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U.S Senate Committee on Environment and Public Works
Subcommittee on Chemical Safety, Waste Management, Environmental Justice, and Regulatory Oversight

July 31, 2024

Good morning, Chair Merkley, Ranking Member Mullin, and Members of this esteemed Subcommittee.

My name is Katrina Lassiter and I am the program manager of the Hazardous Waste and Toxics Reduction Program at the Washington State Department of Ecology. Thank you for the opportunity to speak on the critical issue of N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine, better known as 6PPD.

6PPD-quinone: A Key Cause of Salmon Death

For decades, scientists in the Northwest hunted a mysterious killer. They knew something in urban streams was killing adult coho salmon as they migrated upstream to spawn. Washington's scientists first documented coho salmon dying at a hatchery in the late 1980s.
Then, in the early 2000s, scientists at a National Oceanic and Atmospheric Administration lab in Seattle watched juvenile coho salmon die after adding runoff from a nearby highway in their tank. We knew then that there was a deadly chemical in the runoff, but we did not know what exactly. Finally, in 2020, there was a breakthrough.

Researchers at Washington State University and University of Washington pinpointed a chemical called 6PPD-quinone as the culprit. This discovery was a milestone moment for environmental science. It also marked the beginning of the race to solutions.

6PPD-quinone comes from a chemical added to tires called 6PPD. This chemical, 6PPD, is an antiozonant, which means it prevents the degradation of tire rubber by reacting with ozone in the air. This promotes tire longevity and safety. However, when 6PPD reacts with ozone, it transforms into the extraordinarily toxic 6PPD-quinone.

Because 6PPD is used as an antiozonant in all automobile tires today, 6PPD and 6PPD-quinone are everywhere. Think about the volume of rubber particles and tire dust that comes from tens of millions of tires on vehicles, washing off roads and into streams, rivers, lakes, and the sea.

This is not just a problem for one species of fish in Washington State – 6PPD-quinone harms fish species found throughout the United States. Rainbow trout, steelhead, brook trout, coho salmon, and lake trout all die when exposed to this chemical. And because salmon and trout are keystone species across the United States, the health of other fish and animals, and even entire ecosystems, depends on their existence. We see these impacts vividly in Washington with the decline of

Southern Resident Orcas, of which only around 75 remain. What we have learned about the impact of 6PPD elevates this issue to one of nationwide concern, and we are still learning more every day.

Economic Impacts of Depleted Fish Populations

People across the United States value fish as critical food sources, economic drivers, and connections to culture and tradition. Fisheries, large and small, rely on healthy fish populations to sustain their business operations. Depleted fish stock not only affects the bottom line, but also the families that rely on successful catch for their livelihood. And all of this has a rebound effect on our economy – fewer fish means fewer people fishing, which means higher unemployment and lower GDP.

Concerns around 6PPD and 6PPD-quinone do not end with fish, whales, or the economy. Our country has deep cultural ties to fishing and recreation. Children might grow up learning to fish for trout at the lake, then pass on those memories and traditions for generations. Fish are vital to Indigenous cultures and identities, food sovereignty, nutrition, traditional knowledge, and way of life.

Concerns About Human Health Impacts

We also have reasons to be concerned about impacts to human health, although we still need more research to fully understand the ways these chemicals affect us. We do know that the European Chemicals Agency has categorized 6PPD as a category 1B reproductive toxicant, which means it is presumed to be toxic to the human reproductive system.

Additionally, studies have found 6PPD and 6PPD-quinone at elevated concentrations in pregnant women compared to other adults and children. Studies indicate that both 6PPD and 6PPD-quinone cause damage to the liver of mice, and mother rats exposed to 6PPD experience lengthy, difficult births. Most recently, studies have concluded that 6PPD-quinone impairs sperm quality in male mice. We don’t yet know the significance of these findings on our bodies, but researchers across the nation, and world, are currently searching for answers to these and the many other questions about 6PPD and 6PPD-quinone.

We also know that 6PPD-quinone's impact on fish populations directly reduces access to healthy foods for people who rely on fish for subsistence. This is particularly true for Tribes that consume salmon as a traditional food source and for the fishermen who fish to sustain their families. Not only this, but declining fish populations can erode mental health as culturally significant food sources become unavailable.

Nationwide Actions Needed to Find Solutions

Since the discovery of 6PPD-quinone’s toxic effects in 2020, people across the nation have taken action. This is certainly not a problem that Washington or the West Coast can solve on our own. We are thankful for those who recognize this is a critical worldwide problem and have turned their attention, funding, and support towards finding solutions.

It is worth acknowledging these commitments and early accomplishments today. Progress anywhere benefits communities everywhere. It also shows how complex and critical this work is.

State, county, and local governments are evaluating stormwater projects to see whether certain stormwater best management practices reduce the amount of 6PPD-quinone that makes its way into rivers, creeks, and streams. This includes practices like building bioretention swales near busy roads and increasing street sweeping. Meanwhile, Tribes are taking action to protect treaty resources, including through a joint petition asking EPA to ban 6PPD under the Toxic Substances Control Act.

Federal agencies, including the U.S. Environmental Protection Agency, National Oceanic and Atmospheric Administration, and U.S. Geological Survey are prioritizing this work and leading efforts to address 6PPD and 6PPD-quinone in the environment. The EPA is funding stormwater effectiveness research in Washington State and coordinating across the nation to plan research within their Office of Research and Development. NOAA and USGS are leading the nation's research to identify how 6PPD-quinone enters fish and moves through their bodies. Tire manufacturers have also heard the concerns. They're here at the table with us, actively engaged in the search for a safer alternative to 6PPD.

Washington State's Interagency Approach

So, how is Washington addressing such an urgent, wide-spread problem? A problem this complex requires a holistic approach. We are not pursuing solutions to 6PPD through one avenue alone. To tackle this issue, we are working across state agencies to:

1. Evaluate chemical alternatives to determine if a safer and feasible alternative is available to restrict the use of 6PPD in tires.
2. Develop a statewide action plan to address short- and long-term actions that will mitigate the impacts of 6PPD and 6PPD-quinone on people and the environment.
3. Resolve some of the currently unanswered questions about 6PPD and 6PPD-quinone.
4. Minimize the amount of 6PPD-quinone that makes its way into waterways through stormwater treatment.

Finding a Permanent Solution to 6PPD-quinone

Pollution prevention (removing 6PPD from tires) is the cheapest and most effective way to reduce 6PPD harms to people and the environment. We understand that 6PPD ensures that the tires on our cars, trucks, and other vehicles are long-lasting, deliver the safety and performance we depend on, and available at an affordable price for consumers and businesses. We also understand that potential alternatives will need to meet similar criteria to achieve wide acceptance – as well as being demonstrably less toxic to people, fish, and the environment.

To find a safer replacement for 6PPD, Ecology is evaluating whether chemicals that could serve the same function in tires meet strict toxicity requirements. We've developed 6PPD hazard criteria that set a standard benchmark for identifying whether a chemical is safer than 6PPD. Our

hazard criteria incorporate input from the public, industry, academic researchers, and other interested parties.

We are also taking action through Ecology's Safer Products for Washington program. This program provides a state framework for regulating chemicals in consumer products. In the 2024 Legislative session, state legislators passed a bill that adds 6PPD as a priority chemical. When a safer alternative is found feasible and available, Ecology is authorized to restrict the sale of tires containing 6PPD.

Identifying actions to implement solutions to 6PPD-quinone

Our statewide 6PPD Action Plan will help us determine next steps and solutions to addressing 6PPD and 6PPD-quinone. Rather than waiting for more information, we must identify the actions we can take right now to protect people, the economy, and the environment. To this end, we convened a nationwide advisory committee of 52 people, including Federal, local, and Tribal government partners, industry experts, and community-based organizations, to help us define barriers and identify near-term actions around 6PPD.

A member of this advisory committee, representing the U.S. Tire Manufacturer's Association, is here speaking with us today. Additionally, 12 representatives from Tribal governments and commissions offered their expertise and perspectives on the advisory committee as co-managers of Washington State's natural resources. There are still many questions that must be answered before we can develop long-term recommendations, including what waterways most need to be protected, how we will fund the infrastructure needed to protect these waterways, and how these chemicals impact other fish – and humans.

Identifying Where and How 6PPD-quinone Causes Harm

One of the challenges with discovering a new toxic threat is the need to develop the standards and procedures that allow us to find trustworthy answers through verifiable and repeatable research. The Washington Department of Ecology was first in the nation to develop an accredited lab method to collect and test freshwater samples for 6PPD-quinone.

Ecology is currently sampling salmon-bearing streams to detect toxic levels of 6PPD-quinone to determine **where** the risks to salmon are highest, **when** those risks are highest, and **how long** toxic concentrations of 6PPD-quinone persist. Additionally, the Washington Department of Fish and Wildlife is sampling fish and mussels from Puget Sound habitats. Sampling data will help us understand the amount of exposure and toxicity fish species face from one watershed to the next.

Meanwhile, Washington's Department of Health is tracking and compiling research on human exposure and health effects of 6PPD, 6PPD-quinone, and other transformation products. These efforts are critical to learning more about how 6PPD and 6PPD-quinone affect people.

Preventing Fish Death Caused by 6PPD-quinone in Waterways

While we learn more about 6PPD and 6PPD-quinone, we must prevent toxic concentrations of 6PPD-quinone from making their way into our most vulnerable waterways**.** To accomplish this,

Ecology is evaluating which stormwater best management practices – like stormwater ponds, bioswales, and other green stormwater infrastructure – are most effective at protecting aquatic life. We're also requiring permittees to prioritize and implement best management practices to reduce, control, or treat 6PPD compounds in stormwater.

Additionally, we need to add effective stormwater treatment to address 6PPD compounds on more of our urban and suburban roadways. Washington's Department of Transportation's (WSDOT's) Move Ahead Washington transportation package includes funding for installation of stormwater treatment on existing roads to mitigate the impacts of toxic chemicals.

WSDOT has also received funding through the Federal Highway Administration's Transportation Pooled Fund to address toxics, including 6PPD-quinone, in highway runoff. Along with eight other states, including Oregon and California, WSDOT will evaluate highways to determine the best places to implement stormwater best management practices.

All of this helps protect our waterways not only from 6PPD and 6PPD-quinone, but other toxic chemicals, too. And better management of stormwater runoff can reduce flooding and improve the health of our streams and rivers. As a result, the actions we're taking promote salmon recovery, benefit ecosystem health, and reduce pollution across the state.

Our state and the federal government have already committed millions of dollars to funding research, pilot projects, and stormwater treatment that will help us improve stormwater management and prevent 6PPD-quinone from reaching local waters. But the geographic scope of this problem is vast and there are many locations in need of stormwater treatment. The Federal Leadership Puget Sound Stormwater and Transportation Charter Group has identified 16 demonstration projects to remove toxics from stormwater before they reach salmonid-bearing waterways; however, there is not yet funding to implement this work.

The benefit of this work reaches far beyond Washington and the Pacific Northwest – what we are learning will help all of us better manage our stormwater and the thousands of toxic chemicals released into our environment and finding their way to surface waters across the nation.

That said, stormwater management is only part of the answer when it comes to minimizing impacts from 6PPD-quinone. Ultimately, we know that reducing sources of 6PPD is the best way to protect people, fish, and the environment from 6PPD-quinone.

Immediate Federal Action Needed

Washington State is making progress on 6PPD every day. But solving this problem requires a nationwide, intergovernmental, coordinated effort. We are grateful to be here today to help elevate this conversation. We need the support of this committee, and Congress at large, to meet the challenge facing all of our communities and the people we all serve.

We urge you to resource Federal agencies in order to make progress on this work. Discuss this issue with your constituents. Help us build and maintain partnerships with the agencies,

organizations, and individuals who urgently want to solve this problem. Require transportation projects to include stormwater controls for roadway runoff. Invest in research so we can continue advancing our understanding of these chemicals, and support legislation that reduces the use of 6PPD.

Just like all of our waterways are interconnected, so too are all of the issues I've spoken about today. When we invest our time, energy, and resources into advancing environmental goals, we also advance our own health and prosperity.

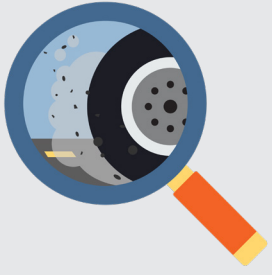
As such, the solution to the 6PPD problem will never be "either/or." Finding a solution to 6PPD is not a choice between people or fish, between business or the environment. We can and must work together to find a solution that fosters the long-term well-being of all.

Thank you again for the opportunity to speak on this issue, and I'm happy to answer any questions you may have.

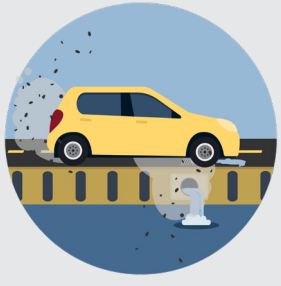
The Connection Between Tires, Fish, and Us

What's that chemical in your tires?

6PPD is a chemical used in tires to prevent cracking and blowouts. It has been used for decades and is found in tires worldwide. When 6PPD reacts with ozone, it transforms into 6PPD-quinone (often referred to as 6PPD-q).



As traffic passes on roads, tire wear particles containing 6PPD and 6PPD-quinone are released into the environment.



6PPD and 6PPD-quinone then travel through air and stormwater runoff and enter rivers, creeks, and streams.

What are we doing to address 6PPD?

1. **Understand the problem**
   We are developing scientific methods to measure 6PPD-quinone in the environment and identifying affected areas.
2. **Reduce sources of 6PPD**
   We are searching for a safer alternative to use in tires and developing an action plan to guide our work.
3. **Reduce stormwater pollution**
   We are identifying and updating guidance on the best ways to capture and manage 6PPD-quinone before it reaches streams.

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What's so bad about 6PPD-quinone? ›

How does 6PPD-quinone impact fish, ecosystems, and humans?

6PPD-quinone is highly toxic to coho salmon and kills these fish before they can lay eggs. It is also toxic to juvenile coho. This threatens the survival of a species that's critical to the resiliency of ecosystems.

People value salmon as an important food source and connection to culture and tradition. Salmon are vital to Indigenous cultures and identities, food sovereignty, traditional knowledge, and way of life.

6PPD-quinone is harmful to other aquatic organisms, including rainbow trout and brook trout. Scientists are also conducting research to learn how 6PPD and 6PPD-quinone may impact human health.



Without proper stormwater infrastructure, salmon migrating during rainfall are exposed to 6PPD-quinone.

DEPARTMENT OF ECOLOGY
State of Washington

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Learn more about 6PPD:

Focus on: Finding Solutions to 6PPD



Figure 1. The Washington Department of Fish and Wildlife and the Puyallup Tribe of Indians monitor toxic contaminants, including 6PPD-quinone, in seaward migrating juvenile Chinook salmon from the Puyallup/White River watershed. Photo: Andrew Berger, Puyallup Tribe of Indians.

6PPD in Washington State

6PPD is an antioxidant and antiozonant used in motor vehicle tires to prevent tire cracking and promote tire longevity. In 2020, Washington State University and University of Washington researchers discovered that 6PPD ozonation leads to the harmful breakdown product 6PPD-quinone (6PPD-q). This chemical has been identified as the second most toxic aquatic chemical ever measured and causes rapid mortality to species of cultural and environmental significance like the coho salmon.

Washington State's work focuses on three objectives:

1. Reducing sources of 6PPD in the environment, including identifying a safer alternative;
2. Minimizing and mitigating the impact of 6PPD in the environment; and
3. Furthering research to better understand 6PPD's effect on human health and key aquatic species.

Statewide Projects

6PPD Action Plan

Washington State is leading development of a statewide 6PPD Action Plan.[1] We are responding to emerging science by producing the plan in phases. Currently, we are developing recommendations that respond to priority and near-term research needs and data gaps. In future phases, we will develop long-term recommendations that reduce the impact of 6PPD and 6PPD-q on people and the environment.

State, Tribal, and Federal Puget Sound Stormwater and Transportation Charter Group

Washington State is partnering with the U.S. Environmental Protection Agency and Tribes in Washington to remove toxics from stormwater before they reach salmonid-bearing surface waters. We've identified 16 demonstration projects based on coho stream crossings along a gradient of traffic conditions.

Interstate Technology & Regulatory Council's Tire Anti-Degradant (6PPD) Team

Ecology and Health collaborate with Federal, State, and Tribal governments, municipalities, and community members to develop 6PPD and 6PPD-q guidance documents and tools, including this fact sheet.[2] These resources are intended to broaden and deepen technical knowledge and expedite quality regulatory decision-making at the state and local level.

Department of Ecology

Alternatives Assessment

Ecology's alternatives assessment will identify, compare, and select safer alternatives to 6PPD in tires. In November 2021, Ecology published the 6PPD Hazard Assessment.[3] The assessment reviewed existing anti-degradants that could potentially replace 6PPD in tires. The 6PPD Hazard Criteria,[4] developed October 2023, describe specific data requirements and standards to assess chemical safety of alternatives to 6PPD. Ecology will use these hazard criteria when comparing the safety of possible replacement chemicals during the alternatives assessment.

Safer Products for Washington

Ecology has listed 6PPD as a priority chemical[5] and motorized tires as a priority consumer product under the Safer Products for Washington program. The Safer Products for Washington program provides a state framework for regulating chemicals in consumer products. If a safer alternative is feasible and available, Ecology could restrict the sale of tires containing 6PPD through this program.

Water Quality



Figure 2. We want to better understand the concentrations of chemicals in stormwater when it rains, including 6PPD-q. Field staff for King County Environmental Lab collect a stormwater runoff sample from the highway above. Photo credit: KCEL.

Ecology has proposed adding requirements to address 6PPD in multiple general permits. The updated municipal stormwater permits[6] will be finalized by end of June 2024 and the industrial stormwater general permit[7] will be finalized by December 2024. Section 1.5[8] and the Emerging Guidance Section[9] of the stormwater management manuals already contain guidance for effective 6PPD-q best management practices (BMPs). In February 2024, Ecology proposed a freshwater acute criterion for 6PPD-q in our draft aquatic life toxics criteria rulemaking.[10] In June 2022, Ecology, university researchers, and industry experts issued a stormwater BMP effectiveness report[11] providing best professional judgement on existing BMP options and their likelihood to manage 6PPD and 6PPD-q. Ecology continues to fund BMP effectiveness projects.[12]

Sampling and Monitoring

Statewide partners supported Ecology's development of the 6PPD in Road Runoff[13] report. This report discusses the complexity of finding 6PPD-q in the environment and identifying the most vulnerable areas. Ecology's Manchester Environmental Laboratory was the first in the nation to produce an accredited 6PPD-q standard operating procedure[14] for analyzing 6PPD-q in water samples.

Mapping

Ecology developed a tire contaminant story map[15] that details traffic, salmon distribution, and watershed characteristics. The story map identifies locations of coho salmon, brook trout, rainbow trout, and steelhead that are at risk of 6PPD-q exposure.

Department of Fish and Wildlife

The Department of Fish and Wildlife is partnering with chemists at the National Oceanic and Atmospheric Administration's Northwest Fisheries Science Center laboratory. They are developing analytical methods to test for 6PPD, 6PPD-q, and other tire-related compounds in juvenile Chinook salmon and bay mussels whole-body tissue and English sole bile and plasma. 6PPD-q was detected in a subset of all tissue samples. The potential impacts for each species at the measured concentrations are currently unknown. Learn more about how the Department of Fish and Wildlife's Toxics Biological Observation System (TBiOS) monitors toxic contaminants in fish[16] and other organisms living in Puget Sound.



Figure 3. A mussel cage anchored at Duwamish Head in Elliott Bay during a 2020 TBiOS study. Photo credit: Puget Soundkeeper.

Department of Health

Department of Health toxicology staff are tracking and compiling research on human exposure and health effects of 6PPD, 6PPD-quinone, and other transformation products. They are preparing an assessment of available human health data and information gaps on 6PPD and its transformation products for the 6PPD Action Plan.

Department of Transportation



Figure 4. Stormwater retrofits help reduce 6PPD-q pollution. This pilot project tests the effectiveness of bioretention planter boxes to treat 6PPD-q. Photo credit: WSDOT.

The Move Ahead Washington transportation funding package includes $500 million over 16 years for stormwater retrofits to enhance stormwater treatment from existing roads and infrastructure, with an emphasis on green infrastructure retrofits. This includes $6 million to establish a new stormwater treatment facility and treat 6PPD-q at the Interstate 5 Ship Canal Bridge in Seattle. The Washington State Department of Transportation (WSDOT) is developing a prioritization plan to invest funds in cost-effective projects that accomplish the following goals:

- Provide benefits to salmon recovery and ecosystem health.
- Reduce pollution, including 6PPD-q.
- Address health disparities.

Learn more about stormwater retrofits on WSDOT's Move Ahead Washington folio.[17]

Related Information

- 6PPD webpage: Tire anti-degradant (6PPD) and 6PPD-quinone[18]
- The Connection Between Tires, Fish, and Us[19]
- Focus on: Best Management Practices for 6PPD-q[20]
- Focus on: Reducing Sources of 6PPD[21]
- Focus on: Monitoring 6PPD-q in the environment[22]
- 6PPD resources[23]
- Join our 6PPD email list to stay up to date on Ecology's 6PPD work[24]

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[1] www.ezview.wa.gov/site/alias__1962/37915/6ppd_action_plan.aspx
[2] 6ppd.itrcweb.org/wp-content/uploads/2023/09/6PPD-Focus-Sheet-Web-Layout-9.pdf
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[6] ecology.wa.gov/muniswreissue
[7] https://apps.ecology.wa.gov/publications/SummaryPages/2410024.html
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[9] ecology.wa.gov/SWMMWW/emergingguide
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Focus on: Reducing Sources of 6PPD

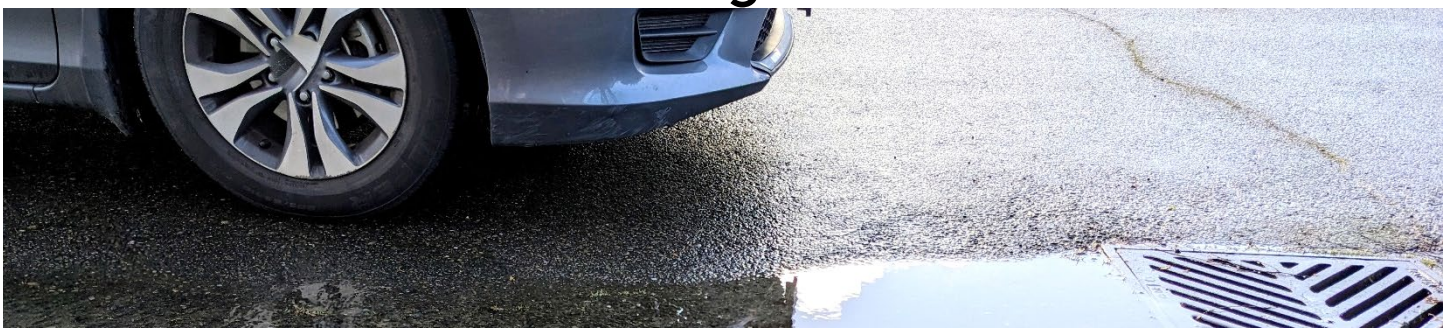


Figure 1. A car driving on a road near a storm drain. Tires are a primary source of 6PPD-quinone in the environment.

The 6PPD Tire Problem

In 2020, scientists at the University of Washington-Tacoma, Washington State University, and other collaborators identified the chemical that causes pre-spawn mortality in coho salmon: 6PPD-quinone (pronounced "qui-KNOWN"), also known as 6PPD-q.[1] This chemical is a transformation product of 6PPD, a compound used in tires.

Tire manufactures use 6PPD to reduce tire cracking and prevent tire blowouts, which keeps passengers safe. 6PPD also increases tire longevity, making them more economical and reducing the number of tires that end up in landfills.

As 6PPD performs these functions, it reacts with ozone in the air and turns to 6PPD-q. Tire dust holding 6PPD-q then washes into rivers and streams when it rains, killing coho salmon before they can spawn. Coho salmon are currently known to be the most sensitive to 6PPD-q, but this chemical is also harmful to other fish, like rainbow trout and brook trout, and possibly other aquatic species.

The discovery of 6PPD-q presents a complex problem: the best way to protect aquatic species is to reduce sources of 6PPD, but tire manufacturers can't abruptly stop using this chemical because it plays a critical role in tire longevity and performance.

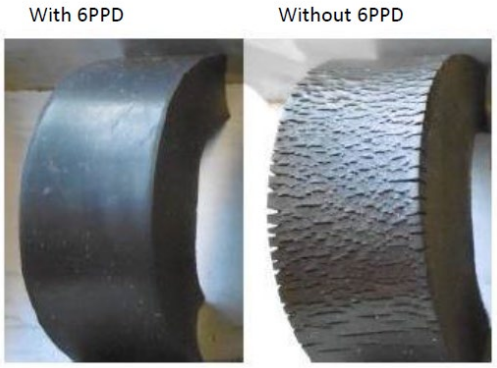


Figure 2: A tire with and without 6PPD. Photo by the U.S. Tire Manufacturers Association.

To find a solution, we're working closely with research institutions; tire manufacturers; federal, state, local, and tribal governments; and other interested parties. Our long-term goal is to identify safer alternatives to 6PPD so we can reduce sources of 6PPD-q. To accomplish this, we must learn more about 6PPD, its toxicity to aquatic species and humans, and the chemicals that can potentially replace it.

6PPD Alternatives Research

Ecology is looking for alternatives and funding research with the Center for Urban Waters (UW-Tacoma), Washington State University, Emissions Analytics, Enthalpy Analytical, and ToxServices to:

- Prepare a hazards assessment for 6PPD and nine other antioxidants/antiozonants (completed in 2021).
- Compare the toxicity of 6PPD on coho salmon to other tire chemicals that could replace 6PPD.

[1] Tian, Z. et al. 2020. A ubiquitous tire rubber-derived chemical induces acute mortality in coho salmon. *Science* 371 (6525): 185-189. doi.org/10.1126/science.abd6951.

- Learn how environmental conditions (like water pH) impact the toxicity of 6PPD-q.
- Measure the presence of 6PPD, 6PPD-q, and other chemicals present in tires (including assorted brands of passenger car, light truck, and commercial truck tires).
- Test the toxicity of 6PPD on rainbow trout and potentially other aquatic species in the future.

Our goal in funding this research is to answer questions such as:

- Are there chemicals that meet the same tire performance requirements as 6PPD?
- Are the potential replacement chemicals safe for fish, other aquatic species, and humans?
- What criteria will we use to determine whether a chemical is safer than 6PPD?
- Can manufacturers make changes to tire design that remove the need for 6PPD or eliminate the pollution of 6PPD (and its transformation products) from tires?

To accelerate the pace of innovation for 6PPD alternatives, we're bringing interested parties together to share resources and ideas. In partnership with UMass Lowell, we held a forum in December 2022 for organizations to discuss collaborative needs and opportunities to find safer, effective alternatives to 6PPD. Participants shared insights and research around 6PPD and identified some critical next steps to solving this complex problem.

Looking Ahead: 6PPD Alternatives Assessment

In 2022, the Legislature allocated funding for Ecology to prepare a 6PPD alternatives assessment (AA). An AA identifies, compares, and selects safer alternatives to unsafe chemicals like 6PPD.

The research we're conducting is a critical step in preparing for the 6PPD AA. Before conducting the AA, Ecology will establish specific data requirements and standards (known as hazard criteria) to assess chemical safety.

When we evaluate potential alternatives in the AA, we can compare a chemical's toxicity, performance, availability, and cost to that of 6PPD. We will use this information to identify alternatives for 6PPD that: 1) meet tire performance requirements; and 2) are safer to humans, coho salmon, and other aquatic life.

Related Information

- Ecology's 6PPD webpage[2]
- Technical Memo: Assessment of Potential Hazards of 6PPD and Alternatives[3]
- Collaborative Innovation Forum: Functional Substitutes to 6PPD in Tires (Meeting Report)[4]

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[2] ecology.wa.gov/6PPD
[3] www.ezview.wa.gov/Portals/_1962/Documents/6ppd/6PPD%20Alternatives%20Technical%20Memo.pdf
[4] www.sustainablechemistrycatalyst.org/s/6PPD-in-Tires-Innovation-Forum-Meeting-Report.pdf



Focus on: Municipal Stormwater and 6PPD

Understanding 6PPD

6PPD is a chemical that prevents tires from breaking down and helps them last longer. When this chemical is exposed to air, it reacts with ozone to create 6PPD-quinone or 6PPD-q. Recent research has shown that 6PPD-q is lethal to salmon, especially coho. This is a problem, as 6PPD-q can move from paved surfaces into waterbodies and harm aquatic life.

Specific to local salmon runs, research shows that 6PPD-q is responsible for the death of coho salmon migrating back to spawning grounds.

Research is ongoing for all of the potential impacts of 6PPD and 6PPD-q, including studying the effectivness of different stormwater treatments in preventing 6PPD-q from reaching the water.

To learn more about all of Ecology's work on 6PPD, visit ecology.wa.gov/6PPD.

Washington's Municipal Stormwater Program

Stormwater runoff is a leading pollution threat to clean water in urban areas of Washington. As rain and snowmelt runs off buildings, paved roads, and parking lots, it increases in speed and volume, and can pick up pollution such as oil, fertilizers, pesticides, tire wear, trash, and pet waste. These pollutants and higher flows are carried into local water bodies, where they can harm water quality and habitat.

To manage this stormwater, Ecology has municipal stormwater permits for the state's most populated cities and counties. The permits are aimed at reducing stormwater pollution at its source, treating it, and controlling volume and flow, so cleaner water goes into creeks, rivers, lakes, groundwater, and Puget Sound.

The regulatory approach in these permits is a programmatic and a holistic approach to stormwater management, which is different from the typical water quality permit. Municipal stormwater permittees are required to develop and implement Stormwater Management programs. These are comprehensive toolboxes of stormwater best management practices (BMPs) known to be effective at preventing, controlling and treating runoff from urbanized landscapes.

We update the municipal stormwater permits every five years. The most recent permit updates were issued on July 1, 2024 and are effective from Aug. 1, 2024 to July 31, 2029.

To address 6PPD and 6PPD-q pollution, Ecology made updates to the municipal permits and the stormwater manuals that support permit implementation.

Updating permits for 6PPD and 6PPD-q

The best way to prevent pollution from reaching stormwater and local waterways is to control it at the source. For example, street sweeping, a commonly used source control best management practice (BMP), removes tire particles, heavy metals, sediment and other pollutants from the roadway before they move downstream by stormwater. Stormwater treatment BMPs remove many kinds of pollutants, including 6PPD-q, from stormwater before it is discharged to surface waters.

There are existing BMPs in the permits and manuals that are effective at addressing tire wear particles. Initial research shows these are effective BMPs for 6PPD and 6PPD-q. These BMPs were designed to address many different pollutants, from metals to fertilizers to tire wear particles, even before we knew about 6PPD.

The following permit changes will help further reduce pollution, including 6PPD, from reaching local waters in the near term and long term:

- Requiring more new development and redevelopment projects to incorporate Runoff Treatment and Flow Control BMPs.
- Increasing the amount of stormwater retrofits required for existing development, to address areas without adequate stormwater treatment.
- Adding a street sweeping requirement to collect pollutants before they are washed into downstream waters.
- Including a new emphasis on transportation-related projects in Stormwater Management Action Plans, as those are likely to generate tire particles and 6PPD-q. These plans also include planning for high priority receiving waters and identifying priority stormwater management activities.

One of the biggest issues when it comes to addressing 6PPD and 6PPD-q are areas without effective stormwater treatment. This will continue to improve as local governments install more stormwater treatment through retrofits of existing development and more stormwater management BMPs as a result of permit requirements.

What stormwater BMPs help with 6PPD and 6PPD-q?

There are a few types of common stormwater BMPs that initial research shows help with 6PPD and 6PPD-q. Research is ongoing to better understand just how effective these BMPs are and what other BMPs might be helpful. We issued our first report on the potential effectiveness of stormwater management BMPs for 6PPD-q in 2022. More information is in our report focus sheet. The report looked at:

Stormwater source control BMPs: prevent stormwater contamination with methods such as street sweeping to remove 6PPD-q and tire wear particles from roadways before they are washed into downstream waters.

Flow control BMPs: slow runoff down and reduce runoff volumes by holding stormwater back with structures such as ponds, infiltration basins, and bioretention.

Runoff treatment BMPs: remove 6PPD-q from stormwater runoff through physical filtration or chemical sorption media like biofiltration swales, bioretention, and certain manufactured treatment devices.

Ecology is funding BMP effectiveness research for 6PPD and 6PPD-q. Focus areas include: stormwater characterization, crumb rubber, street sweeping, decant facilities, soil and media mixes, swales, and embankments.

How communities are monitoring for 6PPD-q

A regional montoring collective, the Stormwater Action Monitoring (SAM) program, remains the most effective monitoring option for municipal stormwater permittees.

SAM conducts long-term regional status and trends monitoring studies in western Washington. These studies aim to understand how collective stormwater management efforts are positively impacting streams and marine waters. Additionally, SAM and municipal stormwater permittees are researching the effectiveness of stormwater BMPs. SAM is studying 6PPD-q in some of its long-running and newer projects.

A SAM project starting in 2024 will analyze stormwater outfall samples from 16 basins across the Puget Sound. This analysis will focus on several Contaminants of Emerging Concern, including 6PPD-q. The study results will inform us of 6PPD-q concentrations in stormwater coming from industrial, commercial, and residential areas.

Related Information

- Muncipal Stormwater General Permits
- Stormwater Manuals

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To request an ADA accommodation, contact Ecology by phone at 360-407-6600 or email at Jessica.Shook@ecy.wa.gov, or visit https://ecology.wa.gov/accessibility. For Relay Service or TTY call 711 or 877-833-6341.

Focus on: Monitoring 6PPD-q in the environment



A scientist collects water samples from a salmon-bearing stream to measure levels of 6PPD-quinone. Impervious surfaces can deliver tire contaminants to our waterways.

6PPD-quinone in the environment

In 2020, after decades of investigative work by a cross-disciplinary research consortium, scientists from University of Washington Tacoma, Washington State University Puyallup, and their collaborators, identified 6PPD-quinone (also known as 6PPD-q) as the chemical that causes pre-spawn mortality in coho salmon. The chemical comes from 6PPD (6 p-phenylenediamine), found in tires and recycled tire products, when tire dust is exposed to air. When rain falls on tires and roads, it washes tire dust including 6PPD-q into rivers, streams, and estuaries.

To support long-term solutions, researchers are developing assessment studies to help us understand when, where, and how 6PPD-q ends up in the environment. These studies will support toxics-reduction planning and mitigation actions.

Initial assessment and recommended strategies

In October 2022, we published a legislative report[1] with key findings, research needs, and proposed strategies to reduce 6PPD-q in road runoff.

Important takeaways from the 2022 report to the Legislature:

- The amount and type of stormwater-management strategies to reduce tire contaminant exposure to vulnerable species varies from one watershed to another.
- We need consistent funding to support regional contaminant research to fill the many data gaps and for our partners to continue characterizing the chemicals and impacts associated with tires.
- At this early stage, we recommend using adaptive management strategies.
- Innovative sampling technologies and GIS mapping are decisive tools to measure and assess 6PPD-q.

[1] https://apps.ecology.wa.gov/publications/SummaryPages/2203020.html

Current and future 6PPD-q monitoring and testing

We are expanding our field monitoring and laboratory capacity to identify areas where the most vulnerable habitats are exposed to road runoff and 6PPD-q. For example:

- We have developed a laboratory method for measuring 6PPD-q in water. This will help us to quantify how much 6PPD-q is in aquatic environments and to evaluate stormwater-management actions.
- We are developing analytical methods for measuring 6PPD-q in stream sediments and fish tissue collected from aquatic environments.
- We are designing field studies to determine the most effective methods for evaluating the scope and scale of 6PPD-q pollution in rivers, streams, and estuaries.
- Mapping tools help us determine how traffic contributes to coho salmon and rainbow trout mortality, including pre-spawn adults and juveniles.
- We are coordinating with local stormwater and salmon monitoring leads to identify areas where tire pollution is most likely to impact aquatic life.



A chemist at Manchester Environmental Lab explains the process for testing 6PPD-q in water samples to Washington's Governor Jay Inslee.

Collaborating with partners

We continue to work closely with our partners on research and monitoring projects to reduce aquatic life exposure to 6PPD-q. Our partners include the Washington State departments of Transportation, Health, and Fish and Wildlife; University of Washington Tacoma's Center for Urban Waters; Washington Stormwater Center at Washington State University's Puyallup Research and Extension Center; National Estuary Program and Puget Sound Recovery at the U.S. Environmental Protection Agency; Puget Sound Ecosystem Monitoring Program; Northwest Indian Fisheries Commission; and local communities.

Related Information

- 6PPD in Road Runoff: Assessment and Mitigation Strategies[2]
- Our 6PPD webpage[3]

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[2] https://apps.ecology.wa.gov/publications/SummaryPages/2203020.html
[3] https://ecology.wa.gov/6PPD