

Microplastics in Stormwater Conceptual Models

Diana Lin

Kelly Moran, Ezra Miller, Miguel Mendez,
Shelly Moore, Rebecca Sutton



Microplastics in San Francisco Bay



Microplastic Stormwater Conceptual Models

- Tires
- Fibers, except cellulose acetate
- Cigarette filters
- Single-use plastic foodware



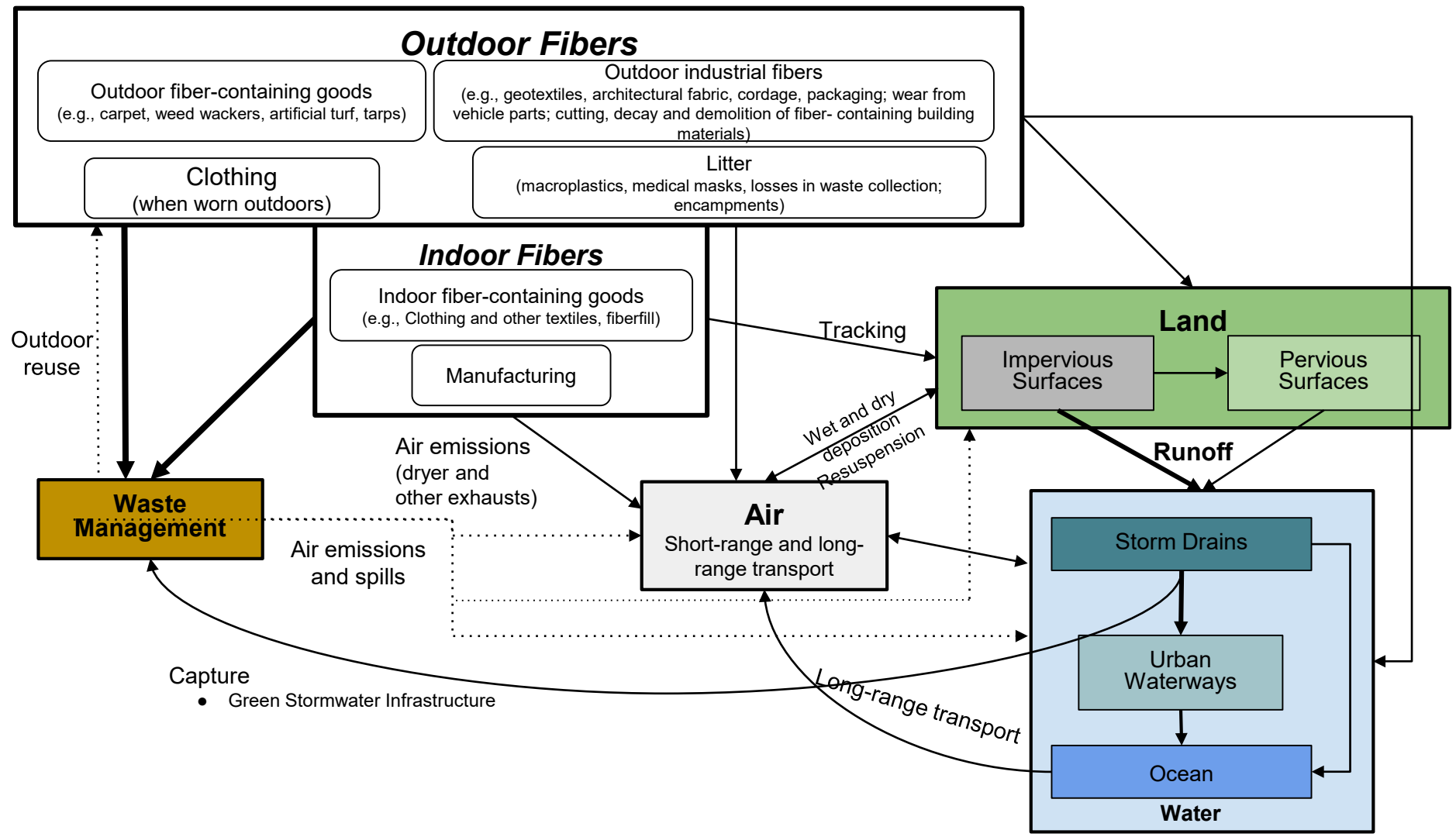
Image Credit: M. Eliot



Image Credit: Wikipedia



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Outdoor Fibers

Outdoor fiber-containing goods
(e.g., carpet, weed wackers, artificial turf, tarps)

Outdoor industrial fibers
(e.g., geotextiles, architectural fabric, cordage, packaging; wear from vehicle parts; cutting, decay and demolition of fiber-containing building materials)

Clothing
(when worn outdoors)

Litter
(macroplastics, medical masks, losses in waste collection; encampments)

Indoor Fibers

Indoor fiber-containing goods
(e.g., Clothing and other textiles, fiberfill)

Manufacturing

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Indoor Fibers

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Manufacturing

Air emissions
(dryer and other exhausts)

Air

Short-range and long-range transport

Land

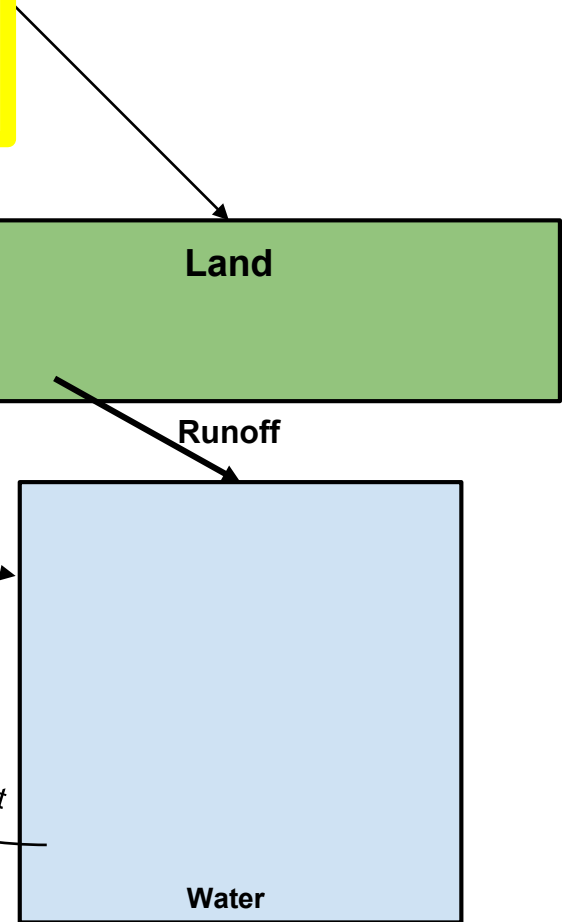
Runoff

Water

Tracking

Wet and dry deposition
resuspension

Long-range transport



Are USA-type dryers a significant fiber release pathway?

USA



Image Credit: Whirlpool

Most of
the world



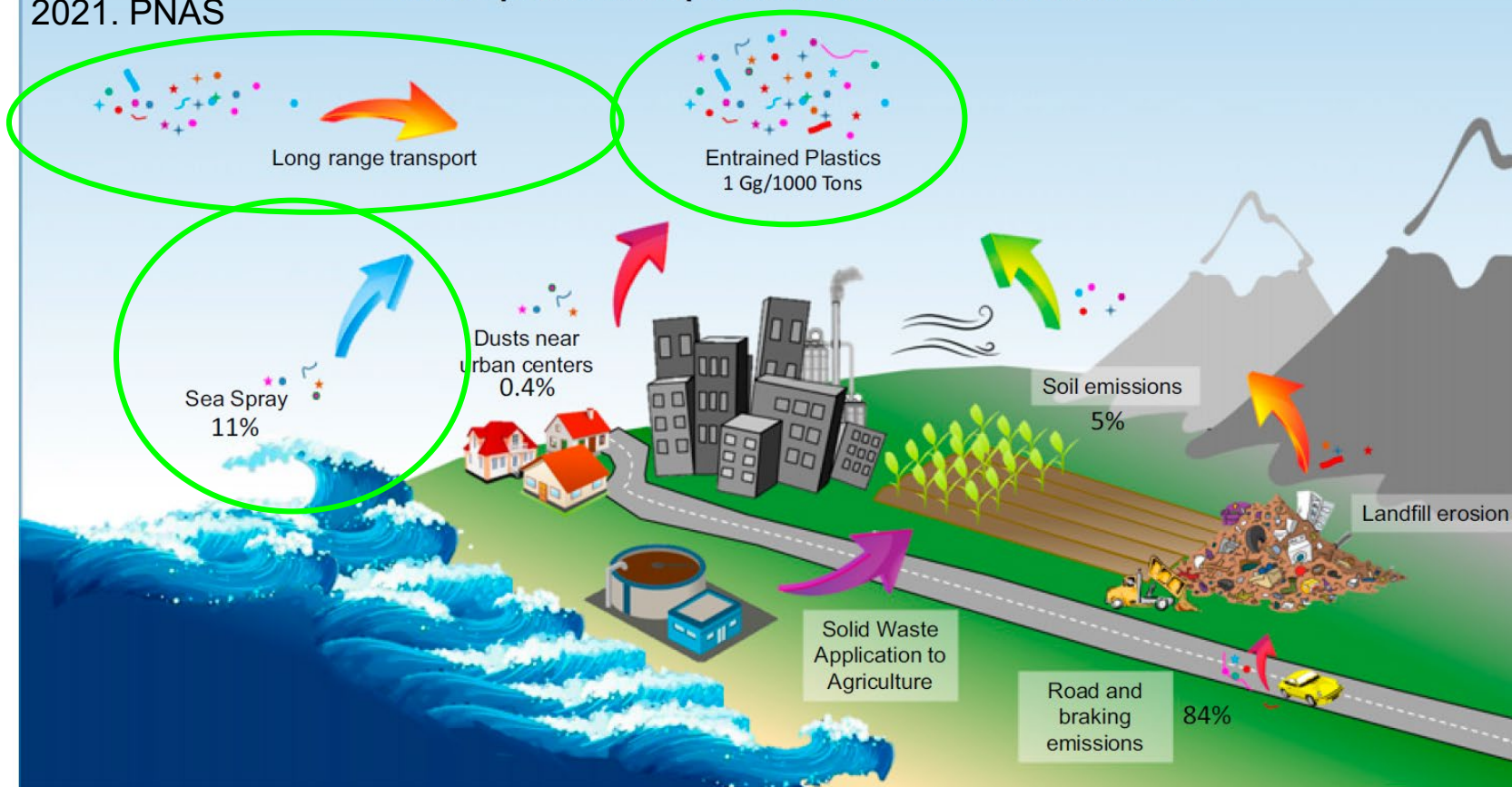
Image Credit: SONGMICS



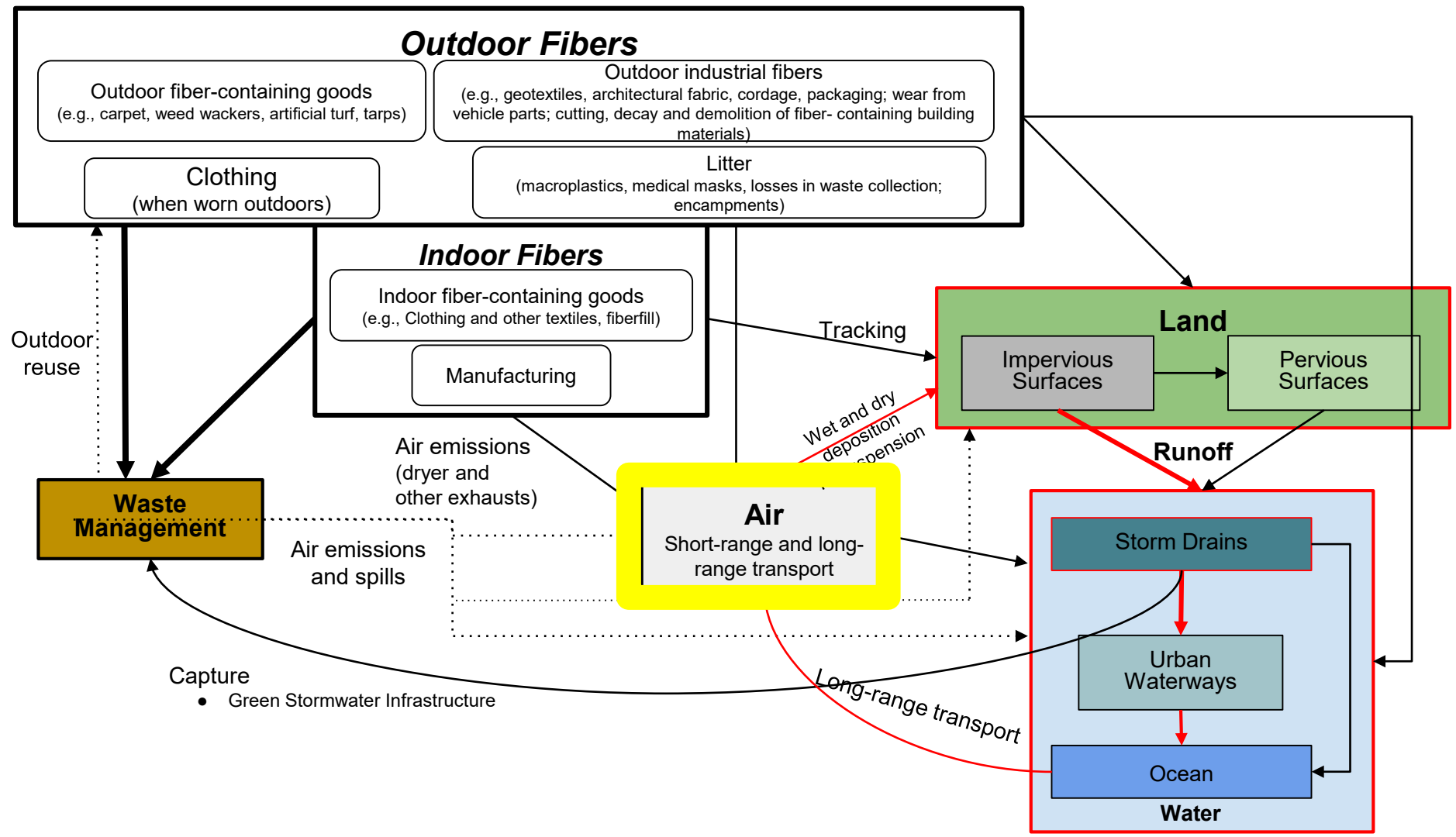
Image Credit: Lorien Fono

Brahney et al.,
2021. PNAS

Atmospheric Microplastic Sources to the Western USA



Are global and cumulative legacy pollution important local sources of microplastic pollution via long-range transport?



Cigarette Filters and Single-Use Plastic Foodware



Image Credit: Wikipedia



Image Credit: M. Eliot



Microplastics carry chemicals into the environment

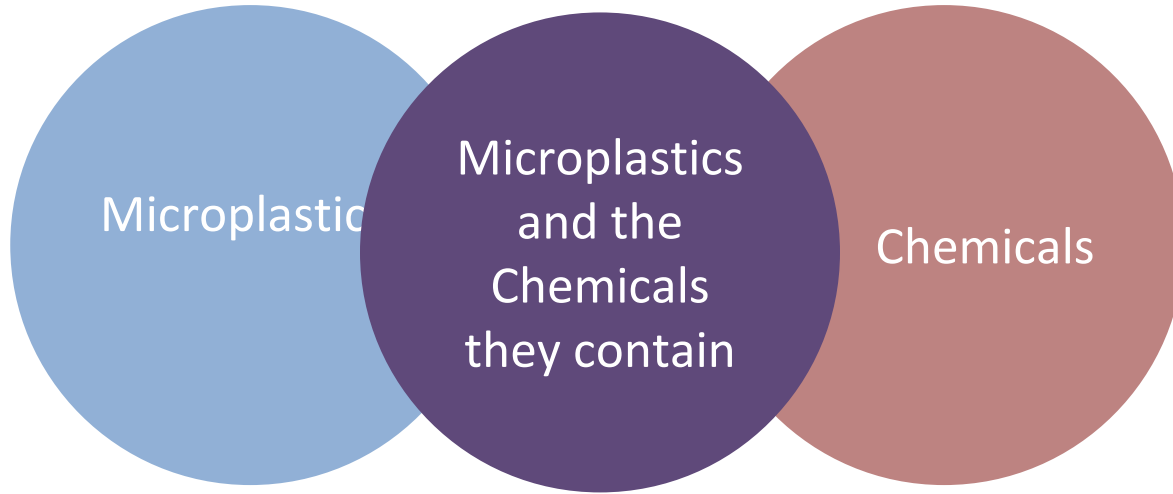


Image Credit: M. Eliot

Wikipedia

Prevention

Remove
toxic/persistent
ingredients or
products



Reduce
environmental
release



Collect and
remove debris
from roads and
runoff



Remediation

Prevention

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Remediation

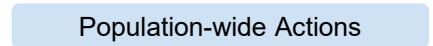
Key:



Industry



Government Action



Population-wide Actions

Prevention

Remove toxic/persistent ingredients or products

- Cigarette redesign:
 - Remove filters
 - Re-formulate filters
 - Implement filter take-back programs
 - Change so can be extinguished without mechanical force

Legislative and local bans on sales of (filtered) cigarettes

- Decrease smoking incidence:
 - Decrease social acceptability
 - Provide addiction treatment and support

Legislative and local smoking bans (e.g., on beaches or in public places)

Reduce environmental release

Additional labeling on cigarette packaging (voluntary or legislatively required)

- Make cigarettes less affordable/economical
 - Taxes and/or fees
 - Set minimum prices
 - Prohibit redemption of coupons or discounts
- Establish hazmat standards for sellers
- Set businesses responsible for waste
- Fines for violating bans

- Increase proper butt disposal:
 - Educate smokers about butt toxicity/persistence
 - Make proper disposal easier by increasing availability of bins and providing smokers with portable ashtrays
 - Reduce other urban litter

Collect and remove debris from roads and runoff



Implement deposit/return programs

Street sweeping

Trash capture devices

- Improved runoff treatment (green infrastructure):
 - Porous pavement (without plastic fiber modifiers)
 - Bioretention runoff treatment
 - Runoff infiltration (if determined safe)

- Increase cleanup frequency and efficacy of trash collection campaigns

Remediation

Key:

- Tobacco Manufacturer Action
- Government Action
- Population-wide Actions

Already Widely Implemented

Novel/Not Widely Implemented

Prevention

Remove toxic/persistent ingredients or products

Product redesign:

- Remove toxic ingredients in manufacturing and final products (e.g. DTSC safer consumer products regulations)
- Re-design products to reduce waste and litter



Reduce environmental release



Collect and remove debris from roads and runoff

Remediation

Key:

Industry

Government Action

Population-wide Actions

Prevention

Remove toxic/persistent ingredients or products

Reduce environmental release

Collect and remove debris from roads and runoff

Remediation

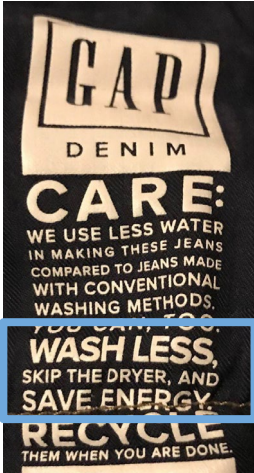
Labeling and public education about fiber pollution and how to minimize through proper material care

Provide economic incentives to switch to condenser dryers

Remove legal barriers to using outdoor clothes lines

Reduce use of traditional dryers vented outdoors

- Reduce overall washing frequency
- Switch to unvented condenser dryers
- Hang textiles to dry



Key:

Industry	Government Action	Population-wide Actions
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Prevention

Remove toxic/persistent ingredients or products



Reduce environmental release



Collect and remove debris from roads and runoff



Install wear debris collection systems on vehicles



Image: Tyre Collective

Remediation

Key:

Industry

Government Action

Population-wide Actions

Prevention

Remove toxic/persistent ingredients or products

Reduce environmental release

Collect and remove debris from roads and runoff

Remediation



Improved runoff treatment (green infrastructure):

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Key:

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Novel/Not Widely Implemented

Final Report

- Available end of October at www.sfei.org/projects/microplastics



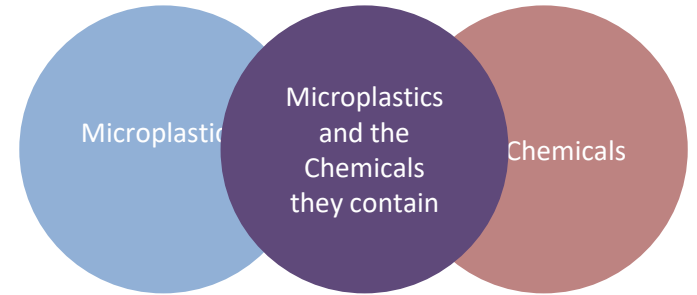
Final Report - Key Themes

- Available end of October at www.sfei.org/projects/microplastics
- Air transport is a major data gap



Final Report - Key Themes

- Available end of October at www.sfei.org/projects/microplastics
- Air transport is a major data gap
- Chemical ingredients in microplastics are important



Final Report - Key Themes

- Available end of October at www.sfei.org/projects/microplastics
- Air transport is a major data gap
- Chemical ingredients in microplastics are important
- Broad spectrum of potential mitigation options

Industry

Government

Community

