 5.2
Bay Shore Estimated Larval Fish Entrainment: 2005-2006 versus 1976-1977

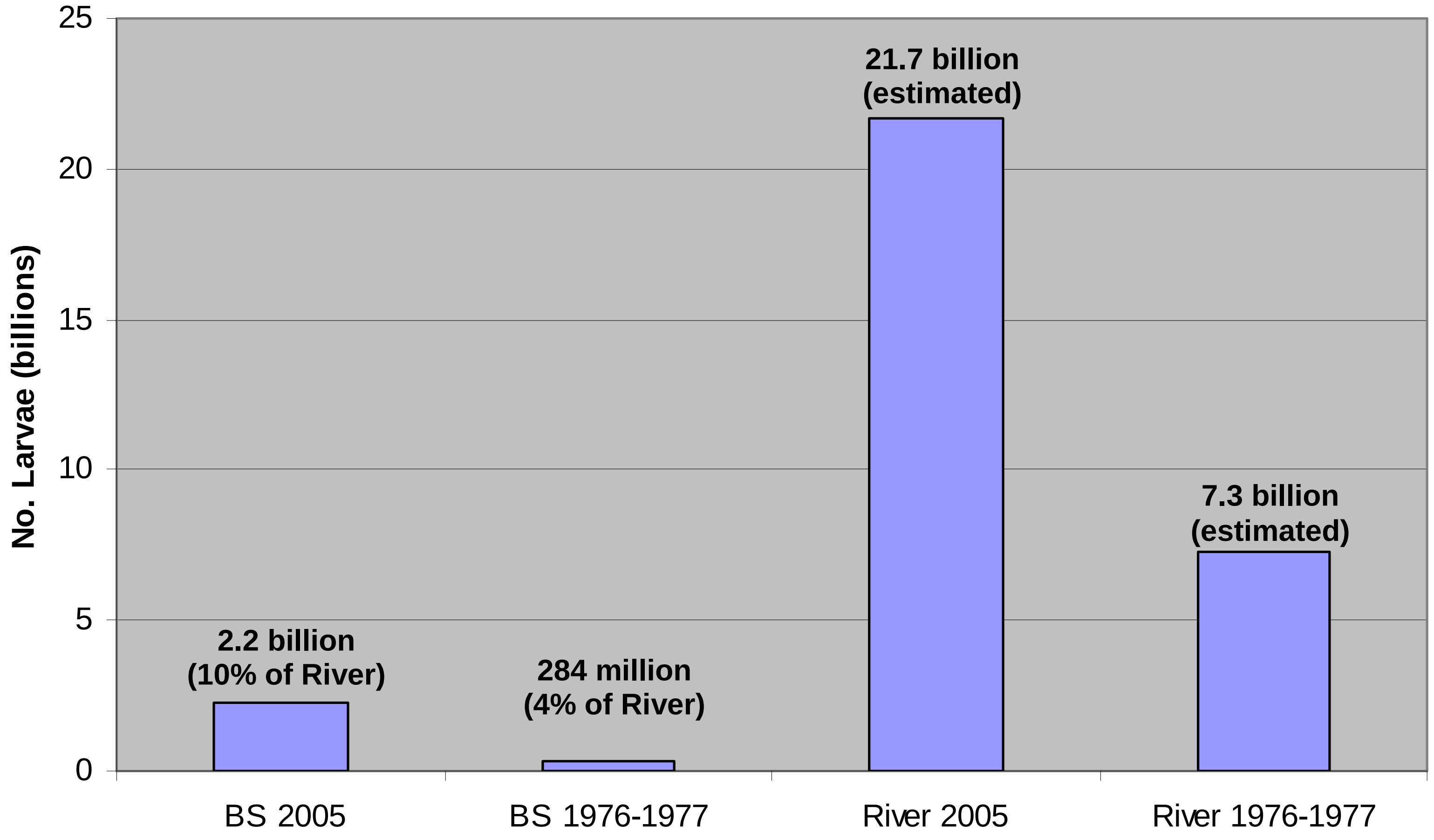
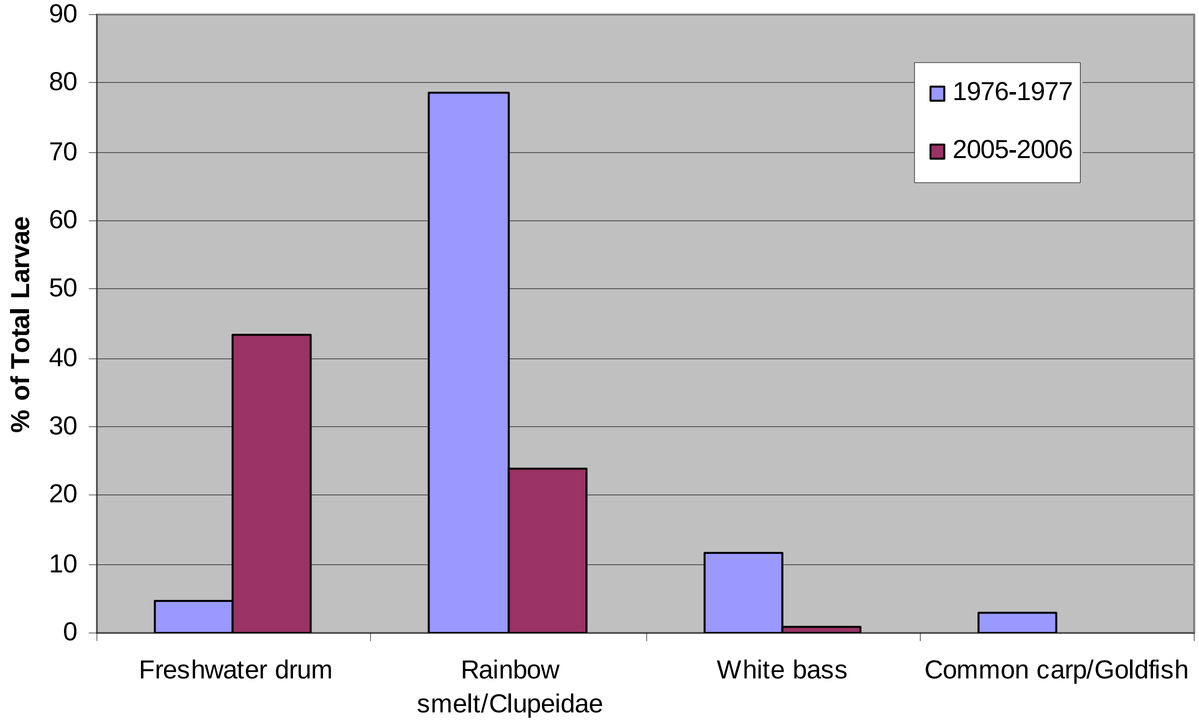


Figure 5.3
Comparison of Most Prominent Entrained Larval Fish at Bay Shore Power Plant
(1976-1977 versus 2005-2006)



5.3 Juvenile Fish Entrainment

A total of 742 entrainable juvenile fish were collected during the 2005-2006 entrainment sampling program. (Juvenile fish capable of passing through a 3/8-in mesh screen were considered to be entrainable.) It is estimated that a total of 13,824,022 juvenile fish were entrained between May 2005 and May 2006 (Table 5.6). The most abundant taxa were Rainbow smelt/Clupeidae (31.6%), Emerald shiner (28.3%) and Round goby (15.7%).

The initial condition of the juvenile fish was recorded as part of the entrainment abundance study. The majority of juvenile fish (91.2%) were categorized as recently dead. Long dead juvenile fish are considered to represent those juveniles that were dead prior to being entrained at Bay Shore. Approximately 7% of entrainable juvenile fish were categorized as long dead. On an annual basis, it is estimated that a total of 12,892,936 live and recently dead juvenile fish were entrained at Bay Shore. The most abundant taxa were Rainbow smelt/Clupeidae (31.2%), Emerald shiner (28.2%) and Round goby (15.8%).

Table 5.6
Annual Number of Estimated Entrainable Juvenile Fish Entrained at Bay Shore Power Plant
(May 2005 – May 2006)

Species	Bay Shore - Estimated Number of Juveniles Entrained									
	May-05	**Jun-05**	**Jul-05**	**Aug-05**	**Sep-05**	**Mar-06**	**Apr-06**	**May-06**	**Total**	**% of Total**
Rainbow smelt/Clupeidae		4,310,763	23,581	31,331					4,365,674	31.6%
Emerald shiner		3,499,021	232,316	91,377	92,851				3,915,565	28.3%
Round goby		1,694,072	480,568						2,174,639	15.7%
Logperch		1,328,768							1,328,768	9.6%
White bass		993,216	104,588						1,097,805	7.9%
Walleye		663,715							663,715	4.8%
Freshwater drum		139,239	16,303						155,542	1.1%
White perch		34,871	23,581						58,452	0.4%
Bluntnose minnow			23,228						23,228	0.2%
Mottled sculpin			23,228						23,228	0.2%
Notropis spp.		17,405							17,405	0.1%
Total	**0**	**12,681,069**	**927,394**	**122,709**	**92,851**	**0**	**0**	**0**	**13,824,022**	**100.0%**

Individual estimates may not add to totals due to rounding.

Table 5.7
Annual Number of Entrainable Juvenile Fish (Excluding Long Dead Juveniles) Entrained at Bay Shore Power Plant
(May 2005 – May 2006)

Species	Bay Shore - Number of Entrained Juveniles (Excluding Long Dead Juveniles)									
	May-05	**Jun-05**	**Jul-05**	**Aug-05**	**Sep-05**	**Mar-06**	**Apr-06**	**May-06**	**TOTAL**	**% of Total**
Rainbow smelt/Clupeidae		3,962,049	23,581	31,331					4,016,961	31.2%
Emerald shiner		3,220,050	232,316	91,377	92,851				3,636,594	28.2%
Round goby		1,554,586	480,568						2,035,154	15.8%
Logperch		1,328,768							1,328,768	10.3%
White bass		993,216	104,588						1,097,805	8.5%
Walleye		499,799							499,799	3.9%
Freshwater drum		139,239	16,303						155,542	1.2%
White perch		34,871	23,581						58,452	0.5%
Bluntnose minnow			23,228						23,228	0.2%
Mottled sculpin			23,228						23,228	0.2%
Notropis spp.		17,405							17,405	0.1%
	0	**11,749,983**	**927,394**	**122,709**	**92,851**	**0**	**0**	**0**	**12,892,936**	**100.0%**

6.0 IMPINGEMENT

A total of 104 impingement events were carried out between May 12, 2005 and December 11, 2006. Sampling was conducted for a total of 16 months during this period. Four months (May, October, November and December) were sampled in both 2005 and 2006. Additional impingement sampling was conducted from October to December 2006 because it was thought that the impingement estimates for the 2005-2006 sampling period were unusually high. Indeed, impingement levels for October to December 2005 (32,213,647) were approximately 3 times higher than observed in 2006 (10,444,297). A comparison of impingement for 2005 versus 2006 is presented in Figure 6.1.

On an annual basis it is estimated that a total of 46,030,006 fish (270,296 kg) were impinged at Bay Shore between May 2005 and May 2006 (Tables 6.1-6.2). The majority of fish (64%) were categorized as recently dead. Approximately 35% of fish were alive and 0.5% of fish were long dead. The most abundant species were emerald shiner (52.3%), gizzard shad (31.1%) and white perch (10.4%).

6.1 Historical Levels of Fish Impingement

The most recent impingement study conducted at Bay Shore was approximately 30 years ago (Reutter *et al*., 1978). As part of this earlier study, it was estimated that a total of 19,019,144 fish (170,776 kg) were impinged at Bay Shore between September 15, 1976 and September 15, 1977. The most abundant species were gizzard shad (71.8%), yellow perch (8.9%), alewife (6.3%) and emerald shiner (4.7%). A comparison of fish impingement levels at Bay Shore (1976-1977 versus 2005-2006) is presented in Figure 6.2. The number of fish impinged during the 2005-2006 sampling program (46,030,006) was approximately twice that observed during the 1976-1977 sampling program.

A comparison of the most prominent species in the 1976-1977 versus 2005-2006 sampling programs is presented in Figure 6.3. For both sampling programs, gizzard shad and emerald shiner comprised the two most abundant species. Emerald shiner increase was likely related to large year class strength. While alewife represented the third most abundant species in 1976-1977, alewife represented only 0.001% of impinged fish during the 2005-2006 sampling program.

Figure 6.1
Comparison of Estimated Impingement Levels at Bay Shore
(2005 versus 2006)

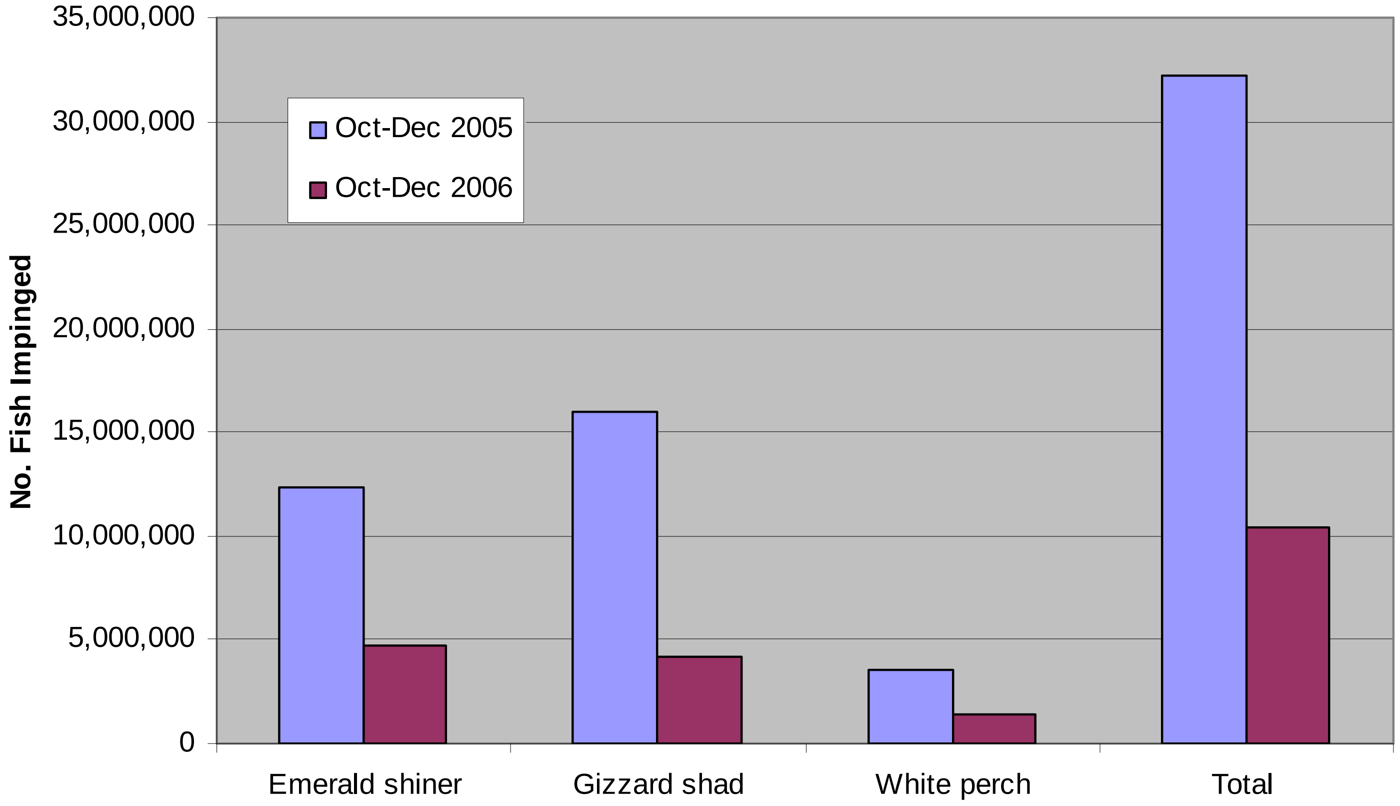


Table 6.1 Annual Estimated Number of Fish Impinged at Bay Shore Power Plant (May 2005 – December 2006)

Species	Bayshore - Annual Number of Impinged Fish													
	Jan-06	**Feb-06**	**Mar-06**	**Apr-06**	**May-05/06**	**Jun-05**	**Jul-05**	**Aug-05**	**Sep-05**	**Oct-05/06**	**Nov-05/06**	**Dec-05/06**	**Total**	**% of Total**
Emerald shiner	2,284,338	1,612,578	6,659,892	3,543,633	595,903	618,371	42,916	42,567	139,778	1,011,807	3,987,719	3,541,376	24,080,877	52.3%
Gizzard shad	841,949	312,631	959,327	343,786	6,797	66,329	1,054,323	189,086	453,612	5,555,938	841,846	3,687,490	14,313,113	31.1%
White perch	17,052	5,046	8,703	23,093	49,640	141,923	1,127,358	520,414	423,310	1,180,641	1,059,587	212,397	4,769,163	10.4%
White bass	486		2,778	5,740	1,624	218,670	1,300,298	45,596	13,570	2,985	1,453		1,593,199	3.5%
Spottail shiner	1,891	702	20,670	51,350	10,473	5,127	65,859	116,259	21,522	9,788	3,836	5,849	313,326	0.7%
Freshwater drum	760	836	745	49,154	25,906	12,826	10,756	78,740	23,383	16,208	5,860	533	225,706	0.5%
Trout-perch	326		20,336	30,366	62,210	11,801	2,015	20,670	8,570	1,515	1,569		159,379	0.3%
Yellow perch	868		1,340	3,649	1,770	1,016	351	974	714	760	111,310	653	123,405	0.3%
Round goby	326		744	2,177	5,862	19,707	16,876	32,361	8,545	5,296	648	1,375	93,918	0.2%
Walleye			645	2,927	1,880	67,861	2,653	118	421	174	1,134		77,812	0.2%
Channel catfish		789	372	14,980	4,520	4,173	10,994	12,106	9,407	16,373	3,431	324	77,469	0.2%
Logperch		294		158	353	1,244	11,543	24,298	1,825	11,216	407	209	51,547	0.1%
Sand shiner			744	29,453	1,915								32,112	0.1%
Bluegill	868		1,936	2,640	676	309	123	816	162	10,287	4,290	995	23,103	0.1%
Brook silverside	760	511	596	977				10,586		391	1,215	5,503	20,538	0.04%
Rainbow smelt		351									4,611	6,510	11,472	0.02%
Silver chub		248		158	2,383	771	1,851	4,278	1,015				10,703	0.02%
Common carp				1,922	626	3,920	2,097		108				8,673	0.02%
Brown bullhead	434	550	1,488	4,409	260		123			116	68		7,448	0.02%
Goldfish	760		373	158	255					1,100	1,927		4,571	0.01%
Smallmouth bass	326	256			130				432	3,081	221		4,445	0.01%
Pumpkinseed			224	1,159	380	93		293	741	444			3,333	0.01%
Largemouth bass				539		307	381	122	270	72	1,339		3,031	0.01%
Bluntnose minnow				126	255	201	1,727			48			2,357	0.01%
Orangespotted sunfish			372	750	105	108	123		162				1,621	0.004%
Shorthead redhorse				630						660	265		1,555	0.003%
Quillback		294		693	223			171		48			1,430	0.003%
Redhorse				508	626	182							1,315	0.003%
White crappie	434				130		237				181	324	1,306	0.003%
Tadpole madtom			372	284					486		130		1,272	0.003%
Yellow bullhead			744	382			123						1,249	0.003%
White sucker			595	252						116		209	1,172	0.003%
Fathead minnow						108	617		270				995	0.002%
Black redhorse										826			826	0.002%
Central stoneroller										815			815	0.002%
Spotfin shiner						309			432				741	0.002%
Black crappie				126								419	545	0.001%
Black bullhead		256			130					72			458	0.001%
Northern pike			224								197		421	0.001%
Golden shiner					186	108		122					416	0.001%
Green sunfish							123				260		384	0.001%
Black darter			372										372	0.001%
Channel darter								342					342	0.001%
Stonecat madtom					125			171					296	0.001%
Bigmouth buffalo				158			123						281	0.001%
Alewife											270		270	0.001%
Lepomis spp.								171					171	<0.001%
Western banded killifish								171					171	<0.001%
Flathead catfish				158									158	<0.001%
Silver lamprey				152									152	<0.001%
Creek chub					130								130	<0.001%
Northern redfin shiner											130		130	<0.001%
Sauger											128		128	<0.001%
Rainbow trout						93							93	<0.001%
Steelhead trout						93							93	<0.001%
Total	**3,151,575**	**1,935,340**	**7,683,592**	**4,116,642**	**775,474**	**1,175,648**	**3,653,593**	**1,100,434**	**1,108,736**	**7,830,777**	**6,034,029**	**7,464,166**	**46,030,006**	**100.0%**

Individual estimates may not add to totals due to rounding.

Table 6.2 Annual Estimated Weight (kg) of Fish Impinged at Bay Shore Power Plant (May 2005 – December 2006)

Species	Bayshore - Annual Weight of Impinged Fish (kg)													
	Jan-06	**Feb-06**	**Mar-06**	**Apr-06**	**May-05/06**	**Jun-05**	**Jul-05**	**Aug-05**	**Sep-05**	**Oct-05/06**	**Nov-05/06**	**Dec-05/06**	**Total**	**% of Total**
Gizzard shad	17,231	4,459	16,364	6,840	509	93	786	576	2,348	49,995	9,315	47,833	156,350	57.8%
Emerald shiner	5,194	2,663	12,400	6,367	1,847	1,766	80	31	250	1,575	8,086	6,556	46,814	17.3%
White perch	101	29	228	3,056	6,689	641	950	1,398	1,868	7,294	6,981	1,241	30,476	11.3%
Walleye			539	2,213	10,503	369	67	40	21	131	743		14,625	5.4%
Freshwater drum	272	90	16	3,353	3,071	1,480	37	717	367	478	274	109	10,263	3.8%
White bass	154		793	544	307	148	662	92	77	78	236		3,090	1.1%
Yellow perch	6		234	184	112	49	25	115	46	39	782	56	1,648	0.6%
Channel catfish		74	1	559	157	104	149	50	82	181	22	8	1,386	0.5%
Trout-perch	2		251	182	332	63	6	23	19	6	5		888	0.3%
Spottail shiner	10	10	131	287	28	8	81	108	42	45	34	39	823	0.3%
White sucker			378	4						4		240	626	0.2%
Redhorse				2	557	0.182							559	0.2%
Smallmouth bass	286	3			27				9	43	27		396	0.1%
Goldfish	7		20	43	7					175	20		272	0.1%
Northern pike			82							0	123		205	0.1%
Silver chub		8		4	116	52	9	4	4	0	0		198	0.1%
Shorthead redhorse				9						123	44		176	0.1%
Largemouth bass				78		0.307	1	2	2	1	92		176	0.1%
Round goby	0.326		2	7	11	39	35	40	17	16	2	3	174	0.1%
Brown bullhead	10	10	36	86	16		0.247			4	10		171	0.1%
Common carp				38	99	2	2		3				143	0.1%
Black redhorse										134			134	0.05%
Sauger										0	123		123	0.05%
Bigmouth buffalo				97			0.123			0	0		97	0.04%
Pumpkinseed			13	28	10	1		9	19	6	0		85	0.03%
Logperch		0.294		1	1	1	11	12	5	38	0	1	72	0.03%
Bluegill	1		3	17	7.109	2	2	1	0.324	18	5	1	57	0.02%
Quillback		2		29	16			2		0.096			48	0.02%
Yellow bullhead			9	16			0.123						25	0.01%
Black crappie				0.252								23	23	0.01%
Brook silverside	1	1	1	1				10		0.275	1	6	21	0.01%
Sand shiner			1	19	1								21	0.01%
Black bullhead		5			7					4			16	0.01%
Central stoneroller										16			16	0.01%
Orangespotted sunfish			10	2	1	0.108	1		3				16	0.01%
Silver Lamprey				15									15	0.01%
White crappie	1				1		0.176				0.311	10	13	0.005%
Rainbow smelt		0.351									3	7	10	0.004%
Rainbow trout						8							8	0.003%
Steelhead trout						8							8	0.003%
Tadpole madtom			2	1					1		0.391		4	0.002%
Golden shiner					0.279	3		0.122					4	0.001%
Stonecat madtom					3			1					4	0.001%
Alewife											3		3	0.001%
Green sunfish							0.123				3		3	0.001%
Bluntnose minnow				0.126	0.380	0.309	2			0.096			3	0.001%
Black darter			2										2	0.001%
Spotfin shiner						0.309			1				2	0.001%
Creek chub					1								1	<0.001%
Fathead minnow						0.108	1		0.270				1	<0.001%
Channel darter								0.342					0.342	<0.001%
Lepomis spp.								0.171					0.171	<0.001%
Western banded killifish								0.171					0.171	<0.001%
Flathead catfish				0.158									0.158	<0.001%
Northern redfin shiner											0.130		0.130	<0.001%
Total	**23,276**	**7,354**	**31,516**	**24,081**	**24,437**	**4,839**	**2,905**	**3,232**	**5,184**	**60,405**	**26,935**	**56,132**	**270,296**	**100.0%**

Individual estimates may not add to totals due to rounding.

Figure 6.2
Comparison of Estimated Fish Impingement Levels at Bay Shore Power Plant
(1976-1977 versus 2005-2006)

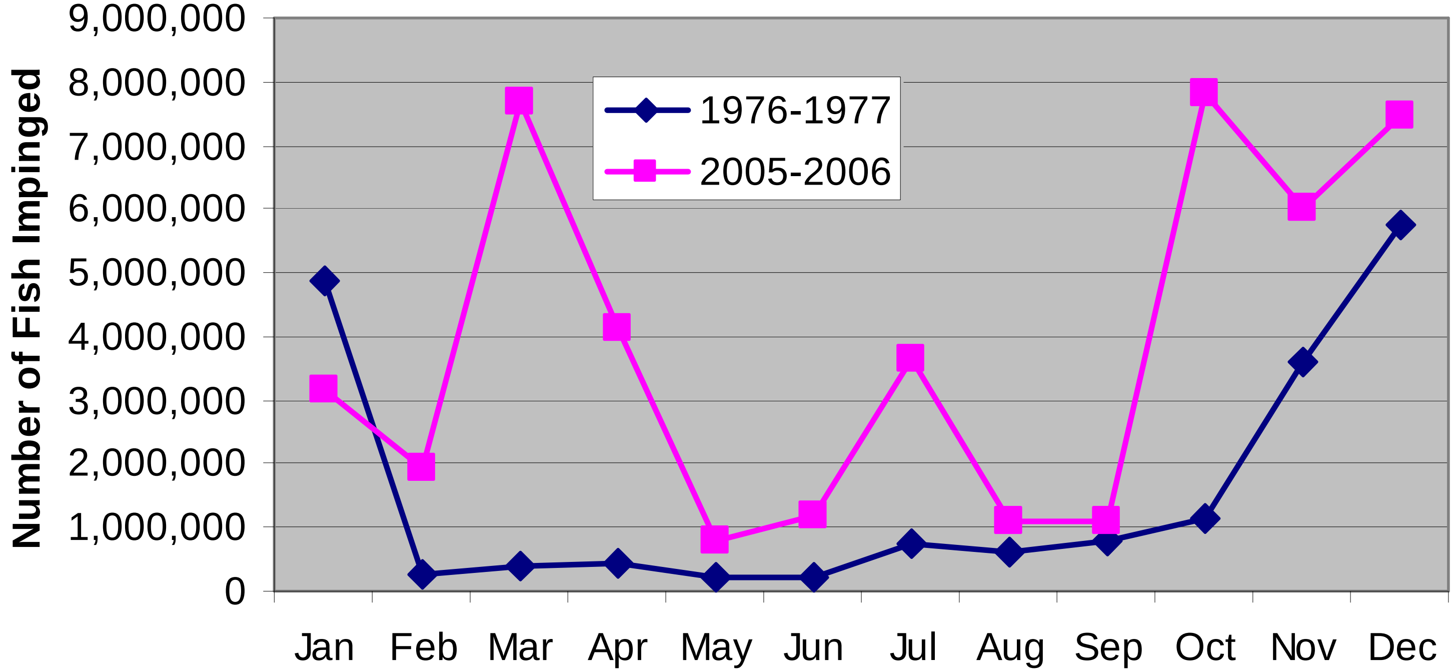
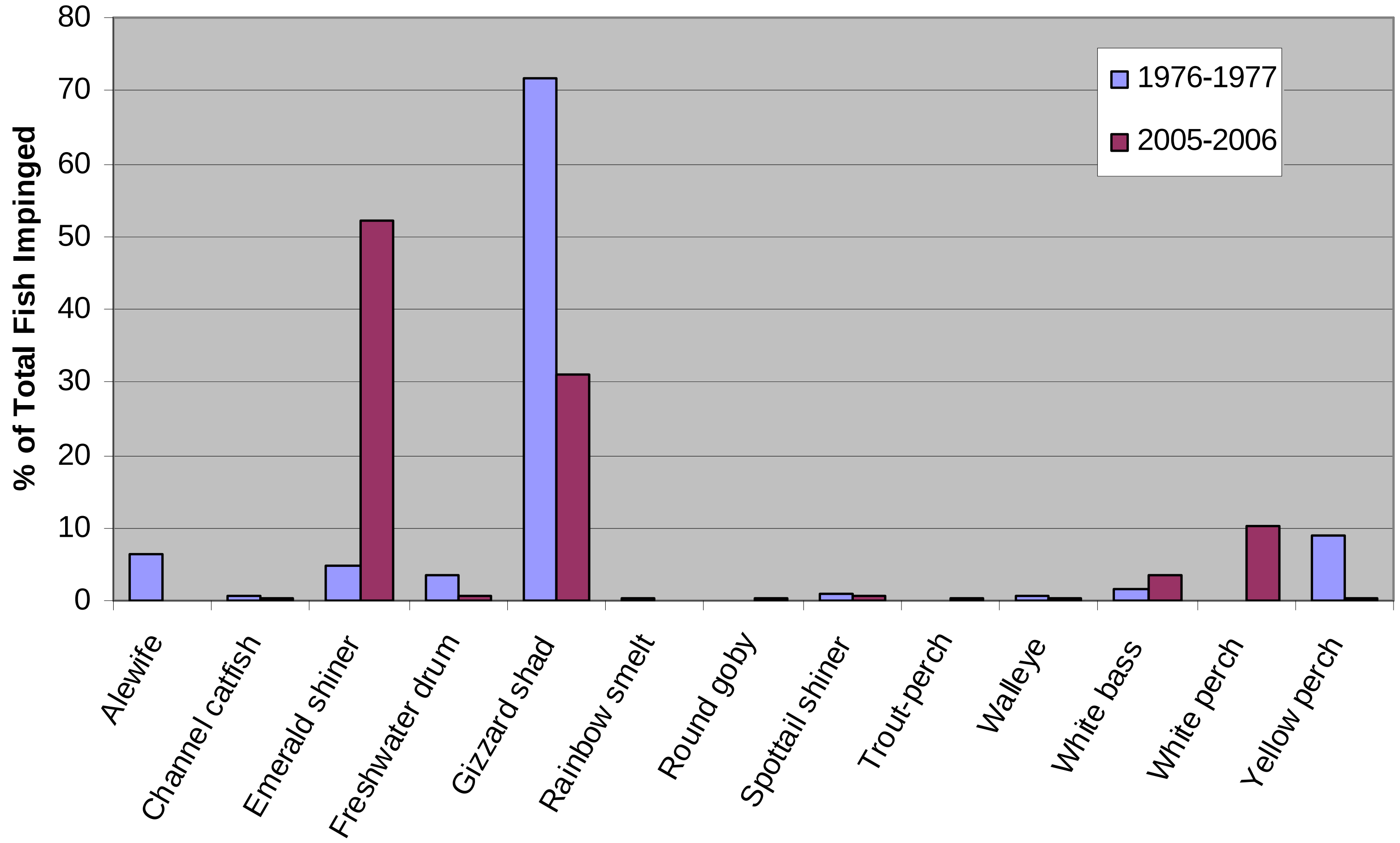


Figure 6.3
Comparison of Most Prominent Impinged Species at Bay Shore Power Plant
(1976-1977 versus 2005-2006)



6.2 Species List

Over the duration of this study 54 different species of fish were impinged at Bay Shore Power Plant. For entrainment, only one species of fish eggs, 19 species of larval fish and 12 species of juvenile fish were entrained over the duration of the study at Bay Shore Power Plant . In some instances, it was possible to identify entrained specimens only to the level of genus or family. A summary of specimens entrained and impinged at Bay Shore is presented in Table 6.3.

The Ohio Department of Natural Resources (ODNR)[5] uses six categories: endangered, threatened, species of concern, special interest, extirpated and extinct, to define the status of selected wildlife. Two impinged species have been identified by the ODNR as being a threatened species (channel darter) or endangered species (western banded killifish). Two entrained species have been identified by the Ohio Department of Natural Resources as being a species of concern (burbot, lake whitefish).

Western Banded Killifish – Endangered Species

On August 23, 2005 one western banded killifish was collected at Bay Shore. The western banded killifish (*Fundulus diaphanus menona*) is slender and pike-like in shape with olive colored sides and numerous vertical bands (Figure 6.4). Adult killifish are usually small reaching between 5-10 cm in length. Historically, the western banded killifish has had a limited Ohio distribution, i.e., northcentral/northwest Ohio and the Portage Lakes. The largest Ohio population of *F.d. menona* remains in Miller Blue Hole, Sandusky County. Because the range of the western banded killifish has declined in Ohio during the 1900's, this species was listed as endangered[6] in Ohio in 1974 (Poly et al., 1995).

Channel Darter – Threatened Species

On August 12, 2005 two channel darters were collected at Bay Shore. The channel darter (*Percina copelandi*) is slender and has 10 to 15 small oblong dark blotches along the side. This species is yellowish-olive in color with scales outlined in brown (Figure 6.6.). Channel darters prefer large beach areas, bars, pools, sluggish riffles with silt-free gravel or rocky bottoms. The channel darter was originally found in both Lake Erie and Ohio River drainages. It inhabited the extensive sand and gravel beaches of Lake Erie and of larger rivers in Ohio, particularly where currents were sluggish. Siltation appears to be the major cause of population decline (Smith et al., 1973). This species is now listed as threatened in Ohio.[7]

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[5] http://www.dnr.state.oh.us/wildlife/resources/mgtplans/specieslist.htm

[6] *Endangered Species:* A native species or subspecies threatened with extirpation from the state. The danger may result from one or more causes, such as habitat loss, pollution, predation, interspecific competition or disease.

[7] *Threatened Species:* A species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists. Continued or increased stress will result in its becoming endangered.

Burbot – Species of Concern

On May 16, 2005 four burbot larvae were collected at Bay Shore. The burbot (Lota lota) is a catfish-like to eel-shaped fish. Most burbot are dark olive brown to brown, with dark brown mottling on the sides and yellowish creme on the underside (Figure 6.7). The burbot is native to Ohio, and is primarily a Lake Erie species. Burbot prefer deep open water, but move to nearshore and river-mouth areas to spawn in the winter. This species is currently listed as a species of concern.[8] Population reduction is probably the result of changing water quality and resultant reduced oxygen content the deeper waters of Lake Erie (Smith, 1973).

Lake Whitefish – Species of Concern

On April 9, 2006 one lake whitefish larvae was collected at Bay Shore. The lake whitefish (*Coregonus clupeaformis*) has a long cylindrical body with olive-green to olive-blue coloring and a silvery overcast (Figure 6.8). Lake whitefish are native to the great lakes, and prefer cooler water temperatures. This species is listed as a species of concern. Reduced population levels in Ohio are the result of changing water quality and unregulated harvest (Smith, 1973).

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[8] *Species of Concern:* A species or subspecies which might become threatened in Ohio under continued or increased stress. Also, a species or subspecies for which there is some concern but for which information is insufficient to permit an adequate status evaluation.

Table 6.3 List of Specimens Entrained and Impinged at Bay Shore Power Plant, (May 2005 – December 2006)

Common Species Name	Scientific Name	Entrainment			Impingement
		Eggs	Larvae	Juvenile	
Alewife	*Alosa pseudoharengus*		Yes	Yes	Yes
Bigmouth buffalo	*Ictiobus cyprinellus*				Yes
Black bullhead	*Ameiurus melas*				Yes
Black crappie	*Pomoxis nigromaculatus*				Yes
Black darter	*Etheostoma duryi*				Yes
Black redhorse	*Moxostoma duquesnei*				Yes
Bluegill	*Lepomis macrochirus*				Yes
Bluntnose minnow	*Pimephales notatus*			Yes	Yes
Brook silverside	*Labidesthes sicculus*				Yes
Brown bullhead	*Ameiurus nebulosus*				Yes
Burbot [1]	*Lota lota* [1]		Yes [1]		
Central stoneroller	*Campostoma anomalum*				Yes
Channel catfish	*Ictalurus punctatus*		Yes		Yes
Channel darter [2]	*Percina copelandi* [2]				Yes [2]
Common carp	*Cyprinus carpio*		Yes		Yes
Creek chub	*Semotilus atromaculatus*				Yes
Emerald shiner	*Notropis atherinoides*		Yes	Yes	Yes
Fathead minnow	*Pimephales promelas*				Yes
Flathead catfish	*Pylodictis olivaris*				Yes
Freshwater drum	*Aplodinotus grunniens*	Yes	Yes	Yes	Yes
Gizzard shad	*Dorosoma cepedianum*		Yes	Yes	Yes
Golden shiner	*Notemigonus crysoleucas*				Yes
Goldfish	*Carassius auratus*		Yes		Yes
Grass pickerel	*Esox americanus*		Yes		
Green sunfish	*Lepomis cyanellus*				Yes
Lake whitefish [1]	*Coregonus clupesformis* [1]		Yes [1]		
Largemouth bass	*Micropterus salmoides*				Yes
Logperch	*Percina caprodes*		Yes	Yes	Yes
Mottled sculpin	*Cottus bairdi*			Yes	
Northern pike	*Esox lucius*				Yes
Redfin shiner	*Lythrurus umbratilis*				Yes
Orangespotted sunfish	*Lepomis humilis*				Yes
Pumpkinseed	*Lepomis gibbosus*				Yes
Quillback	*Carpiodes cyprinus*				Yes
Rainbow smelt	*Osmerus mordax*		Yes	Yes	Yes
Rainbow trout	*Oncorhynchus mykiss*				Yes
Redhorse	*Moxostoma spp.*				Yes
Round goby	*Neogobius melanostomus*			Yes	Yes
Sand shiner	*Notropis stramineus*				Yes
Sauger	*Sander canadensis*				Yes
Shorthead redhorse	*Moxostoma macrolepidotum*				Yes
Silver chub	*Macrhybopsis storeriana*				Yes
Silver lamprey	*Ichthyomyzon unicuspis*				Yes
Smallmouth bass	*Micropterus dolomieu*				Yes
Spotfin shiner	*Cyprinella spiloptera*				Yes
Spottail shiner	*Notropis hudsonius*		Yes		Yes
Steelhead trout	*Oncorhynchus mykiss*				Yes
Stonecat	*Noturus flavus*				Yes
Tadpole madtom	*Noturus gyrinus*				Yes
Trout-perch	*Percopsis omiscomaycus*		Yes		Yes
Walleye	*Sander vitreus*		Yes	Yes	Yes
Western banded killifish [3]	*Fundulus diaphanus menona* [3]				Yes [3]
White bass	*Morone chrysops*		Yes	Yes	Yes
White crappie	*Pomoxis annularis*				Yes
White perch	*Morone americana*		Yes	Yes	Yes
White sucker	*Catostomus commersonii*		Yes		Yes
Yellow bullhead	*Ameiurus natalis*				Yes
Yellow perch	*Perca flavescens*		Yes		Yes
Common Genus Name	**Scientific Name**				
Crappies	*Pomoxis spp.*		Yes		
Shiners	*Notropis spp.*		Yes	Yes	
Sunfishes	*Lepomis spp.*		Yes		Yes
Temperate basses	*Morone spp.*	Yes	Yes		
Common Family Name	**Scientific Name**				
Carps and minnows	Cyprinidae		Yes		
Perches	Percidae		Yes		
Suckers	Catostomidae	Yes	Yes		
Sunfishes	Centrarchidae		Yes		

[1] Identified by the Ohio Department of Natural Resources as a species of concern.

[2] Identified by the Ohio Department of Natural Resources as a threatened species.

[3] Identified by the Ohio Department of Natural Resources as an endangered species.

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