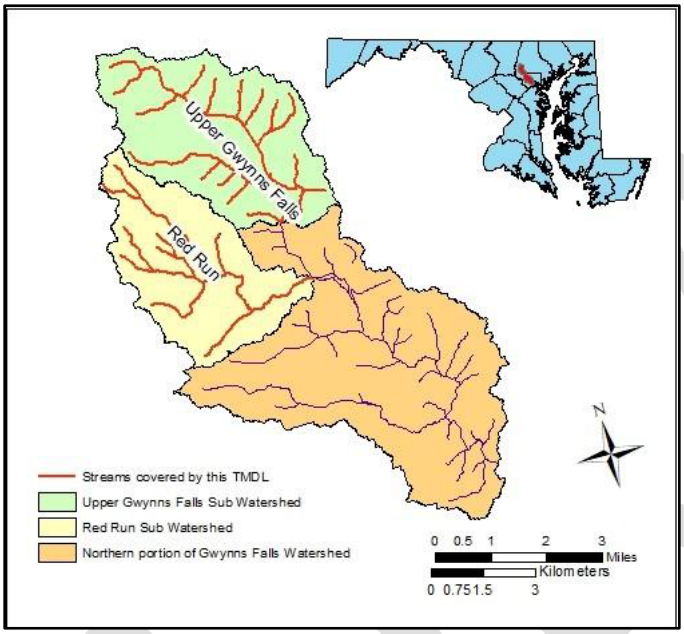
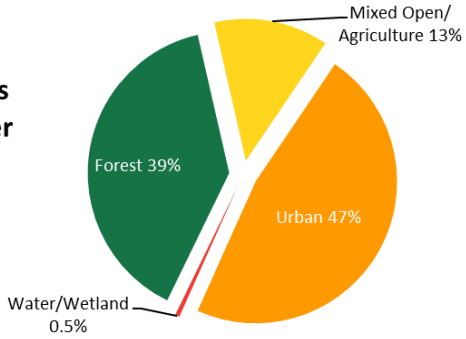
Background

The Total Maximum Daily Load, or TMDL, for temperature for the coldwater portions of the Gwynns Falls watershed establishes thermal limits for each of its two coldwater subwatersheds: Upper Gwynns Falls and Red Run. The goal of this TMDL is to define conditions suitable for a self-sustaining trout population and for other coldwater species. To do this, the TMDL simulates a watershed scenario where stream temperatures are kept below 68°F (20°C), providing estimates of how much forest buffering and stormwater management would be needed to achieve that goal.



The Upper Gwynns Falls and Red Run sub-watersheds are located in western Baltimore County, with the headwaters of Upper Gwynns Falls in Reisterstown and those of Red Run immediately to the southwest. The watershed outlets are located by the intersection of Reisterstown Road and Carlvon Road and the intersection of Painters Mill Road and Grand Central Avenue, respectively. The two watersheds are largely urbanized, with low- to high-density residential and commercial land use, but with a substantial amount of forested land as well.

Land use in the Use Class III, Coldwater Streams, of the Gwynns Falls watershed



Coldwater streams in the Gwynns Falls watershed were first listed as impaired for temperature in 2014. Continuous monitoring was performed at 15 stations throughout the watershed in summers 2016 and 2017 to support TMDL development.

Watershed ID	**Maryland 8-Digit: 02130905 (coldwater streams)**
Watershed size	Upper Gwynns Falls sub-watershed: 6,878 acres Red Run sub-watershed: 4,737 acres
Waterbody type	1st- through 4th-order non-tidal streams
Waterbody designated use not being met	Nontidal Coldwater
Reason for impairment	Growth and Propagation of Trout
TMDL Baseline year	2013
Related Chesapeake Bay Segment	Patapsco River Oligohaline (PATOH)

TMDL

The Soil and Water Assessment Tool (SWAT) hydrological transport model was used to develop this TMDL, using a specialized hydroclimatological stream temperature sub-model described in Ficklin et al. 2012. The model produced temperature and flow estimates which were used to calculate the energy discharged from each watershed. The baseline energy output, in gigajoules per day (GJ/d), was based on the calibration period. A TMDL scenario was developed to meet a 90th-percentile daily summer temperature of 68°F (20°C). Simulated stream temperatures were decreased by increasing the acres of developed land treated by stormwater infiltration practices and increasing the level of forest buffering.

Using the TMDL scenario, a load allocation (LA) was assigned to the agricultural sector based on the energy difference of converting all the agricultural land to forest. A wasteload allocation (WLA) for stormwater (developed land) was estimated in the same manner. The remainder of the TMDL thermal load was assigned to the forest (natural) sector.

	Baseline Temperature & Flow	Baseline Thermal Load Gigajoules/day (GJ/day)	Baseline % Forest Buffer	TMDL Temperature & Flow	TMDL Thermal Load Gigajoules/day (GJ/day)	TMDL % Forest Buffer	Additional % of stormwater infiltration for TMDL
Red Run Sub- Watershed	72.0°F (22.2°C) and 2.1 cfs	399	79	68°F (19.8°C) and 1.9 cfs	338	95	50
Upper Gwynns Falls Sub-Watershed	72.1°F (22.3°C) and 2.6 cfs	493	69	68°F (20.4C) and 2.3 cfs	405	92	50

Next Steps

Temperature reductions in this TMDL are assigned to the agricultural and stormwater sectors. Within the stormwater sector, the vast majority of urban land in these watersheds is regulated under the Phase I Municipal Separate Storm Sewer System (MS4) permits for Baltimore County and the State Highway Administration. Under their permits, these entities are required to develop implementation plans for this TMDL, and to meet a restoration requirement to manage stormwater runoff from existing developed areas. This restoration requirement will act as a driver of restoration work for this TMDL, and permittees should select practices, such as stormwater infiltration facilities, that are likely to positively impact stream temperature. Guidance on selecting appropriate practices can be found in Sections 4.1, 5.6.4 and 5.6.5 of the 2000 Maryland Stormwater Design Manual (2009 revision). Phase II MS4 permittees are also required to do restoration work, which would contribute to temperature reductions, as well. Implementation plans should also consider eliminating artificial channel alterations, such as hardened streambanks, and removing legacy sediment which can inhibit the recharge of cool groundwater into a free flowing stream.

Outside of the MS4 restoration requirements, a number of other programs may also increase tree coverage in the watershed. Maryland and the federal government make a variety of grants available to farmers interested in installing conservation measures, such as riparian forest buffers. These programs include the Maryland Agricultural Cost Share Water Quality Cost-Share Program (MACS) and the Conservation Reserve Enhancement Program (CREP). Through its Chesapeake and Atlantic Coastal Bays Trust Fund, the State pays to plant trees on public land. These efforts are described in Maryland's 2019 Phase III Watershed Implementation Plan for the Chesapeake Bay. To meet the TMDL goals, existing forest must be maintained, and measures such as the Forest Conservation Act and the High Quality Waters (Tier II) program will serve to protect undeveloped land in the watershed.

Climate change is anticipated to increase air temperatures and change precipitation patterns in this region, making it more challenging to meet the temperature goals described in the TMDL. Practices implemented to meet this TMDL, such as tree planting, may also help in adaptations to the impacts of climate change, such as riverine flooding. The carbon sequestration from planting many acres of trees can also be substantial. Maryland may revisit this TMDL at some point in the future if it turns out that the implementation described in this report is inadequate to meet water quality standards due to the effects of climate change.