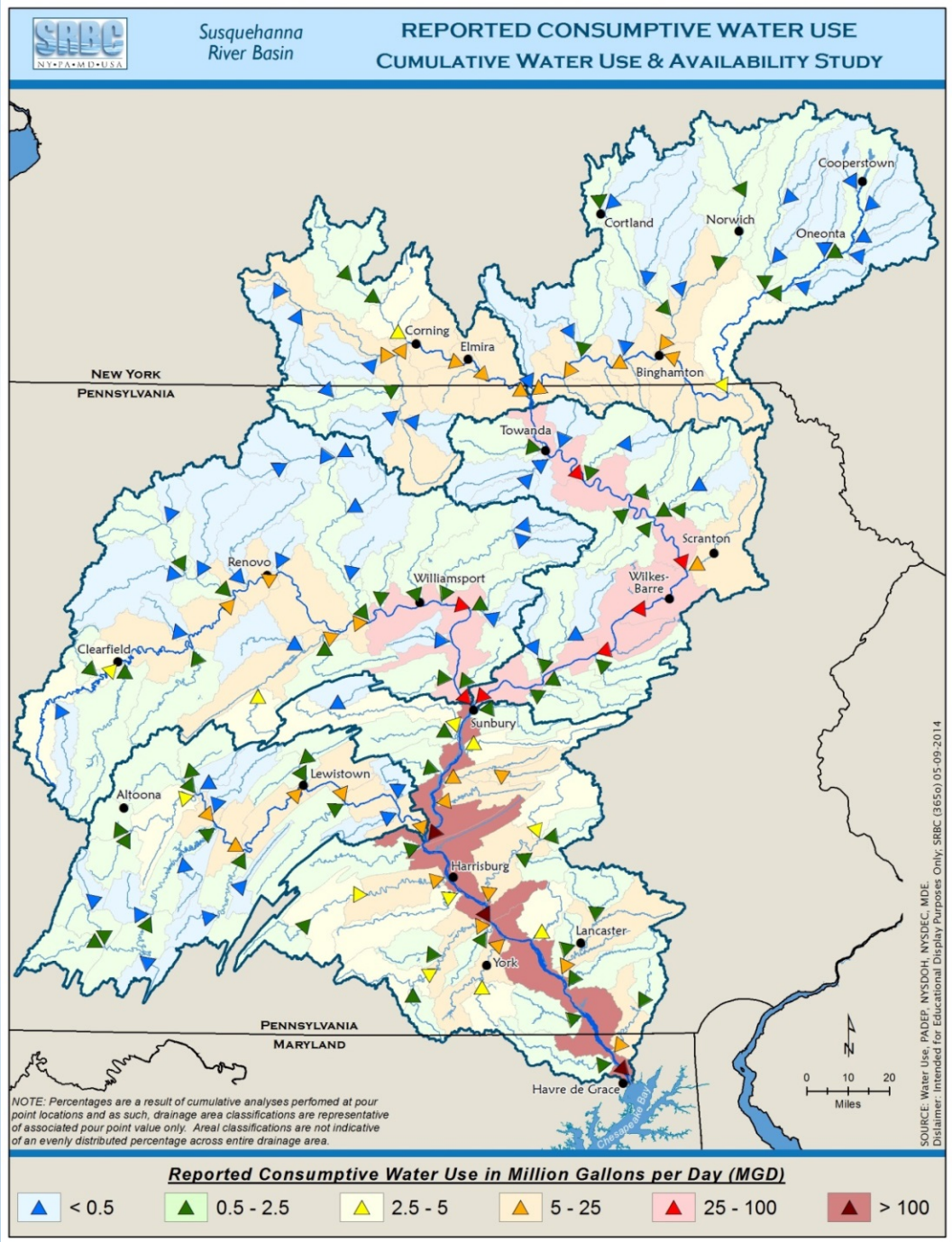
Assessment of Unconventional Gas Development in the Susquehanna River Basin

- Compilation of all SRBC program activities covering the shale gas industry through 2013
- Four-part Assessment
  - Water Acquisition
  - Water Quality
  - Compliance
  - Assessment Results/Recommendations
- Started – February 2014
- Completion – Late Spring 2015

Cumulative Water Use and Availability Study

- Comprehensive view of the basin at the WBD-10 watershed scale
- Anticipate Fall 2015 completion



Water Resources Program (WRP) Overview

- To inform and coordinate activities to implement the Comprehensive Plan.
  - Avoids duplication, builds upon the work of others, helps plan future activities
- Priority Management Areas
  - Sustainable Water Development, Water Quality, Flooding, Ecosystems, Chesapeake Bay, Coordination / Cooperation / Public Information
- WRP Update – June 2015 Commission Meeting
  - Covering activities from July 1, 2015, through June 30, 2017

Priority Management Area A – Sustainable Water Development

Conowingo Dam (photo credit courtesy of Exelon)

Desired Result: ***To regulate and plan for water resources development in a manner that maintains economic viability, protects instream users, and ensures ecological diversity; and meets immediate and future needs of the people of the basin for domestic, municipal, commercial, agricultural, and industrial water supply and recreational activities.***

Sustainable Water Development Goal a.
Support and encourage the sustainable use of water for domestic, industrial, municipal, commercial, agricultural, and recreational activities in the basin.

1. ACTION NEEDED:
Complete a Cumulative Water Use and Availability Study to comprehensively evaluate cumulative consumptive water use, determine water availability at varying spatial scales, consider establishment of locally sustainable limits for water use, and assess alternatives for avoiding, minimizing, or mitigating potential impacts to the water resources of the basin.

Susquehanna River Basin Commission Programs and Projects

1. By June 2015: Complete the Cumulative Water Use and Availability Study.

Water Resources Program (WRP) Overview

- U.S. Geological Survey (USGS), NAWQA
  - Conduct a study to quantify the extent of flow alterations at USGS gaged streams across the Atlantic Highlands Ecoregion by describing how flow alterations are related to the health of aquatic ecosystems, as indicated by changes in the thermal regime, physical habitat, water chemistry, and aquatic biota.
  - Pesticides will be sampled in the Great Valley Carbonate Physiographic Province. In 2015, 30 wells mostly located in the Susquehanna Basin portion of the Great Valley Carbonate Physiographic Province will be sampled for a host of pesticides and pesticide degradation products to assess pesticides in ground water from vulnerable aquifers.
- Maryland Department of Natural Resources (MDNR)
  - Within available time and funding constraints, MDNR would support participation in a comparative study of water quality data collection and laboratory methods with other jurisdictions to assess data quality and the comparability and utility of agency datasets, especially with monitoring efforts of non-standard field/laboratory monitoring procedures (e.g., biological monitoring).

Water Resources Program (WRP) Overview

- Pennsylvania Fish and Boat Commission
  - PFBC will continue to cooperate with USGS, PADEP and SRBC to monitor emerging contaminants of concern as part of the investigation into disease among Smallmouth Bass populations
- U.S. Fish and Wildlife Service
  - Conduct sampling for pesticides and emerging contaminants of concerns in New York and Pennsylvania streams.
- Cortland County Health Department
  - Continue to oversee monitoring for coliform bacteria in public water supplies. The Cortland County Health Department has an interest in monitoring for pharmaceuticals and personal care products, likely requiring municipal public water supplies to sample periodically.

Water Resources Program (WRP) Overview

- Department of Environmental Protection: Point & Non-Point Source Management
  - While DEP has a number of sites outside the Susquehanna basin where we are monitoring conditions that may be a result of climate change we have not established any in basin however we are willing to collaborate as resources allow.

- Maryland Department of Natural Resources (MDNR)
  - MD Department of Conservation Natural Resources - would like to participate in the development of this network as it has identified the same objective in justifying some sites within MD for monitoring climate change impacts is an objective, though none are in Maryland's Susquehanna watershed at present.

Regulatory Program Highlights

- Recent Rule Implementation - by June 2015
  - "Gallon 1" revision in December 2014 – clarification of water uses subject to consumptive use regulation for the shale gas industry
  - To include not just drilling related activities, but now all other water-related activities both on the pad site as well as for related infrastructure

- Future Regulatory Program Considerations
  - Grandfathering, administrative appeals process, and consideration of standards development for a host of topical areas …. including consumptive use mitigation
  - Process to start with our Commissioners in May 2015, and anticipate discussions to continue well into FY16

Water Acquisition
Well Activity
(Bradford, Susquehanna, Lycoming, Tioga)

Year	Wells Permitted	Wells Drilled	Wells Hydraulically Fractured
2008	261	93	10
2009	1259	417	147
2010	2463	931	450
2011	2491	1231	794
2012**	1611	685	836
2013	1706	619	623
Total	9843	3993	2860

Water Acquisition
Water Use

Year	Reported Consumptive Water Use (Million Gallons)	Freshwater Injected (%)	Flowback Injected (%)
2008	~50	100	0
2009	~500	96	11
2010	~2,300	91	10
2011**	~3,800	85	14
2012	~3,600	83	19
2013	~3,100	78	22
Total	~13,400	84	16

Water Acquisition
Water Use Profile

- 4.3 million gallons (ave.) used per well for hydraulic-fracturing (80-88% freshwater, 12-20% reused flowback)
- Sources
  - ~ 76% from surface water
  - ~ 8% groundwater
  - ~ 15% public water supplies and other non-docketed sources
  - < 1% from out of basin
- Approximately 13.4 billion gallons of water consumptively used within basin (industry-wide) since play began
- 8% - 10% of injected water is recovered as flowback (within first 30 days after release of pressure)
- Over 99% of flowback reused in subsequent well fracturing efforts.

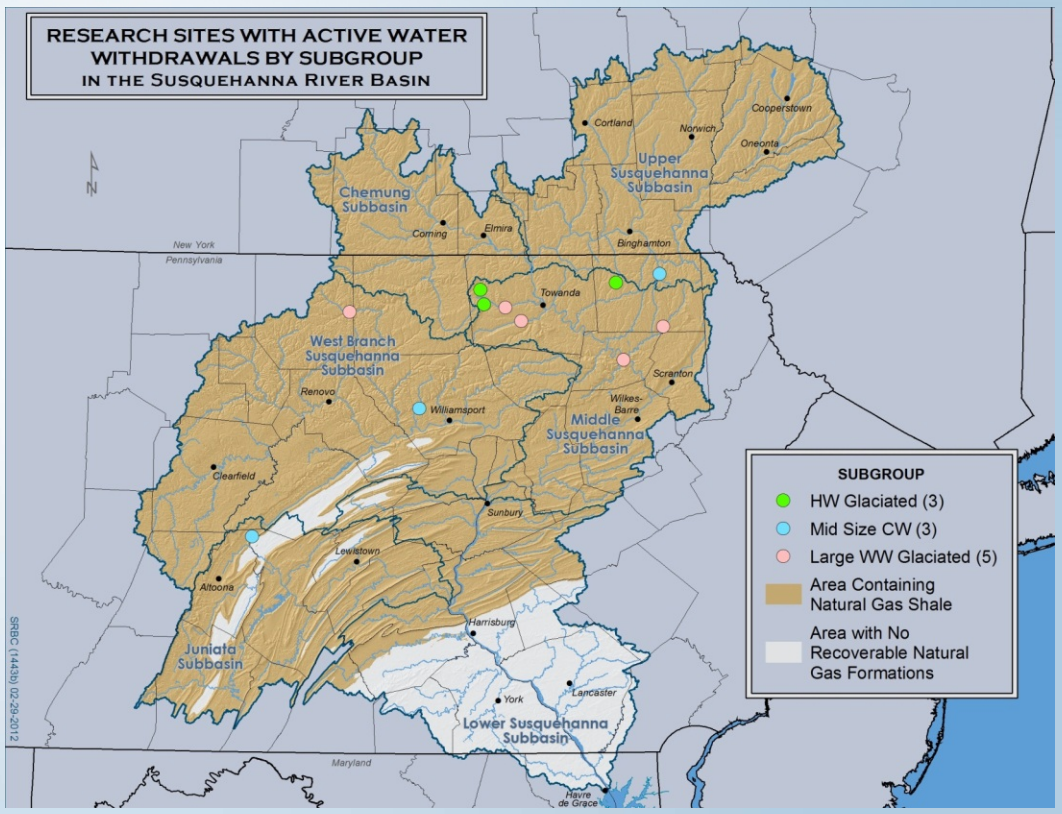
Water Acquisition
Surface Withdrawal Analyses

- Spatial patterns and most utilized watersheds
  - Low Flow Protection Policy effects
- Water Use and Availability
  - Summary results from SRBC's Cumulative Water Use and Availability Study
- Approved versus Actual Use
  - Reasonable foreseeable needs analyses

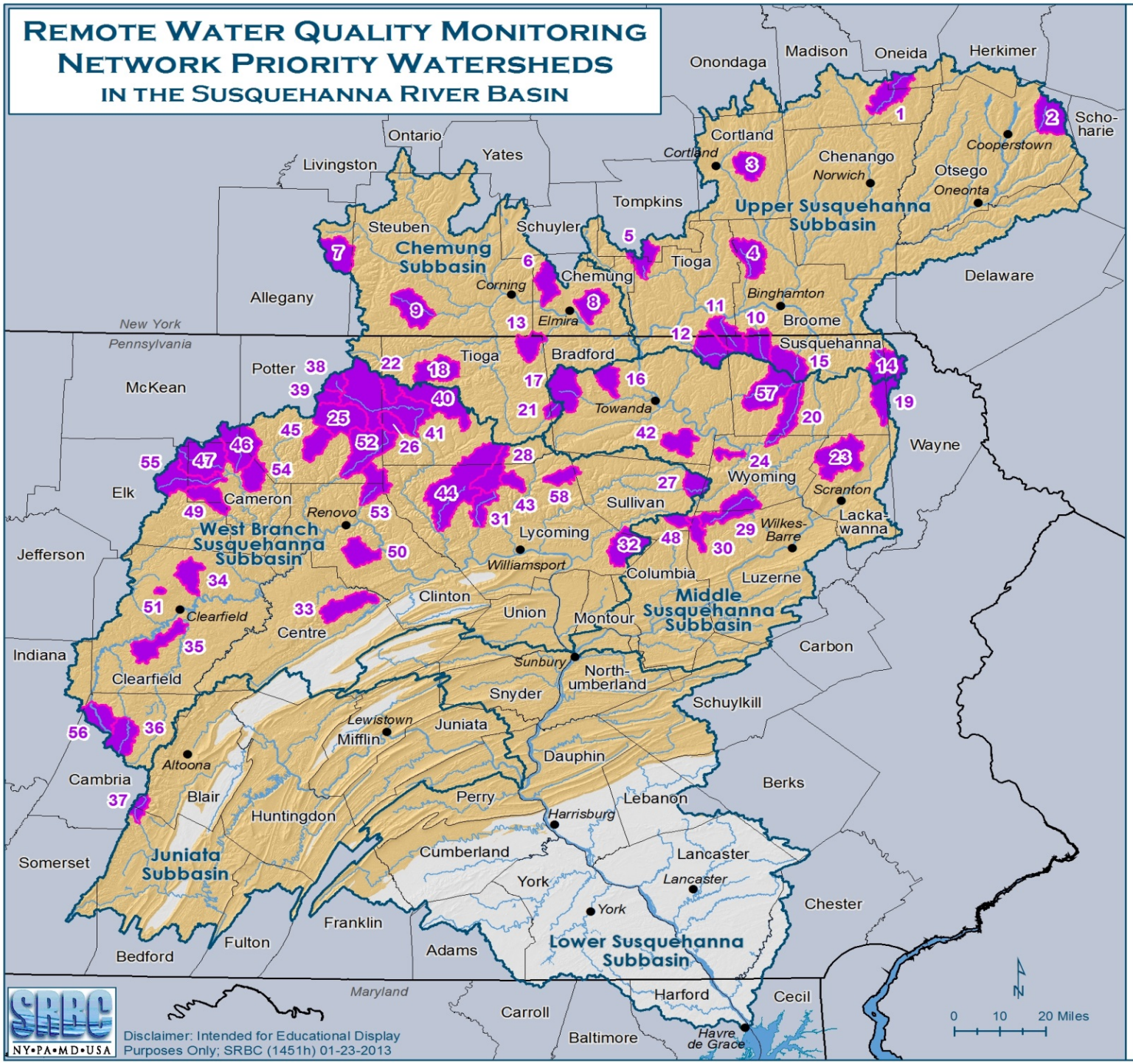
Water Quality
Aquatic Resource Surveys

Are surface water withdrawals impacting fish and/or macroinvertebrate communities?

- Sampling at withdrawal locations started in 2008
- Revisits now occurring with some renewals
- Research Spinoff in 2011
  - Withdrawal Index predictor of abundance of fish/ macroinvertebrate guilds
  - Shale gas industry withdrawals not causing noticeable shifts in communities



Remote Water Quality Monitoring Network Priority Watersheds in the Susquehanna River Basin



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Area Containing Natural Gas Shales

Area with No Recoverable Natural Gas Formations

Recoverable Natural Gas Shales within the Susquehanna River Basin include the Marcellus, Burket, Utica/Antes, Geneseo, Mandata, Middlesex, Needmore, and Rhinestreet Formations.

PRIORITY WATERSHEDS

Station Installed

1. Sangerfield River
2. Cherry Valley Creek
3. Trout Brook
4. Nanticoke Creek
5. Catatonk Creek
6. Sing Sing Creek
7. Canacadea Creek
8. Baldwin Creek
9. Tuscarora Creek
10. Choconut Creek
11. Apalachin Creek
12. Wappasening Creek
13. Hammond Creek
14. Starrucca Creek
15. Snake Creek
16. Tomjack Creek
17. Sugar Creek
18. Crooked Creek
19. Lackawanna River
20. Meshoppen Creek
21. Tioga River
22. Long Run
23. South Branch Tunkhannock Creek
24. Little Mehoopany Creek
25. West Branch Pine Creek
26. Elk Run
27. Loyalsock Creek
28. Blockhouse Creek
29. Bowman Creek
30. Kitchen Creek
31. Larrys Creek
32. Little Muncy Creek
33. Marsh Creek
34. Trout Run
35. Little Clearfield Creek
36. Chest Creek
37. Bobs Creek
38. Upper Pine Creek
39. Ninemile Run
40. Marsh Creek
41. Pine Creek
42. Sugar Run
43. Grays Run
44. Little Pine Creek
45. East Fork First Fork Sinnemahoning Creek
46. Portage Creek
47. Driftwood Branch
48. East Branch Fishing Creek
49. Hicks Run
50. Baker Run
51. Moose Creek
52. Kettle Creek
53. Young Womans Creek
54. Hunts Run
55. West Creek
56. West Branch Susquehanna River
57. East Branch Wyalusing Creek
58. Pleasant Stream

Compliance

- Nature of Violations
  - Approximately 70% administrative in nature (late reports/payments)
  - Remaining more significant and related to exceedances of limits/passby, operating without approval, etc.
- Settlements
  - 2008 - ~$1.7 million
  - 2009 - ~$250,000
  - 2010 - ~$260,000
  - 2011 - ~$18,000
  - 2012 – None
  - 2013 - ~$90,000
- Overall, good compliance considering level of attention

Assessment/Information Dissemination

- Shale Gas Assessment wrap-up in March 2015, look to prepare as a SRBC publication
- Publication of more focused analysis piece on water acquisition and use in a peer-reviewed journal by summer 2015 (submission first quarter 2015)
- Publication of more general data/information in a book covering *Water Use for Oil and Gas Production in the U.S.* sometime in 2016(?)
- ** USEPA's Study of Hydraulic Fracturing **
  - December release?
  - Heavy use of SRBC data
  - Key messages – water use will never be significant region-wide (could be local conflicts), low stress system, good management in place