Summary of Conditions and Recommendations

The *State of the Basin Report 2008* offers a view of the condition of the waters and landscapes of the Delaware River Basin. Based on available information, it serves as a benchmark of current conditions, as a companion to the 1981 *Level B Study*, and as a point of reference for gauging progress towards the goals of the 2004 *Water Resources Plan for the Delaware River Basin.* In accordance with the 2001 Commission directive, condition reporting should be repeated in 5-year cycles following this initial 2008 baseline report.

An indicator is a measure of condition; an environmental indicator is a measure, value or statistic that provides an approximate gauge of the state of the environment and may help to evaluate the effectiveness of an environmental management program or policy.

In all, 37 indicators representing hydrology, water quality, living resources and landscape conditions have been reviewed in this report. Pertinent data, trend analysis, qualitative information, and professional judgment were brought to bear to assign graphic and narrative representation of condition for each individual indicator. Three landscape indicators—land use, population and population density—were reported, but not classified or rated. Although of supreme importance as stressors or causes of changes to water-related resources, they are essential statements of fact that do not warrant a rating.

To summarize each assessment, a simple categorical measure of condition was used; each indicator was assigned a rating of *Good*, *Fair* or *Poor*. The results are shown by indicator category in Table S.1.

Table S.1
Condition Summary by Category

Category	Good	Fair	Poor
Hydrology	4	2	1
Water Quality	3	5	2
Living Resources	2	5	5
Landscape	0	2	3
Total	**9**	**14**	**11**

Summary of Water Resource Status: Fair

Based on overall ratings of 34 of the 37 indicators, the condition of the basin's water-related resources is *Fair*. Variation exists within and among the indicator categories, and suggests where additional effort should be focused.

Hydrology. Hydrologic indicators are overall in good shape. We are meeting the flow targets that are the foci of management efforts, meeting human demand for water, using resources with some degree of efficiency, and making headway in water use and protection, and working to improve flood losses. The potential for increased climatic variation may challenge adaptive management efforts in the future.

Water Quality. Metrics indicate that water quality overall is *Fair.* Dissolved oxygen, nutrients and clarity appear to be good and generally meeting criteria in the tributaries and the river mainstem. However, toxics remain a problem. Lack of criteria for some parameters make evaluation problematic, and deficiencies in monitoring hinder robust assessments of others, especially DO and nutrients.

Living Resources. This category includes species of concern that are affected by changes in water quality and hydrology, e.g., the "endpoints" of changing biological, chemical and physical conditions in waterways and water-related landscapes. The overall condition assessment for this category is *Fair* with a significant number of indicators having a *Poor* rating. Selection of additional indicators may be advised for subsequent reports to include additional species that are of ecological or economic importance.

Landscapes. Indicators in the landscape category include factors that contribute to impacts in the other three categories. Improvements in data quality, availability and timeliness are essential for improved reporting. The functional linkages between landscape change and other indicators are not always well quantified nor well represented through indicators. Additional metrics to help bridge this gap should be considered for the next report.

Summary of Issues and Recommendations

Several issues related to indicator selection, monitoring and assessment were identified during the development of this Report.

Monitoring Needs.

Gaps in the approach to basin-wide monitoring and assessment are evident and an excellent summary can be found in the Final Report of the Delaware River Basin National Water Quality Monitoring Network Pilot Study prepared in February 2008.and available at: http://acwi.gov/monitoring/network/pilots/NWQMN-DRB-Pilot_Final%20Report_02-07-08.pdf

Several items specifically related to monitoring and reporting are summarized below.

- **Enhance continuous monitoring of water quality.** Continuous monitoring of some water quality parameters—particularly DO, pH

and temperature—is necessary for accurate condition assessment. DO, our most fundamental indicator of water body condition is most appropriately assessed this way, since intermittent samples do not capture diurnal changes, especially pre-dawn sags in DO concentrations. Spot measurements may lead to a false sense that criteria are being met, even when they are not.

- **Link monitoring to water quality concerns and criteria.** Each parameter of concern should be reviewed to determine its appropriate monitoring frequency. Intermittent data sets were available for several metals and compounds of interest, but breaks in data, changes or differences in detection capabilities, or differences in the specific chemical form of the parameter of concern rendered the data sets unusable. Some parameters should be monitored routinely, while others may be monitored once every several years to determine that concentrations remain below that of concern. Coordination is necessary to ensure that agencies monitor within similar time frames and for similar chemical forms.

- **Enhance capacity for landscape change analysis.** Land use/land cover data were among the most problematic to obtain and use since no single intra-basin organization coordinates or assembles timely land use and land cover data for the entire basin. USGS National Land Cover Data (NLCD) is inappropriately coarse for delineation and assessment of land use change at any intra-regional (watershed) scale, and the change product comparing 1992 and 2001 (2008) contained too many discrepancies with state photogrammetric-based assessments to be used with any confidence. The change product from NOAA's Coastal Services Center (2008) comparing 1996 and 2001 is used for this report even though it only covers five years of change, and omits a small but important portion of the basin in the fast-developing Appalachian plateau region. Note that both data provide less than up-to-date information. Furthermore, state photogrammetric data sets lack sufficient conformity to join and analyze. There is a significant gap that needs to be filled for adequate landscape change assessment.

- **Link landscape and population assessment.** Landscape change and population reporting should be synchronized to provide a more robust assessment of development patterns and potential impacts to water resources.

- **Increase data accessibility and mapping capability.** While significant progress has been made to improve the retrieval of water data, some water-availability data still reside on local management systems that are difficult or impossible to obtain electronically. Monitoring and assessment data should include a geographic coding to allow them to be spatially represented.

- **Indicator Selection.** Indicator selection was primarily based on data availability and completeness. As a result several indicators originally identified as desirable, including many metals, were not included. Additional indicators should be considered for future reporting.

- **Evaluate water quality and hydrologic indicators.** The use of additional chemical or flow indicators may be advisable. Temperature and pH are two additional indicators to consider. Coordination of state data collection would greatly enhance tributary evaluation. For example, variations in the form of nitrogen collected (NO2, NO3, TN, TKN) hampered analysis and comparison.

- **Appraise indicators for relevancy** to management goals. Programmatic goals and objectives of the Water Resources Plan for the Delaware River Basin (Basin Plan) and the Comprehensive Conservation Management Plan (CCMP) for the Delaware Estuary should be reviewed to inform the selection of additional appropriate indicators.

A reductionist approach—deconstructing a system into its component parts and assessing each individually—may be an efficient means of reporting metrics, but, as the US General Services Administration acknowledged in Sustainable Development and Society (2004), the reductionist approach is inconsistent with the concept and principles of sustainability.

While the 2008 State of the Basin report has laid a foundation, many improvements are needed to enable an assessment of the basin system as a sum of inter-related parts and functions. The challenge for the subsequent State of the Basin report (2013) will be to select, appraise, and reassemble information on the health and function of the systems that contribute to the overall well being of the Delaware River Basin.

Table S.2 Delaware River Basin Indicator Rating 2008

Legend: ◯ = GOOD ◐ = FAIR ● = POOR **NR** = Not Rated

	Indicator	Rating	Present Condition / Trend	Recommendations
Category I: Hydrology	Flows at Trenton	◯	Good; stable Flow target maintained 95% of the time	• Improve reservoir and stormwater management • Evaluate instream flow needs for River and estuary
	Salt Line Location	◯	Very good; fluctuations within acceptable range Drinking water intakes effectively protected	• Investigate effects of other chloride sources and sea level rise scenarios • Manage for climate change impacts
	Water Use Efficiency	◐	Fair Per capita use ranges from 90 to 190 gal. per capita per day	• Improve reporting and utilize conservation technologies
	Water Use	◯	Good Human needs being met; instream needs being studied	• More information needed on agricultural demand and instream needs
	Water Supply Sources	◯	Good; stable Multiple potable supply sources available in many areas	• Employ conjunctive use and expand source water protection for sustainable supply • Evaluate and execute long term supply alternatives
	Areas of Ground Water Stress	◐	Fair; stabilizing with conjunctive use New problem areas identified	• Continue conjunctive use and demand management • Assess effectiveness of SEPA-GWPA program
	Flood Damage	●	Poor; increasing repetitive claims in recent years	• Improve floodplain mapping and management • Evaluate potential climate change impacts.
Category II: Water Quality	Nutrients	◐	Fair; stable Concentrations high compared to other systems, but harmful effects not evident	• Establish criteria to protect aquatic life
	Dissolved Oxygen	◯	Good; stable DRBC and state DO standards being met; upper basin DO is better than lower basin	• Continuous monitoring of DO needed throughout basin
	Water Clarity	◯	Good Naturally turbid estuary; non-tidal river generally clear except after storm events.	• Improve monitoring of suspended solids; add turbidity probes to automatic monitors • Define relationship among nutrients, water clarity and phytoplankton and sediment budgets
	Copper	◐	Fair Dissolved copper below but near water quality criteria.	• Additional monitoring / modeling required to improve assessment, especially River Zone 5
	Fish Consumption	●	Poor Advisories for at least one species on many tributaries and River for mercury and/or PCBs.	• Implement TMDLs for targeted toxics • Monitor additional toxic compounds in water and fish tissue; identify sources
	Toxics: Pesticides	◐	Fair Presence throughout basin, esp. historic agricultural use areas; atrazine concentrations below drinking water standard	• Regular sampling protocols needed • Additional research needed to determine effects levels and set criteria for pesticides
	Toxics: PCBs	●	Poor; possibly improving PCBs persist in water, sediments and fish tissue, esp. in the tidal river/estuary.	• Continue monitoring, source identification and removal; Revise and implement TMDLs
	Support of Designated Use: Tributaries	◐	Fair 37% of assessed tributary miles do not support designated uses	• Assessment information should include chemical, physical and biological conditions • Standardize cartographic representation
	Tributary Water Quality Trends (DO, N, P, TSS)	◯	Good: stable in Upper & Central watersheds; some declines in Lower and Bay watersheds	• Consider additional or different constituents for next report • Criteria needed for Nitrogen and Total Suspended Sediment
	Support of Designated Use: Delaware River	◐	Fair; conditions range from poor to good depending on use designation	• Add data collection for missing reaches • Review current quality criteria for DO • Investigate nutrients, temperature, pH • Restore impaired waters

Table S.2 Delaware River Basin Indicator Rating 2008

Legend: ○ = GOOD ◐ = FAIR ● = POOR **NR = Not Rated**

	Indicator	Rating	Present Condition / Trend	Recommendations
Category III: Living Resources	Benthic Macroinvertebrates	◐	Fair; conditions range from poor to very good All regions show impacts	• Additional data collection • Standardize reporting indices
	Freshwater Mussels	●	Very poor More than 75% have special conservation status due to habitat and water quality degradation	• Proactive monitoring to fill data gaps • Improve coordination between researchers and water managers
	Oysters	●	Poor; recent trend positive Populations are low but seed beds are being carefully managed	• Comprehensive monitoring • Continue restoration efforts • Establish flow needs
	Horseshoe Crabs	◐	Fair; reduced breeding populations are improving Egg densities affect shore birds	• Continue / improve management to re-build populations
	Red Knot	●	Very poor; populations may be crashing Vulnerable to loss of food source and climate impacts	• Continue moratorium/limitations on horseshoe crab harvest
	Louisiana Waterthrush	◐	Fair Sensitive to polluted waters and loss of forested riparian habitat	• More data needed to determine trends • Additional obligate riparian species (e.g., amphibians) indicators needed
	Bald Eagle	○	Good; generally improving	• Continue monitoring of eagles and increase monitoring of water quality, especially emerging contaminants
	Striped Bass	○	Good; restored, but stability uncertain	• Ecological studies to determine dynamic interactions with weakfish and other species
	Weakfish	◐	Fair; recent declines	• Ecological studies of predation & dynamic interaction with other species, especially Striped Bass
	Atlantic Sturgeon	●	Poor; declining	• Study sturgeon population dynamics and continue moratoria and other protections
	Shad	◐	Fair; improved with DO and fish passage, but recent declines evident	• Monitor habitat conditions in spawning areas • Maintain good water quality and fish passage
	Brook Trout	●	Poor Population extirpated or severely reduced in many watersheds	• Data on status and trends needed • Conservation, restoration, and flow management actions needed
Category IV: Landscape	Population Growth and Distribution	NR	Basin population 7.8 million, up 6% (1990-2000)	• Synchronize land use and population change assessments • Employ technologies and LID techniques to minimize effects on water resources
	Population Density	NR	Basin average is 603 p/mi^2 Ranges from <10 to >2,000 p/mi^2.	• Track population & land use change simultaneously • Employ techniques to mitigate impact of density on water resources
	Land Use 2001	NR	Developed area increased by 71 mi^2 in 5 years at expense of forest and agricultural land	• Improve basin-wide monitoring of land use change; increase frequency and synchronize with census
	Land Consumption	●	Poor; *Per capita* rate of developed land has increased	• Current and accurate data on population, land cover, and development trends for more efficient use of land and water resources
	Dams	●	Poor 1550 tributary dams disrupt natural hydrology and fish passage	• Monitoring needed before and after dam removal to detect effects • Inventory and prioritization for restoration
	Forests	◐	Fair; decreasing by size of 1 football field every two hours 48 mi^2 of forest lost in 5 years	• More accurate estimates of forested landscapes are needed to protect water resources • Forests need to be protected to sustain water resources
	Wetlands	◐	Fair Losses occurring at a slower rate; assessment of functional integrity needed	• Improve mapping of forested wetlands • Coordinate monitoring & assessment to track extent and condition of freshwater and tidal wetlands
	Tidal Wetland Buffers	●	Poor in Upper Estuary Fair in Lower Estuary and Bay regions	• Analysis needed to target areas for protection and restoration
State of the Basin		◐	Fair	• Enhance monitoring, evaluation and reporting capacity • Apply integrated sustainability principles and metrics

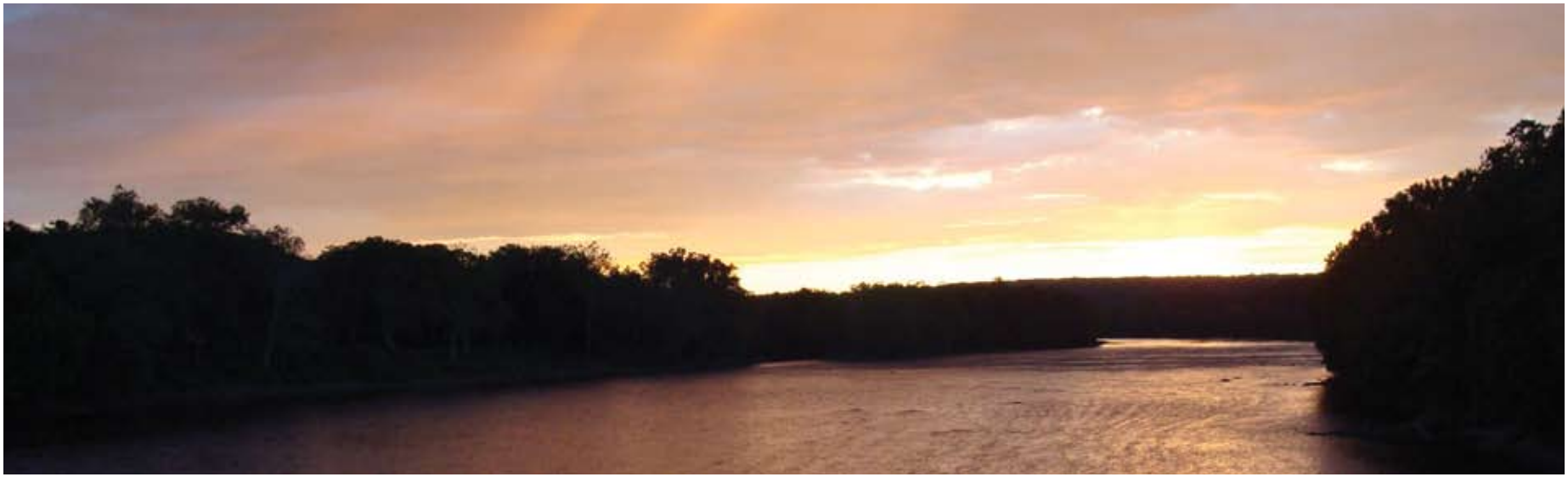
Illustrations

TABLES

FIGURES

Acronyms

Ac	Acre; equal to 43,560 square feet
ASMFC	Atlantic States Marine Fisheries Commission
BBS	Breeding Bird Survey
BMPs	Best Management Practices
BOD	Biological Oxygen Demand
BP	Water Resources Plan for the Delaware River Basin, 2004 (Basin Plan)
CCMP	Comprehensive Conservation and Management Plan for the Delaware Estuary
cfs	Cubic feet per second
CO^2	Carbon dioxide
CWA	Clean Water Act
D&R Canal	Delaware and Raritan Canal
DDT	Dichloro Diphenyl Trichloroethane
DE	Delaware
DNREC	Delaware Department of Natural Resources and Environmental Control
DRBC	Delaware River Basin Commission
DO	Dissolved Oxygen
EPA	United States Environmental Protection Agency
ETM	Estuary Turbidity Maximum
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
GW	Ground water
gpcd	Gallons per capita per day
HUC	Hydrologic Unit Code, used to identify watersheds
ID	Insufficient data
INCODEL	Interstate Commission on the Delaware River
KRA	Key Result Area from the 2004 Basin Plan
LID	Low Impact Development
mgd	Million gallons per day
mg/L	Milligrams per liter
Mi	Mile
MI^2	Square mile; about 640 acres
MSX	Multinucleated Sphere Unknown; oyster disease
N	Nitrogen
NFIP	National Flood Insurance Program
ng/L	Nanograms per liter
NJ	New Jersey
NJDEP	New Jersey Department of Environmental Protection
NLCD	National Land Cover Dataset
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NY	New York
NYC	New York City
NWI	National Wetlands Inventory
Obs	Observation well
P	Phosphorous
P/mi^2	Persons per square mile
PA	Pennsylvania
PADEP	Pennsylvania Department of Environmental Protection
PA-GWPA	Southeastern PA Groundwater Protected Area
PAH	Polycyclic aromatic hydrocarbon
PBDE	Polybrominated Diphenyl Ethers
PCB	Polychlorinated Biphenyls
PDE	Partnership for the Delaware Estuary
PFC	Perfluorinated Compounds
PPCP	Pharmaceuticals and Personal care Products
PRM	Potomac-Raritan Magothy aquifer system
ppm	Parts per million
ppt	Parts per trillion
RM	River Mile
SOTB	State of the Basin
STP	Sewage Treatment Plants
SW	Surface Water
TCE	Trichloroethylene
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solids
TMDL	Total Maximum Daily Load
TU	Turbidity Unit
ug/L	Micrograms per liter
USACE	United States Army Corp. of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds
WHP	Wellhead Protection
WWTP	Wastewater Treatment Plants



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