NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
WATER MONITORING AND STANDARDS ELEMENT
BUREAU OF FRESHWATER AND BIOLOGICAL MONITORING
P.O. Box 420; Mail Code 35-01
TRENTON, NEW JERSEY

Quality Assurance/Quality Control Project Plan

Fish Index of Biotic Integrity

2017 Statewide and Upper Delaware Region Monitoring Project

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Date

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1.0 Project Name: Fish IBI Monitoring Program

2.0 Requesting Agency: NJDEP Water Monitoring and Standards

3.0 Date of Project (Sampling/Data Reporting): 4/2017 - 5/2018

4.0 Project Fiscal Information: Job Number 35950000, Activity Code V4DT

5.0 Project Officer: John Vile, Research Scientist I, BFBM

6.0 Special Training Needs/Certification

Assistants to the project will be trained in the operation and use of all sampling equipment including the proper safety and handling procedures for electroshocking equipment. The training will entail calibration methods, deployment techniques, and data retrieval from the equipment. The Project Officer or designee will be responsible for any necessary training.

BFBM is certified by the Office of Quality Assurance (certified lab ID # 11896) for all parameters to be measured.

7.0 Project Description/Objective:

The objective of the project is to enhance the ability of Water Monitoring & Standards to evaluate water quality in wadeable streams by providing a comprehensive biological assessment. This will be done using the Index of Biotic Integrity (IBI) for New Jersey fish assemblages statewide using the Northern Fish IBI and the Inner Coastal Plain Fish IBI (Southern IBI). The intended use is the assessment of aquatic life use in State waters as required by the federal CWA under section 305(b) and the identification of State impaired waters under section 303(d) of the federal CWA. In addition, Fish IBI data is a significant part of the intensive, data-driven, Category 1 (C-1) selection process (N.J.A.C. 7:9B). Additional uses may occur, such as water quality classifications.

8.0 Network Design/Site Selection:

There will be a total of 41 sites sampled in 2017 consisting of the following: 30 fixed network, 5 probabilistic (random), and 6 sentinel sites.

Fixed Sites (Regional Monitoring)

The data from fixed sites is used to assess status, long term trends, and aquatic life use in the waters of the state for the Integrated Water Quality Monitoring and Assessment Report (IR). Under the Comprehensive Regional Assessment using a rotating basin approach used for the IR, the Department focuses on one of New Jersey's five water regions (Atlantic Coastal, Lower Delaware, Northwest, Raritan, and Northeast) during each Integrated Report cycle. The rotating water region approach results in a comprehensive assessment of the entire state every 10 years. The Department initiated the Regional Comprehensive Assessment process in the Atlantic Coastal Region for the 2014 listing and reporting cycle.

Selected sites are part of the new Fish IBI targeted monitoring network in which all fixed site sampling will occur in one of the five specific DEP Water Regions (Upper Delaware, Lower Delaware, Raritan, Northeast, and Atlantic). In 2017, fixed sites will be sampled in the Upper Delaware region to follow the IR reporting cycle under the Comprehensive Regional Assessment using a rotating basin approach.

Probabilistic sites

Probabilistic sites are important for assessing statewide status as well as long term trends.
Probabilistic sites were selected using USEPA probabilistic site selection methodology {Generalized Random Tessellation Stratified (GRTS) survey design}. Candidate streams included all rivers and streams on NJDEP GIS coverage north of the fall line, non-tidal, and greater than 4.0 square miles in drainage, while candidate sites south of the fall line were non-tidal, greater than 2.0 square miles in drainage, and are located in the Inner Coastal Plain.

A list of candidate streams was drawn in 2015 and include sites to be sampled for the Headwaters IBI and Fish IBI programs. The timeline for sampling 50 probabilistic sites is approximately 3-4 years.

Sentinel sites

Sentinel sites are considered high quality waterbodies located in fully or partially protected watersheds which are sampled on a routine basis to assess environmental changes and natural variability.

Both random and sentinel sites are split between the region north of the fall line, the inner coastal plain, and the outer coastal plain. Fixed and random sites are sampled on a five-year basis, while sentinel sites are sampled every other year.

All Northern IBI sites will be above the fall line with drainage areas greater than 4 square miles. Southern IBI sites will consist of Delaware drainage streams in the inner coastal plain with drainage areas greater than 2.0 square miles. The selected sites will address the varied program needs of the Bureau of Freshwater and Biological Monitoring.

All network sites will be visited prior to selection to make sure they are wadeable, meet the habitat criteria of Barbour et al. (1999) where applicable, and to mark off a 150-meter stream reach. All sites to be sampled will be selected prior to the end of the index period. Using a Trimble GPS capable of sub-meter accuracy, the start and finish of each sample site are recorded as waypoints and later incorporated into GIS. The 2017 Fish IBI sites occur in the following WMA's.

WMA	Latitude	Longitude	Waterbody	Network
1	-74.98071	40.82745	FIBI002 Furnace Brook	Fixed
1	-75.1402	40.69486	FIBI004 Lopatcong Creek	Fixed
1	-74.95985	40.72314	FIBI005 Musconetcong River	Fixed
1	-74.82702	41.08486	FIBI012 Neldon Brook	Fixed
11	-75.05932	40.5274	FIBI026 Nishisakawick Creek	Fixed
11	-75.0211	40.47123	FIBI027 Lockatong Creek	Fixed
11	-74.90463	40.33321	FIBI028 Moore Creek	Fixed
11	-74.94353	40.38753	FIBI029 Alexauken Creek	Fixed
11	-75.06869	40.5482	FIBI034 Harihokake Creek	Fixed
2	-74.63138	41.1973	FIBI040 WB Papakating Creek	Fixed
11	-74.74987	40.25187	FIBI041 Shabakunk Creek	Fixed
1	-74.68622	41.35172	FIBI046 Clove Brook	Fixed
1	-75.04653	40.84289	FIBI047 Beaver Brook	Fixed
2	-74.59497	41.08685	FIBI049 Walkill River	Fixed
1	-74.6762	40.96379	FIBI050 Lubbers Run	Fixed
1	-75.01875	40.96641	FIBI055 Paulins Kill	Fixed
2	-74.6184	41.23587	FIBI056 Clove Brook	Fixed
1	-74.80606	40.87347	FIBI058 Musconetcong River	Fixed
1	-74.83047	40.9426	FIBI064 Pequest River	Fixed
1	-74.80365	41.23935	FIBI065 Little Flat Brook	Fixed
1	-75.08507	40.69853	FIBI067 Pohatcong Creek	Fixed
1	-75.07173	40.7161	FIBI076 Pohatcong Creek	Fixed
1	-74.85614	41.04894	FIBI081 Troy Brook	Fixed
2	-74.58145	41.15246	FIBI099 Wallkill River	Fixed
1	-74.74822	41.1449	FIBI100 Dry Brook (Culvers Creek)	Fixed
1	-75.1668	40.6083	FIBI110 Musconetcong River	Fixed
1	-75.071	40.8196	FIBI111 Pophandusing Brook	Fixed
1	-75.9594	40.9867	FIBI112 Blair Creek	Fixed
1	-74.9805	40.9794	FIBI113 Jacksonburg Creek	Fixed
1	-75.1855	40.6251	FIBI114 Pohatcong Creek	Fixed
20	-74.4605	40.1382	FIBI213 Ivanhoe Brook	S_IBI Sentinel
6	-74.7317	40.8114	FIBI037 Drakes Brook	N_IBI Sentinel
1	-75.0033	41.0578	FIBI039 VanCampens Brook	N_IBI Sentinel
1	-75.11952	40.77253	FIBI048 Buckhorn Creek	N_IBI Sentinel
8	-74.9690	40.6476	FIBI053 Mulhockaway Creek	N_IBI Sentinel
1	-74.77861	41.31303	FIBI107 Shimers Brook	N_IBI Sentinel
8	-74.6297	40.7672	NJS2016-057 North Branch Raritan R	Probabilistic
1	-74.7272	41.12755	NJS2016-060 Paulins Kill	Probabilistic
18	-75.2458	39.73014	NJS2016-062 SB Raccoon Ck	Probabilistic
1	-74.9641	41.0719	NJS2016-064 Vancampens Brook	Probabilistic
18	-75.3109	39.79519	NJS2016-067 Little Timber Creek	Probabilistic

***Probabilistic site list may change due to site conditions and access (Addendum).**

9.0 Sampling Procedures:

Sampling procedures for fish collection are described by Kurtenbach (1994), available as a .pdf document upon request. The sampling objective is to obtain a representative sample of the fish assemblage in a 150 meter stream reach. Fish will be captured using electrofishing equipment (either backpack units or barge mounted unit), identified to species level, and then released. Electrofishing is inherently dangerous and, therefore, team leaders must be trained in safe electrofishing techniques and practices to ensure safe working conditions for themselves and the field staff (AFS Professional Safety Committee 2008). Exposure to low electrical current (like that used in electrofishing) may cause death due to respiratory arrest or cardiac fibrillation (AFS Professional Safety Committee 2008). Due to these dangers, the field team leader and at least one other crew member must be trained in CPR and AED procedures. All crew members are required to wear chest waders with non-slip soles and electrician gloves rated at 7,500 watts. Sampling gear and crew size is directly related to stream width, but is at the discretion of the field team leader.

Stream width (m)	Gear*	Crew size*
≤ 3	1 backpack	3
3 to 10	2 backpacks	4 to 5
10 to 15	3 backpacks/barge	5+
> 15	barge	5+
* At the discretion of the Team Leader		

Sampling will include qualitative habitat assessments for high gradient streams as described in Barbour et al. (1999). In-stream measurements of temperature, DO, pH, conductivity, discharge, substrate, and canopy will be taken at each site as described below in section 6.

11.0 Field Measurements/QAQC:

Dissolved oxygen (DO), pH, water temperature, and specific conductivity will be measured in-field at each site by biomonitoring staff, concurrent with fish sampling, in accordance with N.J.A.C. 7:18 *Regulations Governing the Certification of Laboratories and Environmental Measures* (NJDEP, 2003), Subchapter 8, Analyze-Immediately Environmental Measurements, and NJDEP's *Field Sampling Procedures Manual* (NJDEP, 2005). These physical/chemical parameters will be taken *in situ*, mid-depth, in a free-flowing area of the stream. BFBM is certified by the Office of Quality Assurance for each parameter sampled (Certified Lab ID # 11896). Water temperature, pH, specific conductance, and dissolved oxygen are measured using a Hydrolab MS5. The Hydrolab MS5 is a multi-parameter water quality system that combines temperature, pH, conductance, and luminescent dissolved oxygen (LDO) probes into one meter. The pH, specific conductance, and dissolved oxygen probes will be calibrated on a weekly basis per the manufacturer recommendations.

Visual based habitat assessments will be performed at each site using the format given in the Rapid Bioassessment Protocols (Barbour et al, 1999) for high gradient and low gradient streams. Habitats will be assessed at each site at the time that fish are collected from the site. In addition, a number of qualitative measurements will be made based on visual observation including: substrate composition, weather conditions, water clarity, and presence of aquatic vegetation.

pH: pH will be measured in-stream using a Hydrolab MS5 Water Quality Monitoring System. The meter and probe will be maintained and calibrated in accordance with the Operating Manual (February 2006 Edition 3, HACH Environmental, Loveland, CO). The probe is calibrated on a weekly basis per the manufacturer recommendations. The probe is also checked each day of use with a buffer which corresponds to the expected range of the values to be measured. After three hours of continuous use, the pH of the certified buffer will be checked. Records of all calibrations and calibration checks shall be maintained in the BFBM Fish IBI Field Log.

Dissolved Oxygen: Dissolved oxygen will be measured in-stream using a Hydrolab MS5 Water Quality Monitoring System. The meter and probe will be maintained and air calibrated at each site in accordance with the Operating Manual (February 2006 Edition 3, HACH Environmental, Loveland, CO). The meter is barometrically

compensated and checked at each sampling site. The meter will be checked weekly against a Winkler DO analysis. Calibration records are maintained in the BFBM Fish IBI Field Log.

Water Temperature: Water temperature will be measured in-stream using a Hydrolab MS5 Water Quality Monitoring System. The meter and probe will be maintained and calibrated in accordance with the Operating Manual (February 2006 Edition 3, HACH Environmental, Loveland, CO). Water temperature will be checked against a NIST certified thermometer. Calibration records are maintained in the BFBM Fish IBI Field Log.

Ambient Air Temperature: Air temperature will be measured streamside using a Traceable Flip-Stick thermometer (Fisher Scientific, Friendswood, Texas). The thermometer accurately measures ambient air temperature. The thermometer will be maintained and sent for recalibration in accordance with operating procedures. Air temperature will be checked against a NIST certified thermometer. Calibration records are maintained in the BFBM Fish IBI Field Log.

Specific Conductance: Specific conductance will be measured in-stream using a Hydrolab MS5 Water Quality Monitoring System. The meter and probe will be maintained and calibrated in accordance with the Operating Manual (February 2006 Edition 3, HACH Environmental, Loveland, CO). Specific conductance will be calibrated weekly using the appropriate conductivity standard (500, 1800, 50,000 μmhos/cm). To ensure accuracy, the probe will be checked each day of use with a certified standard which corresponds to the expected range of the values to be measured. Calibration records are maintained in the BFBM Fish IBI Field Log.

Canopy: The percentage of open or closed forest canopy cover over the stream channel will be measured using either a convex or concave Forestry Suppliers Spherical Crown Densiometer. Measurements will be taken at the starting point and at intervals 50, 100, and 150 meters along the sampled reach.

Discharge: Stream discharge will be measured at each stream reach sampled. A typical stream cross-section will be located at each sampling site and the cross-section width measured and divided into approximately 10 equal segments. (For small streams with a width of less than 20 feet, the number of segments may be reduced.) At each segment, the average velocity will be measured using a Marsh McBirney Flo-Mate 2000; the depth of the water at each segment will also be measured. This data will be used to calculate discharge in cubic feet or meters per second.

Nutrients: Phosphorus and nitrogen samples are being collected at IBI sites as part of the ongoing Biological Nutrient Correlation Project. See Biological Nutrient Correlation QAPP for more information.

12.0 Fish Identification/QAQC:

Identification of IBI species shall be according to the following references:

Cooper, E. L. 1983. Fishes of Pennsylvania and the United States. The Pennsylvania State University Press, University Park, PA.

Eddy, S., and J.C. Underhill. 1983. How to Know the Freshwater Fishes 3rd ed. William C. Brown Company, Dubque, Iowa.

Jenkins, R.E. and N.M. Burkhead. 1993. Freshwater Fishes of Virginia American Fisheries Society. Bethesda, MD.

Page, L.M., and B.M. Burr. 1991. Peterson Field Guides, Freshwater Fishes. Houghton Mifflin Company, New York.

Werner, R.G. 1980. Freshwater Fishes of New York State: A Field Guide. Syracuse University Press, New York.

The staff of the BFBM is experienced at identifying freshwater fish species expected to be collected. Individuals that cannot be identified in the field will be preserved in 10% formalin and brought back to the lab for further

evaluation. Additionally, experienced fisheries biologists from the USEPA and the Philadelphia Academy of Natural Sciences of Drexel University are available to assist with unidentified or questionable individuals.

13.0 Data Analysis:

Once fish from sample collections have been identified, counted, examined for disease and anomalies, and recorded, a Fish IBI score will be calculated using the appropriate Northern IBI or Southern IBI metrics. Fish IBI scores are calculated automatically in Access and are hand checked by staff members to ensure accuracy. Any discrepancies in scoring are re-evaluated.

14.0 Time Line – Schedule of Tasks:

Site evaluation and selection is expected to begin during the 1st week of April 2017.

Fish IBI sampling will take place in the daytime, June through early October 2017, during normal or low flows, and never under atypical conditions such as drought, high flows or excessive turbidity caused by significant precipitation. The postponement of a sampling event is determined by the professional judgment of the field crew leader following a visual inspection of the waterbody. Waters stocked with trout will be sampled between July 1 and early October 2017.

15.0 Resource Needs: BFBM will need three hourly staff to complete this project.

16.0 Data Storage and Distribution:

Sampling results will be stored locally in a Microsoft Access database. Following the QA/QC verification of fish identifications, data will be entered into New Jersey's Water Quality Data Exchange (WQDE) and USEPA STORET Data Warehouse by June of the following year it is verified (Appendix). All raw data records shall be maintained for a period of no less than five years.

17.0 Data Reporting

All habitat assessment and flow data, physical/chemical analysis, and site observations will be recorded on the BFBM's Biological Field Observations and Data Sheet, and also recorded electronically in a Microsoft Access database.

All fish identifications will be recorded on the BFBM's Data Sheet and entered into a Microsoft Access database. Habitat assessment data, taxonomic data and counts, and metric and index scores will also be transferred into NJDEP's Water Quality Data Exchange (WQDE). Data will also be uploaded into USEPA's water monitoring data repository, STORET Data Warehouse. Raw taxa data and field chemistries can also be acquired via the Water Quality Portal.

A data summary table, including index scores and ratings, will be posted on the BFBM website (www.state.nj.us/dep/wms/bfbm) after completion of all sample analyses for the Water Region and data review. A report will be issued and will contain at a minimum: taxa and counts of fish, field chemistry results, score and assessment of biological condition ratings, and habitat assessment score and rating.

18.0 Audits

The Office of Quality Assurance (OQA) will be notified prior to commencement of any sampling activities in order that an audit may be performed.

19.0 Assessment, Oversight, and Response

The Project Officer will be responsible for the oversight of all activities relating to this project. The Project Officer will assess field collection functions and make corrections when necessary to maintain the data accuracy as

defined in this plan. If any changes or modifications are made to this plan regarding data collection, as it relates to the objectives(s) and data accuracy required in this project, all original signees of the QAPP will be notified.

20.0 Literature Cited

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. "*Rapid Bioassessement Protocols for Use in Streams and Wadable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition*." EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Kurtenbach, J. P. 1994. "*Index of Biotic Integrity Study of Northern New Jersey Drainages*" U.S.EPA, Region 2, Div. Of Environmental Assessment, Edison, N. J. (Metrics revised April, 2000).

New Jersey Department of Environmental Protection (NJDEP), 2003. Regulations governing the certification of laboratories and environmental measures, N.J.A.C. 7:18, subchapter 8. Trenton, NJ.

New Jersey Department of Environmental Protection (NJDEP), 2005. Field sampling procedures manual. Ch. 6, Trenton, NJ.

New Jersey Department of Environmental Protection (NJDEP), 2005-2008. Annual Volume I Fish IBI Reports. http://www.nj.gov/dep/wms//bfbm/ibireports.html. Trenton, NJ.

Professional Safety Committee. 2008. Fisheries safety handbook. American Fisheries Society, Bethesda, Maryland.

Addendum

21. 2017 Final Site Selection (as requested by OQA):

WMA	Waterbody	Network

Appendix

Data Management Tables

For Data Management purposes, Water Chemistry is defined as parameters analyzed by a lab;
Field measurements are defined as analyze immediately parameters.

Inventory

Geographic Regions	Statewide
Counties	Gloucester, Monmouth, Warren, Sussex, Morris, Hunterdon, Mercer
Dates	6/1/2017 - 10/7/2017
Status	Future/Planned
Sample Frequency	Other
Seasons Sampled	Spring, Summer, Fall
Waterbody Type	River/Stream
Salinity Category	Fresh
Tidal Influence	Non-tidal
Project Description	The objective of the project is to enhance the ability of Water Monitoring & Standards to evaluate water quality in wadeable streams by providing a comprehensive biological assessment. This will be done using the Index of Biotic Integrity (IBI) for New Jersey fish assemblages statew using the Northern Fish IBI and the Inner Coastal Plain Fish IBI (Southern IBI). The intended use the assessment of aquatic life use in State waters as required by the federal CWA under section 305(b) and the identification of State impaired waters under section 303(d) of the federal CWA. I addition, Fish IBI data is a significant part of the intensive, data-driven, Category 1 (C-1) selectio process (N.J.A.C. 7:9B). Additional uses may occur, such as water quality classifications.
Parameters analyzed type	Habitat, Biology:Fish,

Data Management Supplement

QAPP network path file location?	V:\LUM\BFBM\Bfbm\Quality Assurance Plans\Calendar Year 2017 QAPPS\IBI2017
Where will data be recorded in field (media)	Paper
If on tablets or phones, will download at office occur or will you connect wirelessly?	
If on tablets or phones, who will do the download?	
If data collected electronically, where will it be stored?	
Format to be received from Lab	
Method of receipt from lab/s	
Personnel receiving outside lab data	
Is data expected to go to WQDE/STORET?	Yes
Data manager - (Bureau and Name)	BFBM Leigh Lager

Table 1. Site List

Station ID (WQDE compliant and referenced)	Waterbody/Location	Latitude-dd	Longitude-dd	County	Site exists in WQDE already?	Location Type
FIBI002	Furnace Brook	-74.98071	40.82745	Warren	YES	River/stream
FIBI004	Lopatcong Creek	-75.1402	40.69486	Warren	YES	River/stream
FIBI005	Musconetcong River	-74.95985	40.72314	Hunterdon/Warren	YES	River/stream
FIBI012	Neldon Brook	-74.82702	41.08486	Sussex	YES	River/stream
FIBI026	Nishisakawick Creek	-75.05932	40.5274	Hunterdon	YES	River/stream
FIBI027	Lockatong Creek	-75.0211	40.47123	Hunterdon	YES	River/stream
FIBI028	Moore Creek	-74.90463	40.33321	Mercer	YES	River/stream
FIBI029	Alexauken Creek	-74.94353	40.38753	Hunterdon	YES	River/stream
FIBI034	Harihokake Creek	-75.06869	40.5482	Hunterdon	YES	River/stream
FIBI040	WB Papakating Creek	-74.63138	41.1973	Sussex	YES	River/stream
FIBI041	Shabakunk Creek	-74.74987	40.25187	Mercer	YES	River/stream
FIBI046	Clove Brook	-74.68622	41.35172	Sussex	YES	River/stream
FIBI047	Beaver Brook	-75.04653	40.84289	Warren	YES	River/stream
FIBI049	Walkill River	-74.59497	41.08685	Sussex	YES	River/stream
FIBI050	Lubbers Run	-74.6762	40.96379	Sussex	YES	River/stream
FIBI055	Paulins Kill	-75.01875	40.96641	Warren	YES	River/stream
FIBI056	Clove Brook	-74.6184	41.23587	Sussex	YES	River/stream
FIBI058	Musconetcong River	-74.80606	40.87347	Warren	YES	River/stream
FIBI064	Pequest River	-74.83047	40.9426	Warren	YES	River/stream
FIBI065	Little Flat Brook	-74.80365	41.23935	Sussex	YES	River/stream
FIBI067	Pohatcong Creek	-75.08507	40.69853	Warren	YES	River/stream
FIBI076	Pohatcong Creek	-75.07173	40.7161	Warren	YES	River/stream
FIBI081	Troy Brook	-74.85614	41.04894	Sussex	YES	River/stream
FIBI099	Wallkill River	-74.58145	41.15246	Sussex	YES	River/stream
FIBI100	Dry Brook (CulversCk)	-74.74822	41.1449	Sussex	YES	River/stream
FIBI110	Musconetcong River	-75.1668	40.6083	Hunterdon/Warren	NO	River/stream
FIBI111	Pophandusing Brook	-75.071	40.8196	Warren	NO	River/stream
FIBI112	Blair Creek	-75.9594	40.9867	Warren	NO	River/stream

FIBI113	Jacksonburg Creek	-74.9805	40.9794	Warren	NO	River/stream
FIBI114	Pohatcong Creek	-75.1855	40.6251	Hunterdon	NO	River/stream
FIBI213	Ivanhoe Brook	-74.4605	40.1382	Monmouth	YES	River/stream
FIBI037	Drakes Brook	-74.7317	40.8114	Morris	YES	River/stream
FIBI039	VanCampens Brook	-75.0033	41.0578	Warren	YES	River/stream
FIBI048	Buckhorn Creek	-75.11952	40.77253	Warren	YES	River/stream
FIBI053	Mulhockaway Creek	-74.9690	40.6476	Hunterdon	YES	River/stream
FIBI107	Shimers Brook	-74.77861	41.31303	Sussex	YES	River/stream
NJS2016-057	North Branch Raritan R	-74.6297	40.7672	Morris	NO	River/stream
NJS2016-060	Paulins Kill	-74.7272	41.12755	Sussex	NO	River/stream
NJS2016-062	SB Raccoon Ck	-75.2458	39.73014	Gloucester	NO	River/stream
NJS2016-064	Vancampens Brook	-74.9641	41.0719	Warren	NO	River/stream
NJS2016-067	Little Timber Ck	-75.3109	39.79519	Gloucester	NO	River/stream

Table 2. Parameters

STATION ID	Field Msr/Obs	Flow	Water Chemistry	Continuous Monitoring	Biological Sampling	Sediment Collection	Bacteria Collection	Habitat	Metrics	Indices
FIBI002	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI004	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI005	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI012	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI026	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI027	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI028	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI029	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI034	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI040	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI041	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI046	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI047	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI049	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI050	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI055	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI056	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI058	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI064	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI065	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI067	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI076	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI081	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI099	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI100	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI110	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI111	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI112	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI113	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI114	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI213	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI037	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI039	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI048	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI053	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes

FIBI107	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
NJS2016-057	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
NJS2016-060	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
NJS2016-062	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
NJS2016-064	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
NJS2016-067	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes

Table 3. Partners

STATION ID	Field Msr/Obs	Flow	Water Chemistry	Continuous Monitoring	Biological Sampling	Sediment Collection	Bacteria Collection
FIBI002	DEP	DEP	NO	NO	DEP	NO	No
FIBI004	DEP	DEP	NO	NO	DEP	NO	No
FIBI005	DEP	DEP	NO	NO	DEP	NO	No
FIBI012	DEP	DEP	NO	NO	DEP	NO	No
FIBI026	DEP	DEP	NO	NO	DEP	NO	No
FIBI027	DEP	DEP	NO	NO	DEP	NO	No
FIBI028	DEP	DEP	NO	NO	DEP	NO	No
FIBI029	DEP	DEP	NO	NO	DEP	NO	No
FIBI034	DEP	DEP	NO	NO	DEP	NO	No
FIBI040	DEP	DEP	NO	NO	DEP	NO	No
FIBI041	DEP	DEP	NO	NO	DEP	NO	No
FIBI046	DEP	DEP	NO	NO	DEP	NO	No
FIBI047	DEP	DEP	NO	NO	DEP	NO	No
FIBI049	DEP	DEP	NO	NO	DEP	NO	No
FIBI050	DEP	DEP	NO	NO	DEP	NO	No
FIBI055	DEP	DEP	NO	NO	DEP	NO	No
FIBI056	DEP	DEP	NO	NO	DEP	NO	No
FIBI058	DEP	DEP	NO	NO	DEP	NO	No
FIBI064	DEP	DEP	NO	NO	DEP	NO	No
FIBI065	DEP	DEP	NO	NO	DEP	NO	No
FIBI067	DEP	DEP	NO	NO	DEP	NO	No
FIBI076	DEP	DEP	NO	NO	DEP	NO	No
FIBI081	DEP	DEP	NO	NO	DEP	NO	No
FIBI099	DEP	DEP	NO	NO	DEP	NO	No
FIBI100	DEP	DEP	NO	NO	DEP	NO	No
FIBI110	DEP	DEP	NO	NO	DEP	NO	No

FIBI111	DEP	DEP	NO	NO	DEP	NO	No
FIBI112	DEP	DEP	NO	NO	DEP	NO	No
FIBI113	DEP	DEP	NO	NO	DEP	NO	No
FIBI114	DEP	DEP	NO	NO	DEP	NO	No
FIBI213	DEP	DEP	NO	NO	DEP	NO	No
FIBI037	DEP	DEP	NO	NO	DEP	NO	No
FIBI039	DEP	DEP	NO	NO	DEP	NO	No
FIBI048	DEP	DEP	NO	NO	DEP	NO	No
FIBI053	DEP	DEP	NO	NO	DEP	NO	No
FIBI107	DEP	DEP	NO	NO	DEP	NO	No
NJS2016-057	DEP	DEP	NO	NO	DEP	NO	No
NJS2016-060	DEP	DEP	NO	NO	DEP	NO	No
NJS2016-062	DEP	DEP	NO	NO	DEP	NO	No
NJS2016-064	DEP	DEP	NO	NO	DEP	NO	No
NJS2016-067	DEP	DEP	NO	NO	DEP	NO	No

Table 4. Field Measurements

Field Name	**WQDE Name**	**Media**	**Units**
DO	Dissolved oxygen (DO)	Water	mg/l
Water Temp	Temperature, Water	Water	deg C
Spec Cond	Specific conductance	Water	uS/cm
pH	pH	Water	None
Flow	Flow	Water	cfs
Barometric Pressure	Barometric Pressure	Air	mmHg
DO Sat	Dissolved oxygen saturation	Water	%
Temperature, air	Temperature, air	Air	deg C

Table 7. RBP Habitat

Characteristic Name
RBP2, Low G, Pool Variability (choice list)
RBP2, Low G, Sediment Deposition (choice list)
RBP2, Low G, Channel Flow Status (choice list)
RBP2, Low G, Channel Alteration (choice list)
RBP2, Low G, Epifaunal Substrate/Available Cover (choice list)
RBP2, Low G, Pool Substrate Characterization (choice list)
RBP2, Low G, Bank Stability, Left Bank (choice list)
RBP2, Low G, Vegetative Protection, Left Bank (choice list)
RBP2, Low G, Channel Sinuosity (choice list)
RBP2, Low G, Bank Stability, Right Bank (choice list)
RBP2, Low G, Vegetative Protection, Right Bank (choice list)
RBP2, Low G, Riparian Vegetative Zone Width, Left Bank (choice list)
RBP2, Low G, Riparian Vegetative Zone Width, Right Bank (choice list)
RBP2, High G, Embeddedness (choice list)
RBP2, High G, Velocity/Depth Regime (choice list)
RBP2, High G, Sediment Deposition (choice list)
RBP2, High G, Channel Flow Status (choice list)
RBP2, High G, Frequency of Riffles (or bends) (choice list)
RBP2, High G, Epifaunal Substrate/Available Cover (choice list)
RBP2, High G, Bank Stability, Right Bank (choice list)
RBP2, High G, Channel Alteration (choice list)
RBP2, High G, Bank Stability, Left Bank (choice list)
RBP2, High G, Vegetative Protection, Left Bank (choice list)
RBP2, High G, Vegetative Protection, Right Bank (choice list)
RBP2, High G, Riparian Vegetative Zone Width, Left Bank (choice list)
RBP2, High G, Riparian Vegetative Zone Width, Right Bank (choice list)

Table 8. RBP Total Habitat
CharacteristicName
RBP2, High G, habitat assessment total score
RBP2, High G, habitat assessment total rating
RBP2, Low G, habitat assessment total score
RBP2, Low G, habitat assessment total rating

Table 9. Fish Metrics

CharacteristicName
Percent Richness of Rheophilic Species (adjusted for drainage size minus T. Darter)
Percent Abundance Cold and Nontolerant Coolwater Species (adjusted for drainage size)
Percent Richness Generalist Feeders
Tolerance Index
Percent Richness of Lithophilic Spawners (minus w. sucker)
Percent Abundance Cyprinidae (adjusted for drainage size)
Percent Abundance Dominant Three Taxa (not including Blacknose Dace)
Percent Richness Benthic Insectivores
Percent Insectivore Individuals
Number of individuals in sample
Percent Piscivore Individuals
Percent DELT Anomalies
Native Species Richness
Benthic Species Richness
Intolerant Species Richness
Percent Tolerant Individuals

Table 10. Total Fish Score and Rating

CharacteristicName
Fish Index of Biotic Integrity
FIBI Rating
Inner Coastal Plain Low Gradient Fish Index
ICPLGFI Rating

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Appendix

1.0 Project Name: Fish IBI Monitoring Program

2.0 Requesting Agency: NJDEP Water Monitoring and Standards

3.0 Date of Project (Sampling/Data Reporting): 4/2017 - 5/2018

4.0 Project Fiscal Information: Job Number 35950000, Activity Code V4DT

5.0 Project Officer: John Vile, Research Scientist I, BFBM

6.0 Special Training Needs/Certification

Assistants to the project will be trained in the operation and use of all sampling equipment including the proper safety and handling procedures for electroshocking equipment. The training will entail calibration methods, deployment techniques, and data retrieval from the equipment. The Project Officer or designee will be responsible for any necessary training.

BFBM is certified by the Office of Quality Assurance (certified lab ID # 11896) for all parameters to be measured.

7.0 Project Description/Objective:

The objective of the project is to enhance the ability of Water Monitoring & Standards to evaluate water quality in wadeable streams by providing a comprehensive biological assessment. This will be done using the Index of Biotic Integrity (IBI) for New Jersey fish assemblages statewide using the Northern Fish IBI and the Inner Coastal Plain Fish IBI (Southern IBI). The intended use is the assessment of aquatic life use in State waters as required by the federal CWA under section 305(b) and the identification of State impaired waters under section 303(d) of the federal CWA. In addition, Fish IBI data is a significant part of the intensive, data-driven, Category 1 (C-1) selection process (N.J.A.C. 7:9B). Additional uses may occur, such as water quality classifications.

8.0 Network Design/Site Selection:

There will be a total of 41 sites sampled in 2017 consisting of the following: 30 fixed network, 5 probabilistic (random), and 6 sentinel sites.

Fixed Sites (Regional Monitoring)

The data from fixed sites is used to assess status, long term trends, and aquatic life use in the waters of the state for the Integrated Water Quality Monitoring and Assessment Report (IR). Under the Comprehensive Regional Assessment using a rotating basin approach used for the IR, the Department focuses on one of New Jersey's five water regions (Atlantic Coastal, Lower Delaware, Northwest, Raritan, and Northeast) during each Integrated Report cycle. The rotating water region approach results in a comprehensive assessment of the entire state every 10 years. The Department initiated the Regional Comprehensive Assessment process in the Atlantic Coastal Region for the 2014 listing and reporting cycle.

Selected sites are part of the new Fish IBI targeted monitoring network in which all fixed site sampling will occur in one of the five specific DEP Water Regions (Upper Delaware, Lower Delaware, Raritan, Northeast, and Atlantic). In 2017, fixed sites will be sampled in the Upper Delaware region to follow the IR reporting cycle under the Comprehensive Regional Assessment using a rotating basin approach.

Probabilistic sites

Probabilistic sites are important for assessing statewide status as well as long term trends.
Probabilistic sites were selected using USEPA probabilistic site selection methodology {Generalized Random Tessellation Stratified (GRTS) survey design}. Candidate streams included all rivers and streams on NJDEP GIS coverage north of the fall line, non-tidal, and greater than 4.0 square miles in drainage, while candidate sites south of the fall line were non-tidal, greater than 2.0 square miles in drainage, and are located in the Inner Coastal Plain.

A list of candidate streams was drawn in 2015 and include sites to be sampled for the Headwaters IBI and Fish IBI programs. The timeline for sampling 50 probabilistic sites is approximately 3-4 years.

Sentinel sites

Sentinel sites are considered high quality waterbodies located in fully or partially protected watersheds which are sampled on a routine basis to assess environmental changes and natural variability.

Both random and sentinel sites are split between the region north of the fall line, the inner coastal plain, and the outer coastal plain. Fixed and random sites are sampled on a five-year basis, while sentinel sites are sampled every other year.

All Northern IBI sites will be above the fall line with drainage areas greater than 4 square miles. Southern IBI sites will consist of Delaware drainage streams in the inner coastal plain with drainage areas greater than 2.0 square miles. The selected sites will address the varied program needs of the Bureau of Freshwater and Biological Monitoring.

All network sites will be visited prior to selection to make sure they are wadeable, meet the habitat criteria of Barbour et al. (1999) where applicable, and to mark off a 150-meter stream reach. All sites to be sampled will be selected prior to the end of the index period. Using a Trimble GPS capable of sub-meter accuracy, the start and finish of each sample site are recorded as waypoints and later incorporated into GIS. The 2017 Fish IBI sites occur in the following WMA's.

WMA	Latitude	Longitude	Waterbody	Network
1	-74.98071	40.82745	FIBI002 Furnace Brook	Fixed
1	-75.1402	40.69486	FIBI004 Lopatcong Creek	Fixed
1	-74.95985	40.72314	FIBI005 Musconetcong River	Fixed
1	-74.82702	41.08486	FIBI012 Neldon Brook	Fixed
11	-75.05932	40.5274	FIBI026 Nishisakawick Creek	Fixed
11	-75.0211	40.47123	FIBI027 Lockatong Creek	Fixed
11	-74.90463	40.33321	FIBI028 Moore Creek	Fixed
11	-74.94353	40.38753	FIBI029 Alexauken Creek	Fixed
11	-75.06869	40.5482	FIBI034 Harihokake Creek	Fixed
2	-74.63138	41.1973	FIBI040 WB Papakating Creek	Fixed
11	-74.74987	40.25187	FIBI041 Shabakunk Creek	Fixed
1	-74.68622	41.35172	FIBI046 Clove Brook	Fixed
1	-75.04653	40.84289	FIBI047 Beaver Brook	Fixed
2	-74.59497	41.08685	FIBI049 Walkill River	Fixed
1	-74.6762	40.96379	FIBI050 Lubbers Run	Fixed
1	-75.01875	40.96641	FIBI055 Paulins Kill	Fixed
2	-74.6184	41.23587	FIBI056 Clove Brook	Fixed
1	-74.80606	40.87347	FIBI058 Musconetcong River	Fixed
1	-74.83047	40.9426	FIBI064 Pequest River	Fixed
1	-74.80365	41.23935	FIBI065 Little Flat Brook	Fixed
1	-75.08507	40.69853	FIBI067 Pohatcong Creek	Fixed
1	-75.07173	40.7161	FIBI076 Pohatcong Creek	Fixed
1	-74.85614	41.04894	FIBI081 Troy Brook	Fixed
2	-74.58145	41.15246	FIBI099 Wallkill River	Fixed
1	-74.74822	41.1449	FIBI100 Dry Brook (Culvers Creek)	Fixed
1	-75.1668	40.6083	FIBI110 Musconetcong River	Fixed
1	-75.071	40.8196	FIBI111 Pophandusing Brook	Fixed
1	-75.9594	40.9867	FIBI112 Blair Creek	Fixed
1	-74.9805	40.9794	FIBI113 Jacksonburg Creek	Fixed
1	-75.1855	40.6251	FIBI114 Pohatcong Creek	Fixed
20	-74.4605	40.1382	FIBI213 Ivanhoe Brook	S_IBI Sentinel
6	-74.7317	40.8114	FIBI037 Drakes Brook	N_IBI Sentinel
1	-75.0033	41.0578	FIBI039 VanCampens Brook	N_IBI Sentinel
1	-75.11952	40.77253	FIBI048 Buckhorn Creek	N_IBI Sentinel
8	-74.9690	40.6476	FIBI053 Mulhockaway Creek	N_IBI Sentinel
1	-74.77861	41.31303	FIBI107 Shimers Brook	N_IBI Sentinel
8	-74.6297	40.7672	NJS2016-057 North Branch Raritan R	Probabilistic
1	-74.7272	41.12755	NJS2016-060 Paulins Kill	Probabilistic
18	-75.2458	39.73014	NJS2016-062 SB Raccoon Ck	Probabilistic
1	-74.9641	41.0719	NJS2016-064 Vancampens Brook	Probabilistic
18	-75.3109	39.79519	NJS2016-067 Little Timber Creek	Probabilistic

***Probabilistic site list may change due to site conditions and access (Addendum).**

9.0 Sampling Procedures:

Sampling procedures for fish collection are described by Kurtenbach (1994), available as a .pdf document upon request. The sampling objective is to obtain a representative sample of the fish assemblage in a 150 meter stream reach. Fish will be captured using electrofishing equipment (either backpack units or barge mounted unit), identified to species level, and then released. Electrofishing is inherently dangerous and, therefore, team leaders must be trained in safe electrofishing techniques and practices to ensure safe working conditions for themselves and the field staff (AFS Professional Safety Committee 2008). Exposure to low electrical current (like that used in electrofishing) may cause death due to respiratory arrest or cardiac fibrillation (AFS Professional Safety Committee 2008). Due to these dangers, the field team leader and at least one other crew member must be trained in CPR and AED procedures. All crew members are required to wear chest waders with non-slip soles and electrician gloves rated at 7,500 watts. Sampling gear and crew size is directly related to stream width, but is at the discretion of the field team leader.

Stream width (m)	Gear*	Crew size*
≤ 3	1 backpack	3
3 to 10	2 backpacks	4 to 5
10 to 15	3 backpacks/barge	5+
> 15	barge	5+
* At the discretion of the Team Leader		

Sampling will include qualitative habitat assessments for high gradient streams as described in Barbour et al. (1999). In-stream measurements of temperature, DO, pH, conductivity, discharge, substrate, and canopy will be taken at each site as described below in section 6.

11.0 Field Measurements/QAQC:

Dissolved oxygen (DO), pH, water temperature, and specific conductivity will be measured in-field at each site by biomonitoring staff, concurrent with fish sampling, in accordance with N.J.A.C. 7:18 *Regulations Governing the Certification of Laboratories and Environmental Measures* (NJDEP, 2003), Subchapter 8, Analyze-Immediately Environmental Measurements, and NJDEP's *Field Sampling Procedures Manual* (NJDEP, 2005). These physical/chemical parameters will be taken *in situ*, mid-depth, in a free-flowing area of the stream. BFBM is certified by the Office of Quality Assurance for each parameter sampled (Certified Lab ID # 11896). Water temperature, pH, specific conductance, and dissolved oxygen are measured using a Hydrolab MS5. The Hydrolab MS5 is a multi-parameter water quality system that combines temperature, pH, conductance, and luminescent dissolved oxygen (LDO) probes into one meter. The pH, specific conductance, and dissolved oxygen probes will be calibrated on a weekly basis per the manufacturer recommendations.

Visual based habitat assessments will be performed at each site using the format given in the Rapid Bioassessment Protocols (Barbour et al, 1999) for high gradient and low gradient streams. Habitats will be assessed at each site at the time that fish are collected from the site. In addition, a number of qualitative measurements will be made based on visual observation including: substrate composition, weather conditions, water clarity, and presence of aquatic vegetation.

pH: pH will be measured in-stream using a Hydrolab MS5 Water Quality Monitoring System. The meter and probe will be maintained and calibrated in accordance with the Operating Manual (February 2006 Edition 3, HACH Environmental, Loveland, CO). The probe is calibrated on a weekly basis per the manufacturer recommendations. The probe is also checked each day of use with a buffer which corresponds to the expected range of the values to be measured. After three hours of continuous use, the pH of the certified buffer will be checked. Records of all calibrations and calibration checks shall be maintained in the BFBM Fish IBI Field Log.

Dissolved Oxygen: Dissolved oxygen will be measured in-stream using a Hydrolab MS5 Water Quality Monitoring System. The meter and probe will be maintained and air calibrated at each site in accordance with the Operating Manual (February 2006 Edition 3, HACH Environmental, Loveland, CO). The meter is barometrically

compensated and checked at each sampling site. The meter will be checked weekly against a Winkler DO analysis. Calibration records are maintained in the BFBM Fish IBI Field Log.

Water Temperature: Water temperature will be measured in-stream using a Hydrolab MS5 Water Quality Monitoring System. The meter and probe will be maintained and calibrated in accordance with the Operating Manual (February 2006 Edition 3, HACH Environmental, Loveland, CO). Water temperature will be checked against a NIST certified thermometer. Calibration records are maintained in the BFBM Fish IBI Field Log.

Ambient Air Temperature: Air temperature will be measured streamside using a Traceable Flip-Stick thermometer (Fisher Scientific, Friendswood, Texas). The thermometer accurately measures ambient air temperature. The thermometer will be maintained and sent for recalibration in accordance with operating procedures. Air temperature will be checked against a NIST certified thermometer. Calibration records are maintained in the BFBM Fish IBI Field Log.

Specific Conductance: Specific conductance will be measured in-stream using a Hydrolab MS5 Water Quality Monitoring System. The meter and probe will be maintained and calibrated in accordance with the Operating Manual (February 2006 Edition 3, HACH Environmental, Loveland, CO). Specific conductance will be calibrated weekly using the appropriate conductivity standard (500, 1800, 50,000 μmhos/cm). To ensure accuracy, the probe will be checked each day of use with a certified standard which corresponds to the expected range of the values to be measured. Calibration records are maintained in the BFBM Fish IBI Field Log.

Canopy: The percentage of open or closed forest canopy cover over the stream channel will be measured using either a convex or concave Forestry Suppliers Spherical Crown Densiometer. Measurements will be taken at the starting point and at intervals 50, 100, and 150 meters along the sampled reach.

Discharge: Stream discharge will be measured at each stream reach sampled. A typical stream cross-section will be located at each sampling site and the cross-section width measured and divided into approximately 10 equal segments. (For small streams with a width of less than 20 feet, the number of segments may be reduced.) At each segment, the average velocity will be measured using a Marsh McBirney Flo-Mate 2000; the depth of the water at each segment will also be measured. This data will be used to calculate discharge in cubic feet or meters per second.

Nutrients: Phosphorus and nitrogen samples are being collected at IBI sites as part of the ongoing Biological Nutrient Correlation Project. See Biological Nutrient Correlation QAPP for more information.

12.0 Fish Identification/QAQC:

Identification of IBI species shall be according to the following references:

Cooper, E. L. 1983. Fishes of Pennsylvania and the United States. The Pennsylvania State University Press, University Park, PA.

Eddy, S., and J.C. Underhill. 1983. How to Know the Freshwater Fishes 3rd ed. William C. Brown Company, Dubque, Iowa.

Jenkins, R.E. and N.M. Burkhead. 1993. Freshwater Fishes of Virginia American Fisheries Society. Bethesda, MD.

Page, L.M., and B.M. Burr. 1991. Peterson Field Guides, Freshwater Fishes. Houghton Mifflin Company, New York.

Werner, R.G. 1980. Freshwater Fishes of New York State: A Field Guide. Syracuse University Press, New York.

The staff of the BFBM is experienced at identifying freshwater fish species expected to be collected. Individuals that cannot be identified in the field will be preserved in 10% formalin and brought back to the lab for further

evaluation. Additionally, experienced fisheries biologists from the USEPA and the Philadelphia Academy of Natural Sciences of Drexel University are available to assist with unidentified or questionable individuals.

13.0 Data Analysis:

Once fish from sample collections have been identified, counted, examined for disease and anomalies, and recorded, a Fish IBI score will be calculated using the appropriate Northern IBI or Southern IBI metrics. Fish IBI scores are calculated automatically in Access and are hand checked by staff members to ensure accuracy. Any discrepancies in scoring are re-evaluated.

14.0 Time Line – Schedule of Tasks:

Site evaluation and selection is expected to begin during the 1st week of April 2017.

Fish IBI sampling will take place in the daytime, June through early October 2017, during normal or low flows, and never under atypical conditions such as drought, high flows or excessive turbidity caused by significant precipitation. The postponement of a sampling event is determined by the professional judgment of the field crew leader following a visual inspection of the waterbody. Waters stocked with trout will be sampled between July 1 and early October 2017.

15.0 Resource Needs: BFBM will need three hourly staff to complete this project.

16.0 Data Storage and Distribution:

Sampling results will be stored locally in a Microsoft Access database. Following the QA/QC verification of fish identifications, data will be entered into New Jersey's Water Quality Data Exchange (WQDE) and USEPA STORET Data Warehouse by June of the following year it is verified (Appendix). All raw data records shall be maintained for a period of no less than five years.

17.0 Data Reporting

All habitat assessment and flow data, physical/chemical analysis, and site observations will be recorded on the BFBM's Biological Field Observations and Data Sheet, and also recorded electronically in a Microsoft Access database.

All fish identifications will be recorded on the BFBM's Data Sheet and entered into a Microsoft Access database. Habitat assessment data, taxonomic data and counts, and metric and index scores will also be transferred into NJDEP's Water Quality Data Exchange (WQDE). Data will also be uploaded into USEPA's water monitoring data repository, STORET Data Warehouse. Raw taxa data and field chemistries can also be acquired via the Water Quality Portal.

A data summary table, including index scores and ratings, will be posted on the BFBM website (www.state.nj.us/dep/wms/bfbm) after completion of all sample analyses for the Water Region and data review. A report will be issued and will contain at a minimum: taxa and counts of fish, field chemistry results, score and assessment of biological condition ratings, and habitat assessment score and rating.

18.0 Audits

The Office of Quality Assurance (OQA) will be notified prior to commencement of any sampling activities in order that an audit may be performed.

19.0 Assessment, Oversight, and Response

The Project Officer will be responsible for the oversight of all activities relating to this project. The Project Officer will assess field collection functions and make corrections when necessary to maintain the data accuracy as

defined in this plan. If any changes or modifications are made to this plan regarding data collection, as it relates to the objectives(s) and data accuracy required in this project, all original signees of the QAPP will be notified.

20.0 Literature Cited

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. "*Rapid Bioassessement Protocols for Use in Streams and Wadable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition*." EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Kurtenbach, J. P. 1994. "*Index of Biotic Integrity Study of Northern New Jersey Drainages*" U.S.EPA, Region 2, Div. Of Environmental Assessment, Edison, N. J. (Metrics revised April, 2000).

New Jersey Department of Environmental Protection (NJDEP), 2003. Regulations governing the certification of laboratories and environmental measures, N.J.A.C. 7:18, subchapter 8. Trenton, NJ.

New Jersey Department of Environmental Protection (NJDEP), 2005. Field sampling procedures manual. Ch. 6, Trenton, NJ.

New Jersey Department of Environmental Protection (NJDEP), 2005-2008. Annual Volume I Fish IBI Reports. http://www.nj.gov/dep/wms//bfbm/ibireports.html. Trenton, NJ.

Professional Safety Committee. 2008. Fisheries safety handbook. American Fisheries Society, Bethesda, Maryland.

Addendum

21. 2017 Final Site Selection (as requested by OQA):

WMA	Waterbody	Network

Appendix

Data Management Tables

For Data Management purposes, Water Chemistry is defined as parameters analyzed by a lab;
Field measurements are defined as analyze immediately parameters.

Inventory

Geographic Regions	Statewide
Counties	Gloucester, Monmouth, Warren, Sussex, Morris, Hunterdon, Mercer
Dates	6/1/2017 - 10/7/2017
Status	Future/Planned
Sample Frequency	Other
Seasons Sampled	Spring, Summer, Fall
Waterbody Type	River/Stream
Salinity Category	Fresh
Tidal Influence	Non-tidal
Project Description	The objective of the project is to enhance the ability of Water Monitoring & Standards to evaluate water quality in wadeable streams by providing a comprehensive biological assessment. This will be done using the Index of Biotic Integrity (IBI) for New Jersey fish assemblages statew using the Northern Fish IBI and the Inner Coastal Plain Fish IBI (Southern IBI). The intended use the assessment of aquatic life use in State waters as required by the federal CWA under section 305(b) and the identification of State impaired waters under section 303(d) of the federal CWA. I addition, Fish IBI data is a significant part of the intensive, data-driven, Category 1 (C-1) selectio process (N.J.A.C. 7:9B). Additional uses may occur, such as water quality classifications.
Parameters analyzed type	Habitat, Biology:Fish,

Data Management Supplement

QAPP network path file location?	V:\LUM\BFBM\Bfbm\Quality Assurance Plans\Calendar Year 2017 QAPPS\IBI2017
Where will data be recorded in field (media)	Paper
If on tablets or phones, will download at office occur or will you connect wirelessly?	
If on tablets or phones, who will do the download?	
If data collected electronically, where will it be stored?	
Format to be received from Lab	
Method of receipt from lab/s	
Personnel receiving outside lab data	
Is data expected to go to WQDE/STORET?	Yes
Data manager - (Bureau and Name)	BFBM Leigh Lager

Table 1. Site List

Station ID (WQDE compliant and referenced)	Waterbody/Location	Latitude-dd	Longitude-dd	County	Site exists in WQDE already?	Location Type
FIBI002	Furnace Brook	-74.98071	40.82745	Warren	YES	River/stream
FIBI004	Lopatcong Creek	-75.1402	40.69486	Warren	YES	River/stream
FIBI005	Musconetcong River	-74.95985	40.72314	Hunterdon/Warren	YES	River/stream
FIBI012	Neldon Brook	-74.82702	41.08486	Sussex	YES	River/stream
FIBI026	Nishisakawick Creek	-75.05932	40.5274	Hunterdon	YES	River/stream
FIBI027	Lockatong Creek	-75.0211	40.47123	Hunterdon	YES	River/stream
FIBI028	Moore Creek	-74.90463	40.33321	Mercer	YES	River/stream
FIBI029	Alexauken Creek	-74.94353	40.38753	Hunterdon	YES	River/stream
FIBI034	Harihokake Creek	-75.06869	40.5482	Hunterdon	YES	River/stream
FIBI040	WB Papakating Creek	-74.63138	41.1973	Sussex	YES	River/stream
FIBI041	Shabakunk Creek	-74.74987	40.25187	Mercer	YES	River/stream
FIBI046	Clove Brook	-74.68622	41.35172	Sussex	YES	River/stream
FIBI047	Beaver Brook	-75.04653	40.84289	Warren	YES	River/stream
FIBI049	Walkill River	-74.59497	41.08685	Sussex	YES	River/stream
FIBI050	Lubbers Run	-74.6762	40.96379	Sussex	YES	River/stream
FIBI055	Paulins Kill	-75.01875	40.96641	Warren	YES	River/stream
FIBI056	Clove Brook	-74.6184	41.23587	Sussex	YES	River/stream
FIBI058	Musconetcong River	-74.80606	40.87347	Warren	YES	River/stream
FIBI064	Pequest River	-74.83047	40.9426	Warren	YES	River/stream
FIBI065	Little Flat Brook	-74.80365	41.23935	Sussex	YES	River/stream
FIBI067	Pohatcong Creek	-75.08507	40.69853	Warren	YES	River/stream
FIBI076	Pohatcong Creek	-75.07173	40.7161	Warren	YES	River/stream
FIBI081	Troy Brook	-74.85614	41.04894	Sussex	YES	River/stream
FIBI099	Wallkill River	-74.58145	41.15246	Sussex	YES	River/stream
FIBI100	Dry Brook (CulversCk)	-74.74822	41.1449	Sussex	YES	River/stream
FIBI110	Musconetcong River	-75.1668	40.6083	Hunterdon/Warren	NO	River/stream
FIBI111	Pophandusing Brook	-75.071	40.8196	Warren	NO	River/stream
FIBI112	Blair Creek	-75.9594	40.9867	Warren	NO	River/stream

FIBI113	Jacksonburg Creek	-74.9805	40.9794	Warren	NO	River/stream
FIBI114	Pohatcong Creek	-75.1855	40.6251	Hunterdon	NO	River/stream
FIBI213	Ivanhoe Brook	-74.4605	40.1382	Monmouth	YES	River/stream
FIBI037	Drakes Brook	-74.7317	40.8114	Morris	YES	River/stream
FIBI039	VanCampens Brook	-75.0033	41.0578	Warren	YES	River/stream
FIBI048	Buckhorn Creek	-75.11952	40.77253	Warren	YES	River/stream
FIBI053	Mulhockaway Creek	-74.9690	40.6476	Hunterdon	YES	River/stream
FIBI107	Shimers Brook	-74.77861	41.31303	Sussex	YES	River/stream
NJS2016-057	North Branch Raritan R	-74.6297	40.7672	Morris	NO	River/stream
NJS2016-060	Paulins Kill	-74.7272	41.12755	Sussex	NO	River/stream
NJS2016-062	SB Raccoon Ck	-75.2458	39.73014	Gloucester	NO	River/stream
NJS2016-064	Vancampens Brook	-74.9641	41.0719	Warren	NO	River/stream
NJS2016-067	Little Timber Ck	-75.3109	39.79519	Gloucester	NO	River/stream

Table 2. Parameters

STATION ID	Field Msr/Obs	Flow	Water Chemistry	Continuous Monitoring	Biological Sampling	Sediment Collection	Bacteria Collection	Habitat	Metrics	Indices
FIBI002	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI004	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI005	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI012	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI026	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI027	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI028	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI029	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI034	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI040	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI041	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI046	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI047	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI049	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI050	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI055	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI056	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI058	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI064	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI065	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI067	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI076	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI081	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI099	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI100	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI110	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI111	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI112	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI113	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI114	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI213	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI037	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI039	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI048	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
FIBI053	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes

FIBI107	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
NJS2016-057	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
NJS2016-060	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
NJS2016-062	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
NJS2016-064	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes
NJS2016-067	YES	YES	NO	NO	YES	NO	NO	Yes	Yes	Yes

Table 3. Partners

STATION ID	Field Msr/Obs	Flow	Water Chemistry	Continuous Monitoring	Biological Sampling	Sediment Collection	Bacteria Collection
FIBI002	DEP	DEP	NO	NO	DEP	NO	No
FIBI004	DEP	DEP	NO	NO	DEP	NO	No
FIBI005	DEP	DEP	NO	NO	DEP	NO	No
FIBI012	DEP	DEP	NO	NO	DEP	NO	No
FIBI026	DEP	DEP	NO	NO	DEP	NO	No
FIBI027	DEP	DEP	NO	NO	DEP	NO	No
FIBI028	DEP	DEP	NO	NO	DEP	NO	No
FIBI029	DEP	DEP	NO	NO	DEP	NO	No
FIBI034	DEP	DEP	NO	NO	DEP	NO	No
FIBI040	DEP	DEP	NO	NO	DEP	NO	No
FIBI041	DEP	DEP	NO	NO	DEP	NO	No
FIBI046	DEP	DEP	NO	NO	DEP	NO	No
FIBI047	DEP	DEP	NO	NO	DEP	NO	No
FIBI049	DEP	DEP	NO	NO	DEP	NO	No
FIBI050	DEP	DEP	NO	NO	DEP	NO	No
FIBI055	DEP	DEP	NO	NO	DEP	NO	No
FIBI056	DEP	DEP	NO	NO	DEP	NO	No
FIBI058	DEP	DEP	NO	NO	DEP	NO	No
FIBI064	DEP	DEP	NO	NO	DEP	NO	No
FIBI065	DEP	DEP	NO	NO	DEP	NO	No
FIBI067	DEP	DEP	NO	NO	DEP	NO	No
FIBI076	DEP	DEP	NO	NO	DEP	NO	No
FIBI081	DEP	DEP	NO	NO	DEP	NO	No
FIBI099	DEP	DEP	NO	NO	DEP	NO	No
FIBI100	DEP	DEP	NO	NO	DEP	NO	No
FIBI110	DEP	DEP	NO	NO	DEP	NO	No

FIBI111	DEP	DEP	NO	NO	DEP	NO	No
FIBI112	DEP	DEP	NO	NO	DEP	NO	No
FIBI113	DEP	DEP	NO	NO	DEP	NO	No
FIBI114	DEP	DEP	NO	NO	DEP	NO	No
FIBI213	DEP	DEP	NO	NO	DEP	NO	No
FIBI037	DEP	DEP	NO	NO	DEP	NO	No
FIBI039	DEP	DEP	NO	NO	DEP	NO	No
FIBI048	DEP	DEP	NO	NO	DEP	NO	No
FIBI053	DEP	DEP	NO	NO	DEP	NO	No
FIBI107	DEP	DEP	NO	NO	DEP	NO	No
NJS2016-057	DEP	DEP	NO	NO	DEP	NO	No
NJS2016-060	DEP	DEP	NO	NO	DEP	NO	No
NJS2016-062	DEP	DEP	NO	NO	DEP	NO	No
NJS2016-064	DEP	DEP	NO	NO	DEP	NO	No
NJS2016-067	DEP	DEP	NO	NO	DEP	NO	No

Table 4. Field Measurements

Field Name	**WQDE Name**	**Media**	**Units**
DO	Dissolved oxygen (DO)	Water	mg/l
Water Temp	Temperature, Water	Water	deg C
Spec Cond	Specific conductance	Water	uS/cm
pH	pH	Water	None
Flow	Flow	Water	cfs
Barometric Pressure	Barometric Pressure	Air	mmHg
DO Sat	Dissolved oxygen saturation	Water	%
Temperature, air	Temperature, air	Air	deg C

Table 7. RBP Habitat

Characteristic Name
RBP2, Low G, Pool Variability (choice list)
RBP2, Low G, Sediment Deposition (choice list)
RBP2, Low G, Channel Flow Status (choice list)
RBP2, Low G, Channel Alteration (choice list)
RBP2, Low G, Epifaunal Substrate/Available Cover (choice list)
RBP2, Low G, Pool Substrate Characterization (choice list)
RBP2, Low G, Bank Stability, Left Bank (choice list)
RBP2, Low G, Vegetative Protection, Left Bank (choice list)
RBP2, Low G, Channel Sinuosity (choice list)
RBP2, Low G, Bank Stability, Right Bank (choice list)
RBP2, Low G, Vegetative Protection, Right Bank (choice list)
RBP2, Low G, Riparian Vegetative Zone Width, Left Bank (choice list)
RBP2, Low G, Riparian Vegetative Zone Width, Right Bank (choice list)
RBP2, High G, Embeddedness (choice list)
RBP2, High G, Velocity/Depth Regime (choice list)
RBP2, High G, Sediment Deposition (choice list)
RBP2, High G, Channel Flow Status (choice list)
RBP2, High G, Frequency of Riffles (or bends) (choice list)
RBP2, High G, Epifaunal Substrate/Available Cover (choice list)
RBP2, High G, Bank Stability, Right Bank (choice list)
RBP2, High G, Channel Alteration (choice list)
RBP2, High G, Bank Stability, Left Bank (choice list)
RBP2, High G, Vegetative Protection, Left Bank (choice list)
RBP2, High G, Vegetative Protection, Right Bank (choice list)
RBP2, High G, Riparian Vegetative Zone Width, Left Bank (choice list)
RBP2, High G, Riparian Vegetative Zone Width, Right Bank (choice list)

Table 8. RBP Total Habitat
CharacteristicName
RBP2, High G, habitat assessment total score
RBP2, High G, habitat assessment total rating
RBP2, Low G, habitat assessment total score
RBP2, Low G, habitat assessment total rating

Table 9. Fish Metrics

CharacteristicName
Percent Richness of Rheophilic Species (adjusted for drainage size minus T. Darter)
Percent Abundance Cold and Nontolerant Coolwater Species (adjusted for drainage size)
Percent Richness Generalist Feeders
Tolerance Index
Percent Richness of Lithophilic Spawners (minus w. sucker)
Percent Abundance Cyprinidae (adjusted for drainage size)
Percent Abundance Dominant Three Taxa (not including Blacknose Dace)
Percent Richness Benthic Insectivores
Percent Insectivore Individuals
Number of individuals in sample
Percent Piscivore Individuals
Percent DELT Anomalies
Native Species Richness
Benthic Species Richness
Intolerant Species Richness
Percent Tolerant Individuals

Table 10. Total Fish Score and Rating

CharacteristicName
Fish Index of Biotic Integrity
FIBI Rating
Inner Coastal Plain Low Gradient Fish Index
ICPLGFI Rating