

Urban runoff  
rubber tire  
contaminant

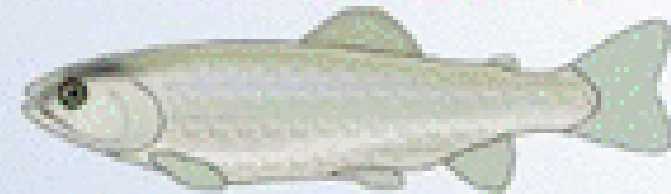
Rainbow trout: **sensitive**



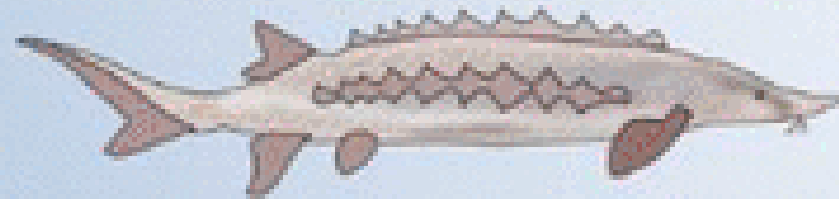
Brook trout: **sensitive**



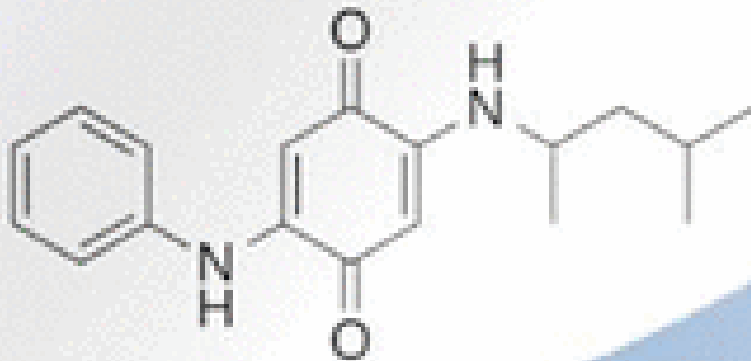
Arctic char: **tolerant**



White sturgeon: **tolerant**



6PPD-quinone

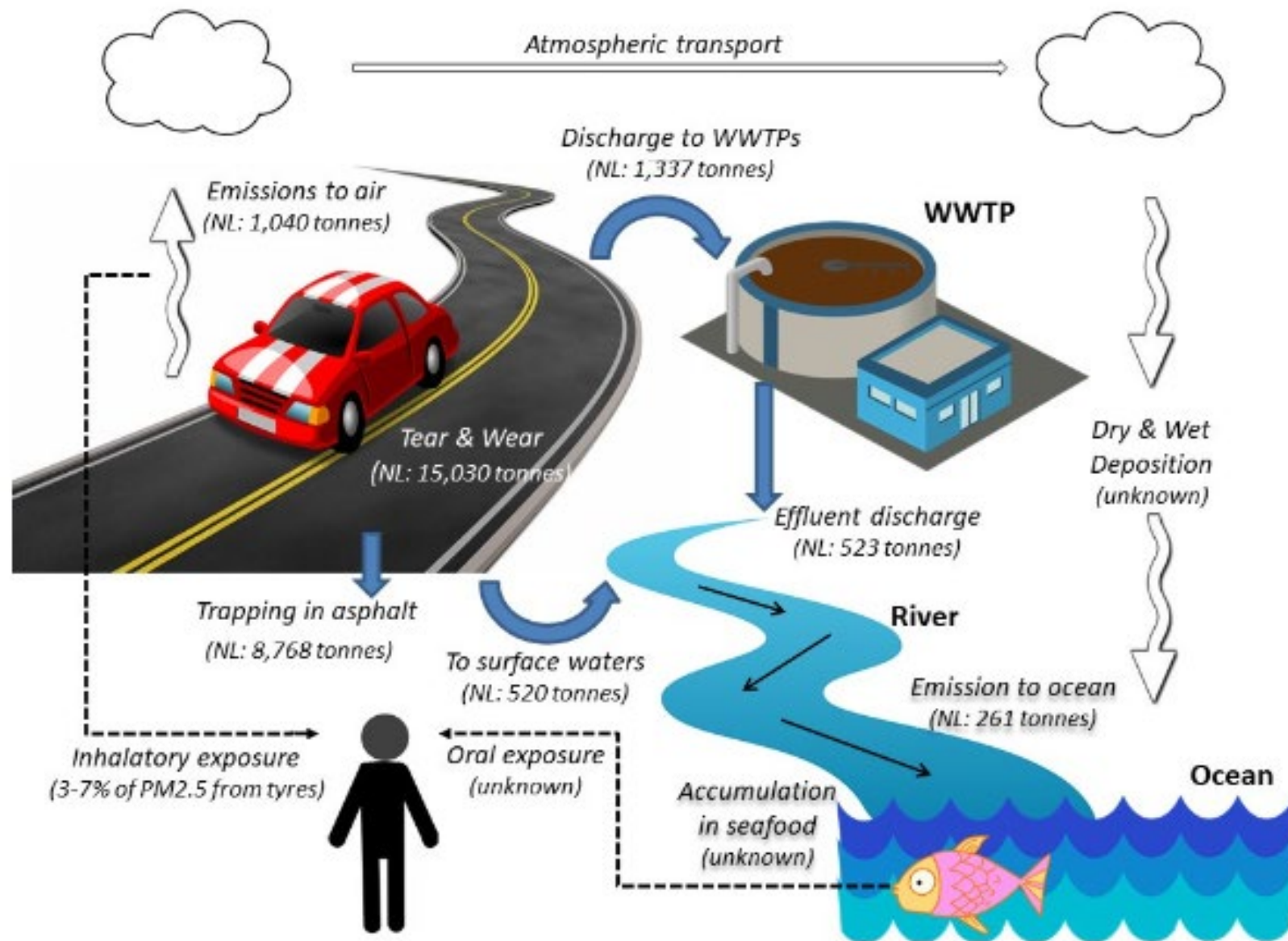


# ROAD RUNOFF

6PPD  
&  
6PPD – Q  
&  
Tire wear particles

Chemical Toxicity  
Considerations:

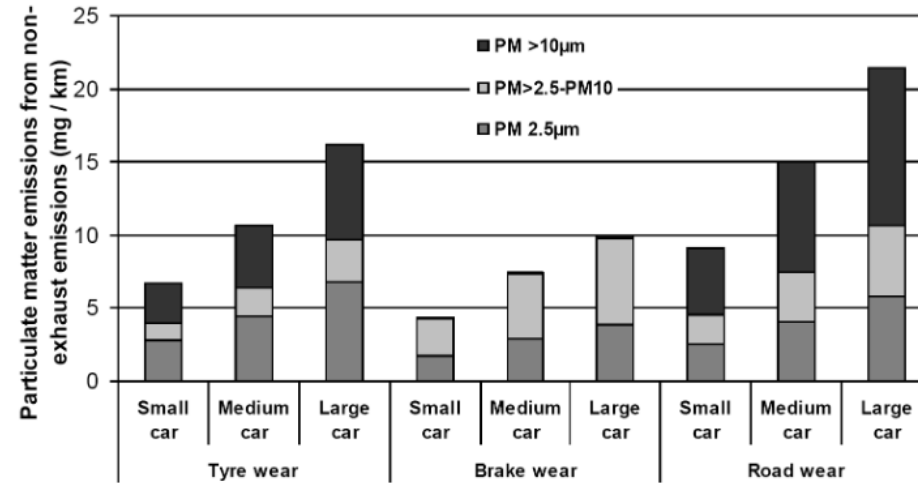
Acute - lethal  
&  
Chronic - sublethal



**Table 16.** Weight of Internal Combustion Engine (ICE)-cars compared to the electric version. The weight of the petrol car includes a half full tank.

Petrol Version	Weight [kg]	E-Version	Weight [kg]	Extra Weight E-Version
Volkswagen high Up! petrol	958	Volkswagen e-Up!	1114	16%
Volkswagen Golf 1.4 TSI	1205	Volkswagen E-Golf	1485	23%
Ford Focus	1380	Ford Focus Electric	1674	21%
Mercedes-Benz B 250	1465	Mercedes-Benz B 250 e	1725	18%

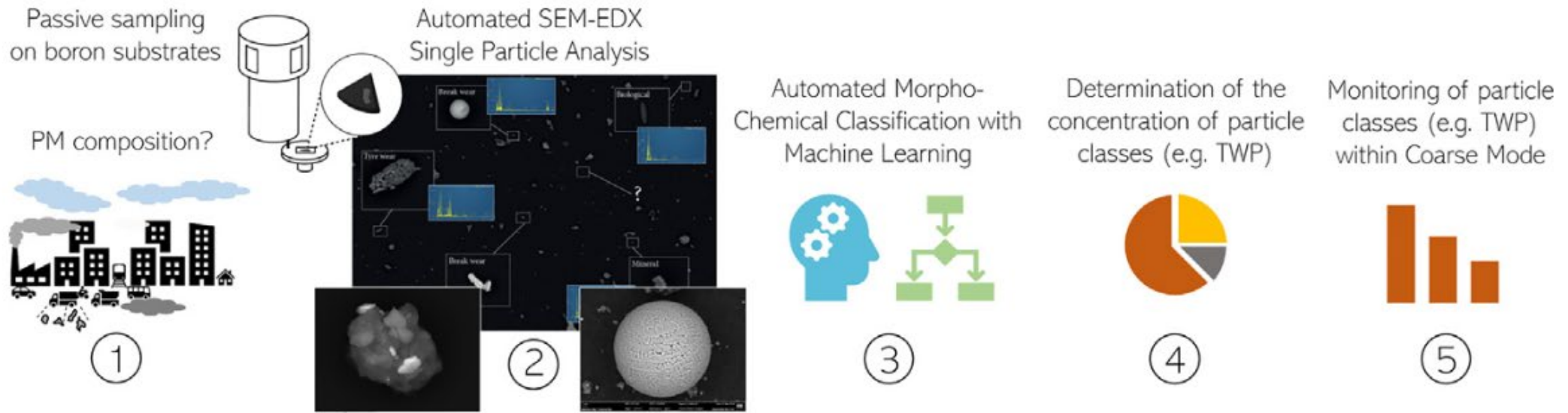
*Kole et al. 2017*



**Figure 4.** Non-exhaust particulate matter (PM) emissions by source and car size, from Simons [113] based on Ntziachristos and Boulter [117].

## Tire Wear Particle Loading & 6PPD – Quinone correlations

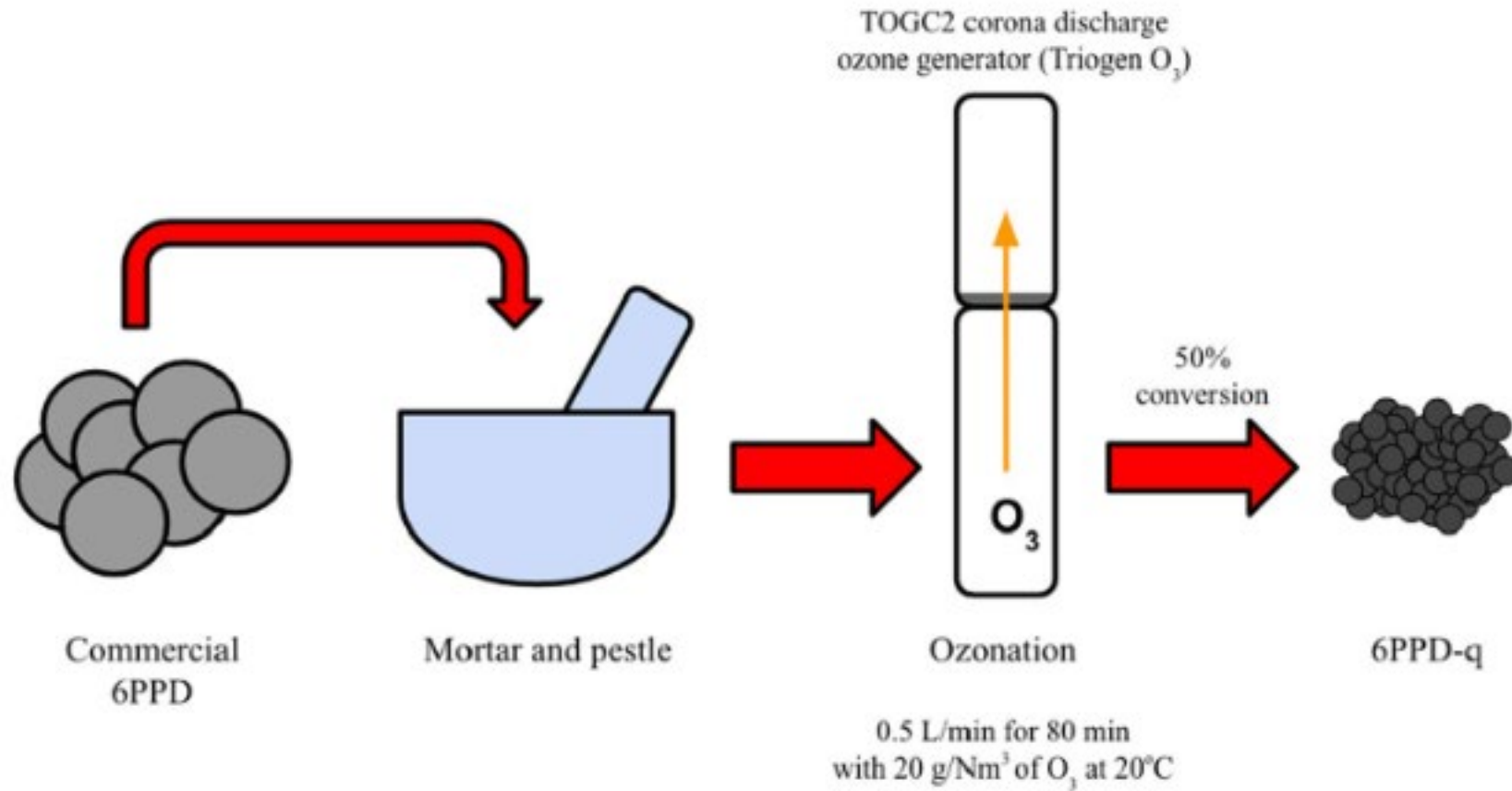
Further research and field inventories are needed to understand the scope and scale of the problem

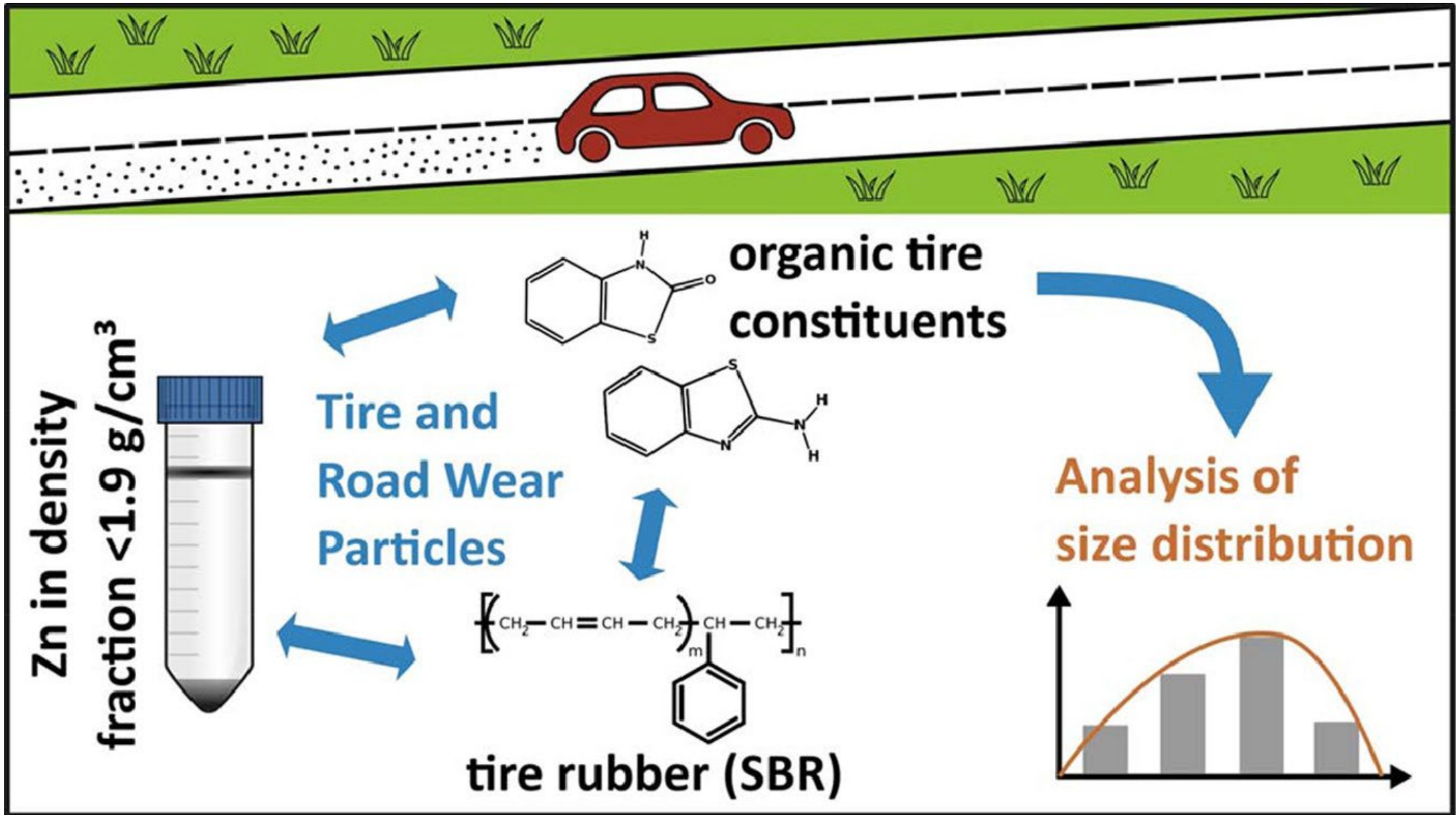


*Rausch et al. 2022*

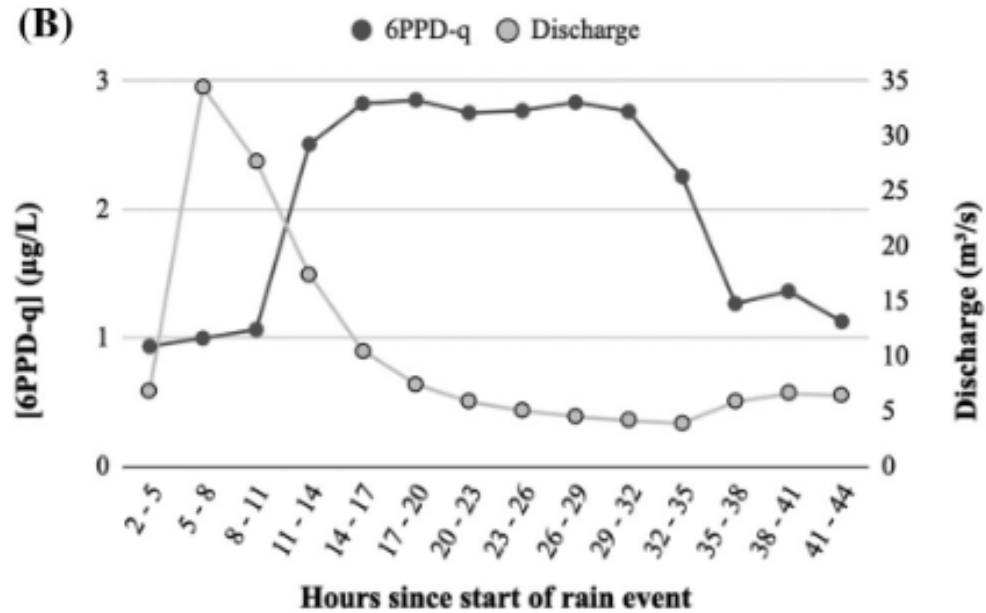
More research completed on Tire Wear Particles & Microplastic impacts, than tire chemicals

**Fig. 1** Schematic of the ozonation process for generating 6PPD-quinone (6PPD-q) by the oxidation of 6PPD



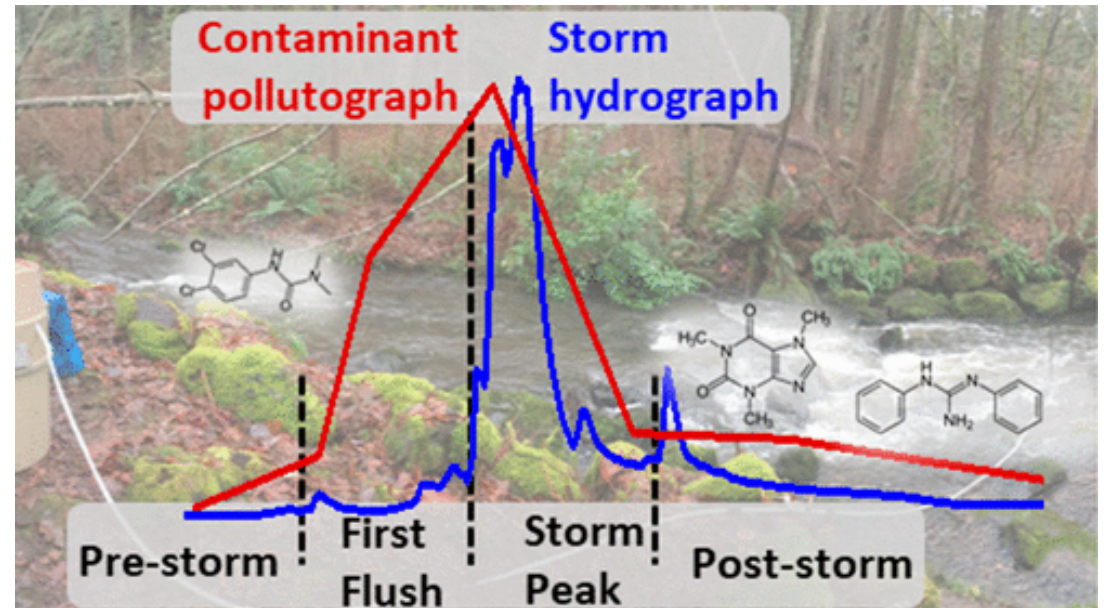






*Don River, Urban, Toronto, Canada*

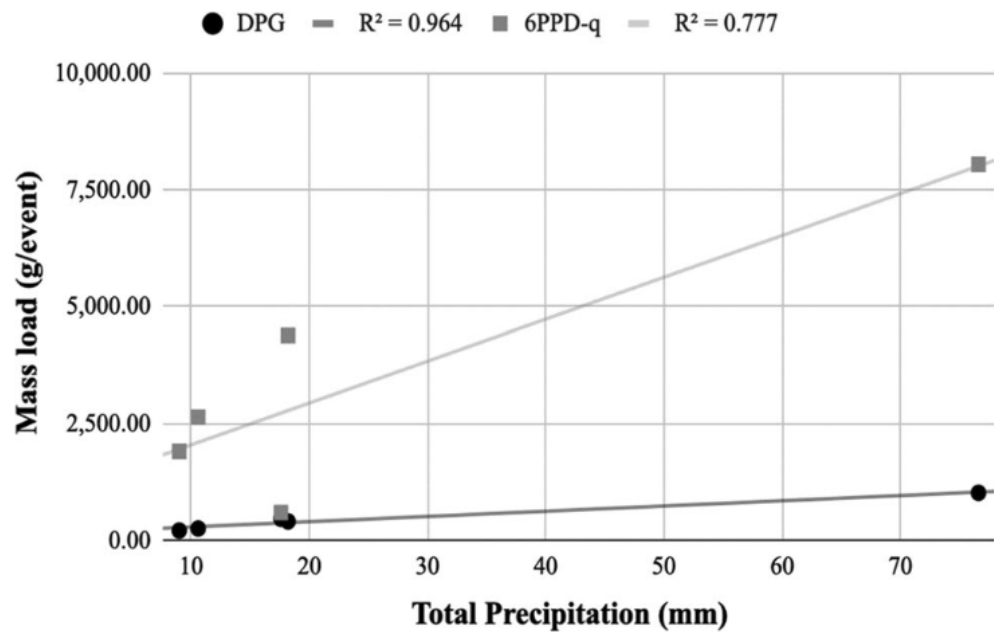
*Johannessen et al. 2022*



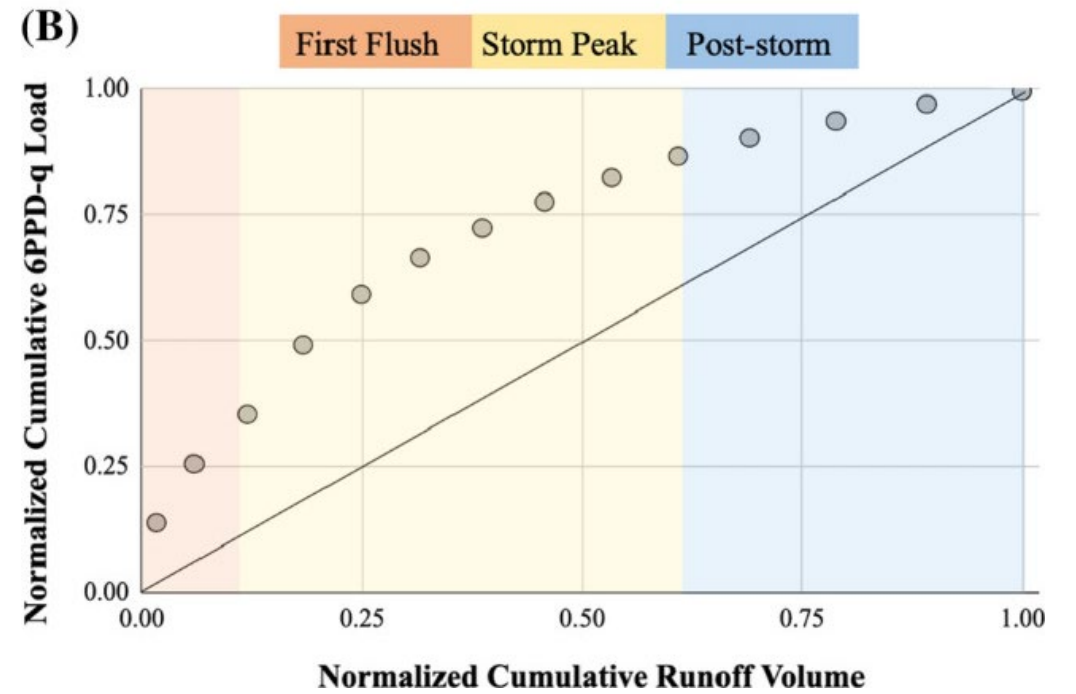
*Miller Creek, Urban, Puget Sound*

*Peter et al. 2021*

1. Is it really a first flush after dry periods problem, how much rain is needed to flush 6PPD-quinone? How long does it last in the environment?
2. What environmental variables drive 6PPD persistence?



**Fig. 3** Relationship between total precipitation and average ( $n=3$ ) mass loadings (g/event) of diphenyl guanidine (DPG, dark gray lines and circle symbols) and 6PPD-quinone (6PPD-q, light gray lines and square symbols) in the Don River during hydrological events in 2019 and 2020



*Don River, Urban, Toronto, Canada*

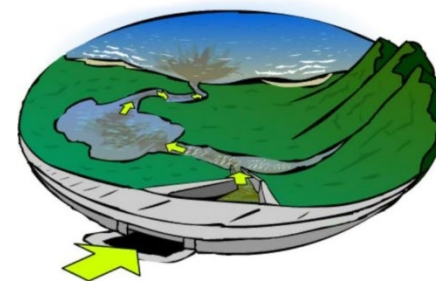
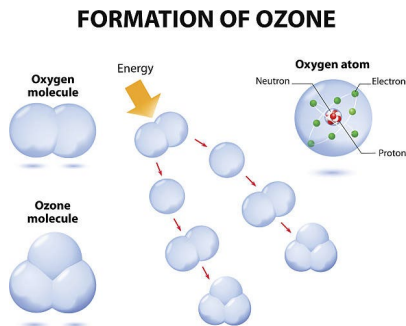
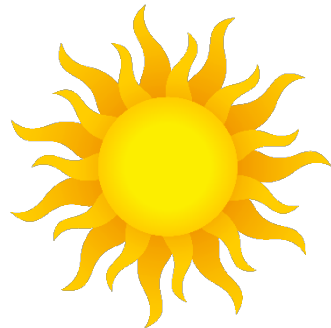
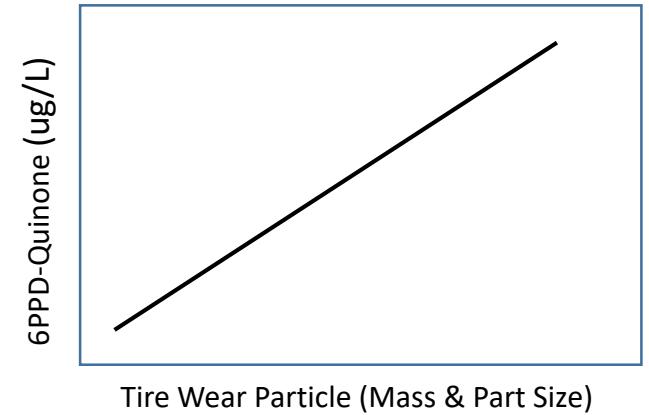
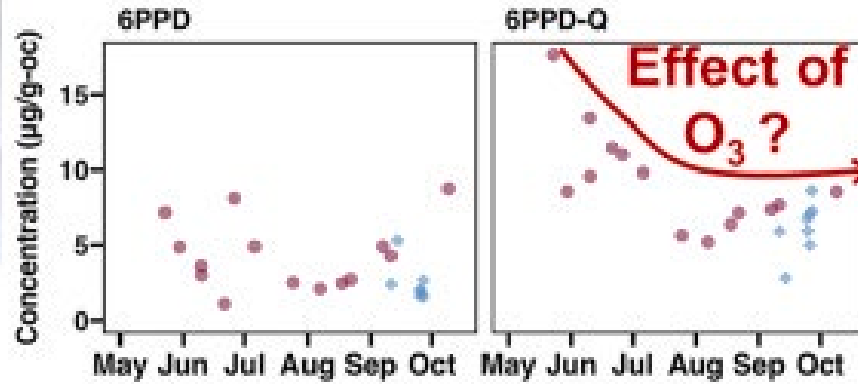
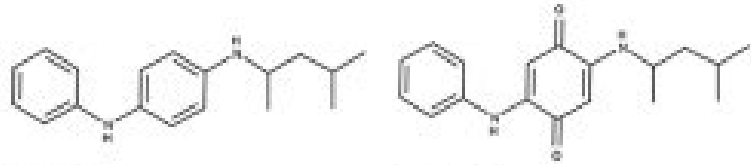
*Johannessen et al. 2022*



# Graphical abstract



Hiki et al. 2022



Tire Wear Particles



6PPD



6PPD - Quinone