DEPARTMENT OF ECOLOGY
State of Washington

Step-by-Step Pathways of Exposure for Priority Chemicals

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Publication Information

This document is available on the Department of Ecology's website at:
https://apps.ecology.wa.gov/publications/summarypages/2504037.html

This document contains written explanations of the **exposure pathway figures** from the Safer Products for Washington cycle 2, phase 2 Technical Supporting Documentation for Priority Products[1] report. These descriptions aim to accurately reflect the science behind each exposure pathway and chemical release, while also making the information easier to understand.

These figure descriptions appear in the same order as in the report.

View our Report Identification of Priority Chemicals Report to the Legislature[2] for additional information.

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1 https://apps.ecology.wa.gov/publications/summarypages/2504031.html
2 https://apps.ecology.wa.gov/publications/summarypages/2504030.html

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PFAS in Artificial Turf

1. Introduction and Use in Turf

Exposure to **PFAS in artificial turf** may occur during the **product manufacturing, installation, and maintenance** phase.

PFAS are used to manufacture grass blades and are found in artificial turf.

2. Field Use

After artificial turf is installed, PFAS can be released by:

- **Product wear** and **breakdown**.
- **Stormwater runoff**.
- These processes may result in **environmental releases of PFAS** during field use, leading to potential exposure in sensitive species and people.

3. Field Removal & Disposal

When artificial turf is removed, the **disposal** phase begins. This stage can further introduce PFAS into the environment if not properly handled.

4. Outdoor Environment

PFAS are persistent in the environment and do not break down completely.

PFAS released to the **outdoor environment** enter:

- **Water** (for example, streams, lakes, stormwater systems).
- **Soil**.
- **Sediments** in bodies of water.

5. Impact on Sensitive Species

PFAS are toxic and bioaccumulate in sensitive species, including:

- **Aquatic (water-based) organisms**.
- **Livestock and game animals**.

6. Human Exposure

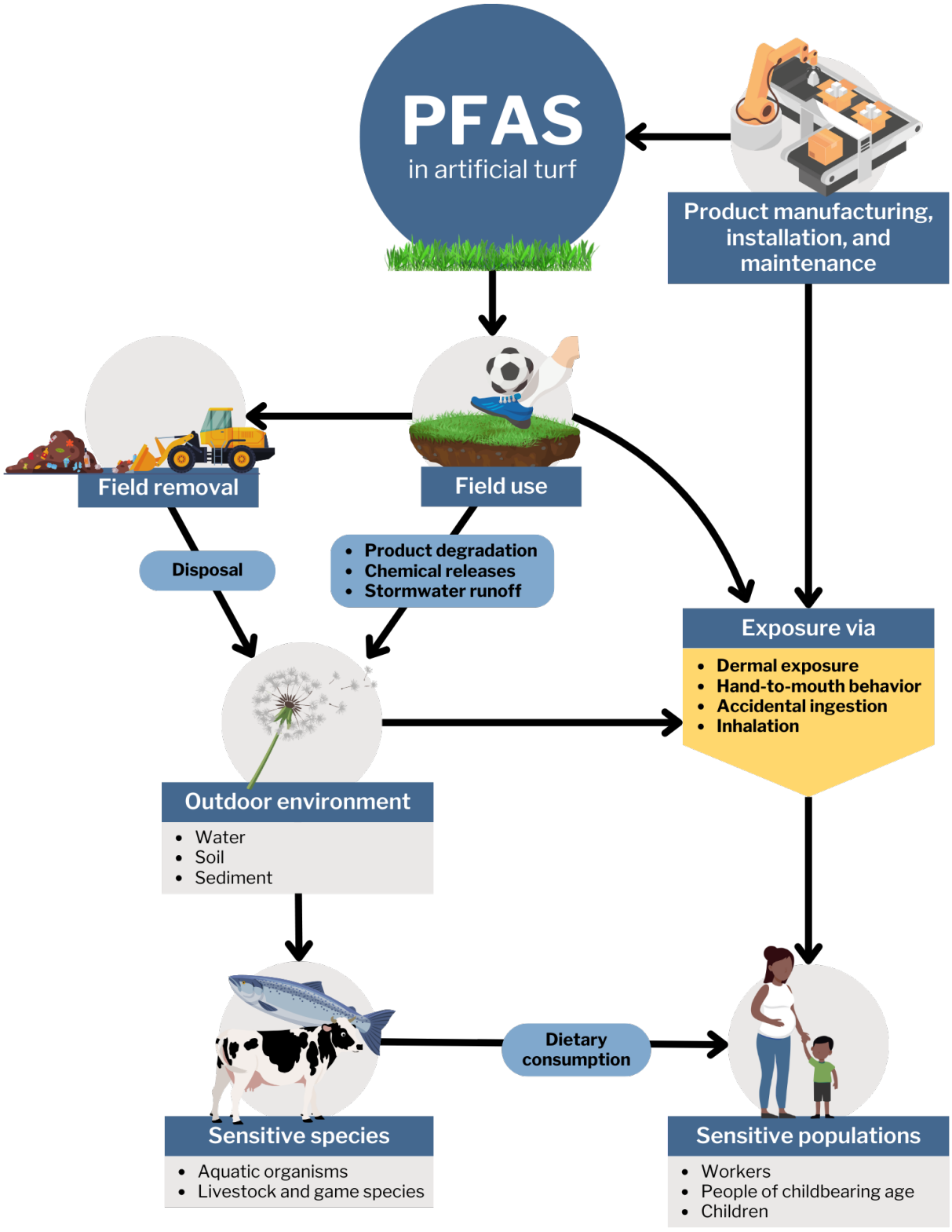
Humans may also be exposed to PFAS through:

- **Dermal (skin) contact**.
- **Hand-to-mouth behavior**.
- **Accidental ingestion** of turf particles.
- **Eating** contaminated species or **drinking** contaminated water.

7. Sensitive Populations

This exposure is a concern for:

- **Workers**.
- **People of childbearing age**.
- **Children**.


PFAS
in artificial turf
Product manufacturing, installation, and maintenance
Field removal
Field use
Disposal
Product degradation
Chemical releases
Stormwater runoff
Exposure via
Dermal exposure
Hand-to-mouth behavior
Accidental ingestion
Inhalation
Outdoor environment
Water
Soil
Sediment
Dietary consumption
Sensitive species
Aquatic organisms
Livestock and game species
Sensitive populations
Workers
People of childbearing age
Children

6PPD in Artificial Turf

1. Introduction and Use in Turf

Exposure to **6PPD in artificial turf** may occur during the **product manufacturing, installation, and maintenance** phases.

6PPD is found in crumb rubber used to make infill for artificial turf.

2. Field Use

After artificial turf is installed, 6PPD can be released by:

- **Product wear** and **breakdown**.
- **Stormwater runoff**.
- These processes result in **environmental releases of 6PPD and its breakdown products** during field use, leading to potential exposures in sensitive species and people.

3. Field Removal & Disposal

When artificial turf is removed, the **disposal** phase begins. This stage can further introduce 6PPD into the environment if not properly handled.

4. Outdoor Environment

Released chemicals enter the **outdoor environment** through:

- **Water** (for example, streams, lakes, stormwater systems).
- **Outdoor dust** (for example, small particles carried by wind or settling in soil).

5. Impact on Sensitive Species

6PPD and its breakdown products, such as 6PPDQ, affect sensitive species, including:

- **Coho salmon** and other fish species.
- **Bioaccumulative species** (species that accumulate chemicals from their environment) like shrimp.

6. Human Exposure

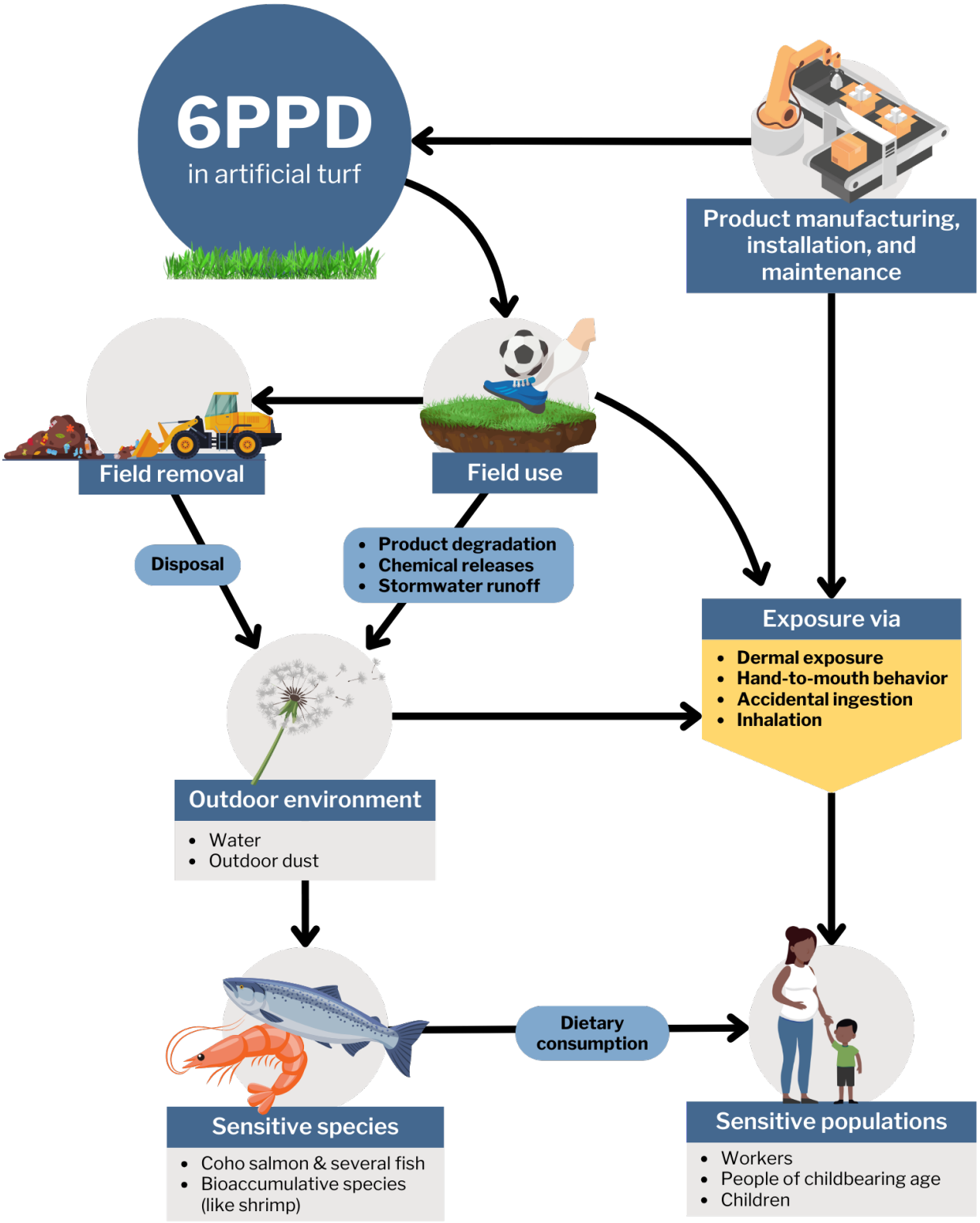
Humans may also be exposed to 6PPD through:

- **Dermal (skin) contact**.
- **Hand-to-mouth behavior**.
- **Accidental ingestion** of turf particles.
- **Inhalation** of turf particles.
- **Eating** contaminated species or **drinking** contaminated water.

7. Sensitive Populations

This exposure is a concern for:

- **Workers**.
- **People of childbearing age**.
- **Children**.


6PPD
in artificial turf
Product manufacturing, installation, and maintenance
Field removal
Field use
Disposal
Product degradation
Chemical releases
Stormwater runoff
Exposure via
Dermal exposure
Hand-to-mouth behavior
Accidental ingestion
Inhalation
Outdoor environment
Water
Outdoor dust
Dietary consumption
Sensitive species
Coho salmon & several fish
Bioaccumulative species (like shrimp)
Sensitive populations
Workers
People of childbearing age
Children

cVMS in Cosmetics

1. Introduction and Use in Cosmetics

Exposure to **cVMS in cosmetics** may occur in the **product manufacturing phase** or during **product use**.

cVMS are used to provide a smoother feel to cosmetics.

2. Use and Disposal of Products

cVMS can enter the environment during **product use** and **waste disposal**.

- Exposures occur when cosmetics are **sprayed in the air** or **applied to hair or skin**.
- Disposed products found in **landfills** and **wastewater** can lead to environmental releases.

3. Chemical Releases from Products

As cVMS are released in air, they contaminate **outdoor** and **indoor environments**.

- cVMS are released to **outdoor environments** through **air and water** and **can accumulate in sediment** (bodies of water) and **soil**.
- cVMS are released to **indoor environments** in **air** and build up in **dust**.

4. Impact on Sensitive Species

cVMS may impact sensitive species including:

- **Aquatic (water-based) organisms** like rainbow trout.
- **Bioaccumulative species** (species that accumulate chemicals from their environment) like benthic organisms that live in or near sediment.

5. Human Exposure

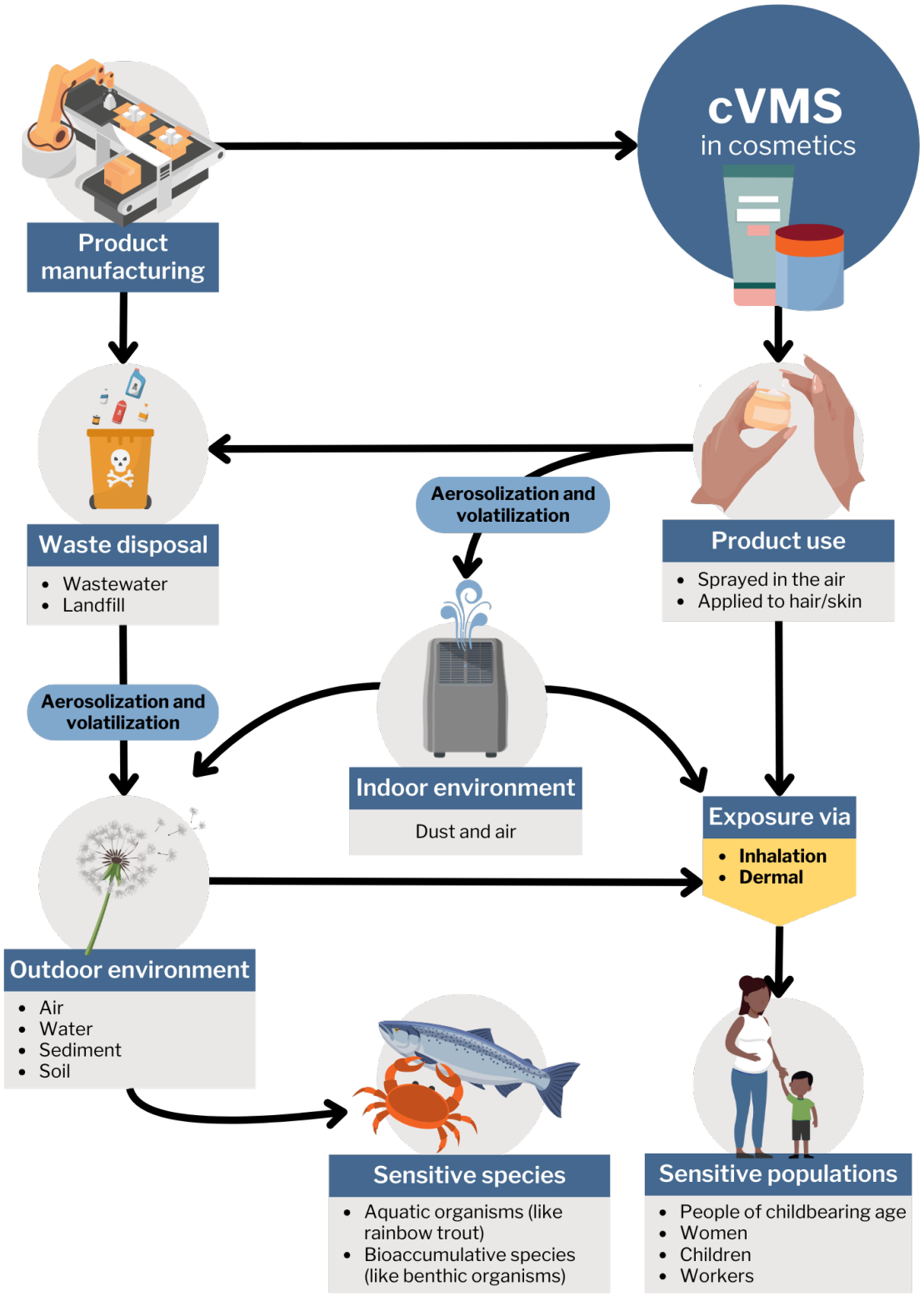
Humans may also be exposed to cVMS through:

- **Inhalation**.
- **Dermal (skin) contact**.

6. Sensitive Populations

This exposure is a concern for:

- **People of childbearing age**.
- **Women**.
- **Children**.
- **Workers**.


cVMS
in cosmetics
Product manufacturing
Waste disposal
• Wastewater
• Landfill
Aerosolization and volatilization
Aerosolization and volatilization
Product use
• Sprayed in the air
• Applied to hair/skin
Indoor environment
Dust and air
Exposure via
• Inhalation
• Dermal
Outdoor environment
• Air
• Water
• Sediment
• Soil
Sensitive species
• Aquatic organisms (like rainbow trout)
• Bioaccumulative species (like benthic organisms)
Sensitive populations
• People of childbearing age
• Women
• Children
• Workers

OFRs in Insulation

1. Introduction

Exposure to **OFRs in insulation** may occur during the **product manufacturing, installation**, and **demolition** phases.

OFRs are found in insulation and are used as **flame retardants**.

2. Use and Disposal of Insulation

During and after insulation is installed, OFRs can be released through:

- **Product installation and use** leading to **indoor air releases** and **dust buildup**.
- **Dust tracked outdoors** or **released to wastewater**.
- **Demolition** of buildings and **disposal** of materials.

3. Outdoor Environment

If not properly handled, OFRs released to the environment can contaminate:

- **Air**.
- **Water**.
- **Soil**.
- **Sediment**.

4. Impact on Sensitive Species

OFRs are toxic to **sensitive species**, including:

- **Aquatic (water-based) organisms**.
- **Bioaccumulative species** (species that accumulate chemicals from their environment) like birds.

5. Human Exposure

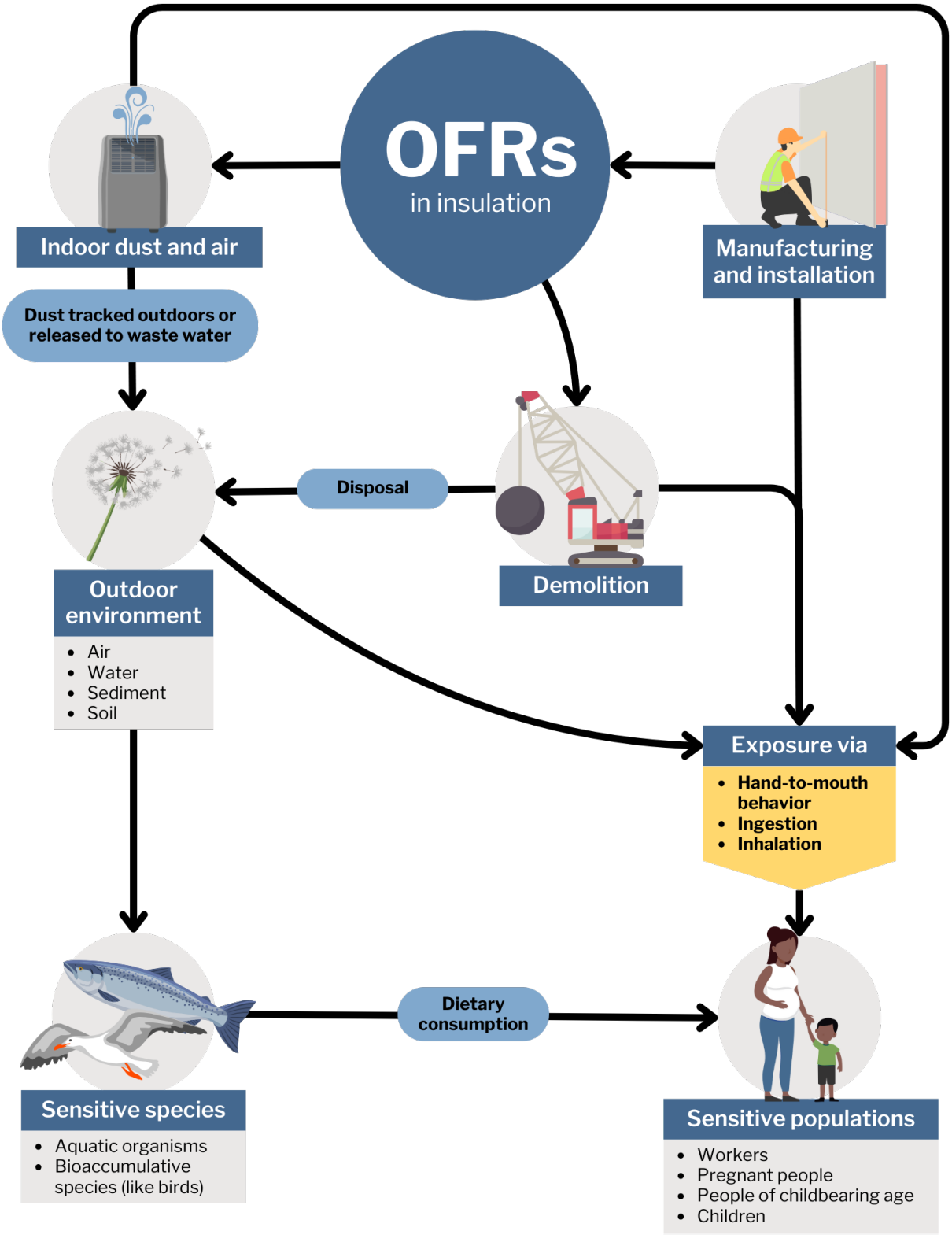
Humans may be exposed to OFRs through:

- **Dermal (skin) contact**.
- **Accidental ingestion**.
- **Inhalation**.
- **Eating** contaminated species or **drinking** contaminated water.

6. Sensitive Populations

This exposure is a concern for:

- **Workers**.
- **Pregnant people**.
- **People of childbearing age**.
- **Children**.


OFRs
in insulation
Indoor dust and air
Dust tracked outdoors or released to waste water
Manufacturing and installation
Disposal
Demolition
Outdoor environment
Air
Water
Sediment
Soil
Exposure via
Hand-to-mouth behavior
Ingestion
Inhalation
Dietary consumption
Sensitive species
Aquatic organisms
Bioaccumulative species (like birds)
Sensitive populations
Workers
Pregnant people
People of childbearing age
Children

Lead and Cadmium in Jewelry and Accessories

1. Introduction and Use

Exposure to **lead and cadmium in jewelry and accessories** may occur during **product manufacturing** and **product use**.

Lead and cadmium are used to connect pieces together, as well as make pieces shinier and heavier.

2. Product Use

When jewelry and accessories with lead and cadmium are handled, human exposures can occur.

3. Waste Disposal and Outdoor Environment

When jewelry and accessories are disposed of, lead and cadmium can release into **wastewater** and **landfills**. Over time, these chemicals can enter the environment and contaminate:

- **Water**.
- **Sediment**.
- **Soil**.

4. Impact on Sensitive Species

Lead and cadmium are toxic to **sensitive species**, including:

- **Forage fish**.
- **Salmon**.
- **Orcas**.
- **Wild birds**.

5. Human Exposure

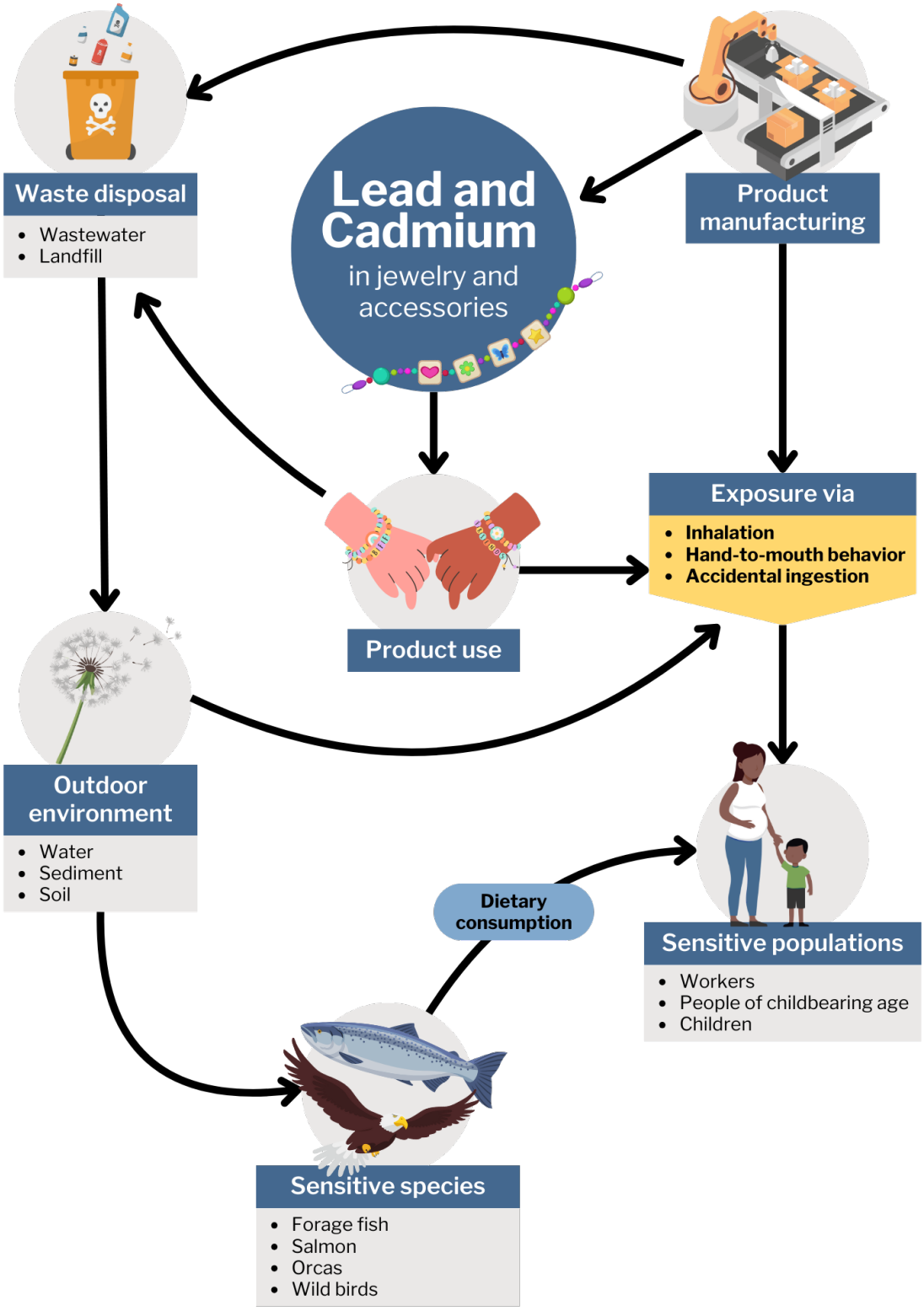
Humans can be exposed to lead and cadmium through:

- **Inhalation** (for example, **breathing** of fumes when making products).
- **Hand-to-mouth behavior**.
- **Accidental ingestion**.
- **Eating** contaminated species or **drinking** contaminated water.

6. Sensitive Populations

This exposure is especially concerning for:

- **Children**.
- **People of childbearing age**.
- **Workers**.


Lead and Cadmium
in jewelry and accessories
Waste disposal
Wastewater
Landfill
Product manufacturing
Product use
Exposure via
Inhalation
Hand-to-mouth behavior
Accidental ingestion
Outdoor environment
Water
Sediment
Soil
Dietary consumption
Sensitive populations
Workers
People of childbearing age
Children
Sensitive species
Forage fish
Salmon
Orcas
Wild birds

BTEX in Nail Products

1. Introduction and Use

Exposure to **BTEX in nail products** may occur during **product manufacturing** and **product use**.

BTEX help with even color distribution and quicker drying applications.

2. Product Use

Exposures to BTEX occur when nail products are applied at **salons** or for **personal use**.

3. Waste Disposal and Outdoor Environment

BTEX can be released into **wastewater** and **landfills** when nail products are disposed of.

4. Human Exposure

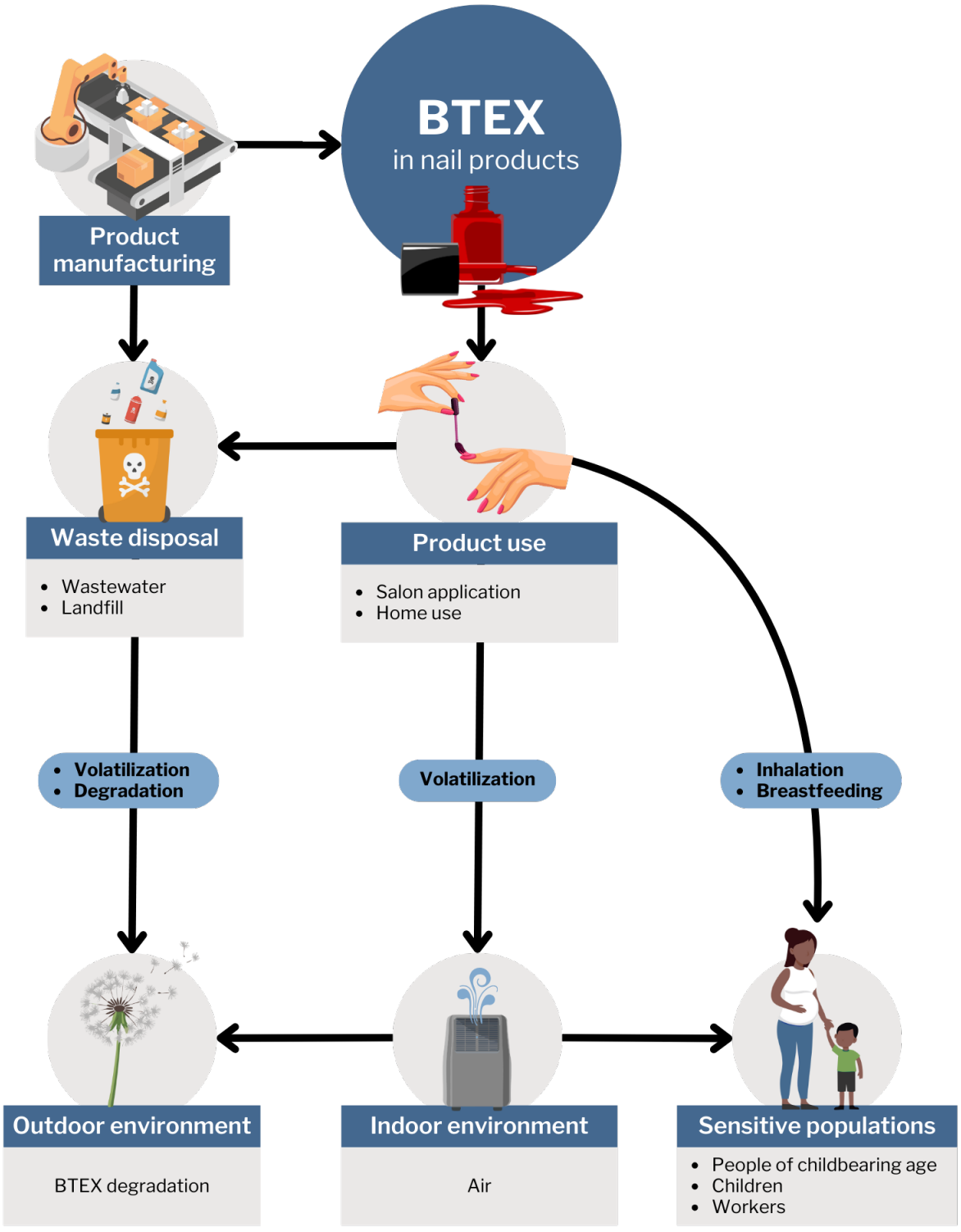
Humans can be exposed to BTEX through:

- **Inhalation** of fumes during product application.
- **Breastfeeding** children who may be indirectly exposed.

5. Sensitive Populations

This exposure is a concern for:

- **People of childbearing age**.
- **Children**.
- **Workers**.


BTEX
in nail products
Product manufacturing
Waste disposal
Wastewater
Landfill
Product use
Salon application
Home use
Volatilization
Degradation
Volatilization
Inhalation
Breastfeeding
Outdoor environment
BTEX degradation
Indoor environment
Air
Sensitive populations
People of childbearing age
Children
Workers

PFAS in Architectural Paints

1. Introduction and Use in Architectural Paints

Exposure to **PFAS in architectural paints** may occur during **product manufacturing** and **product use**.

PFAS are used to improve paint distribution and durability during product use.

2. Product Use and Disposal

During and after use, PFAS can be released through:

- **Product use** leading to **indoor air releases** and **dust buildup**, as paint chips or chalks.
- **Outdoor air releases** when paint breaks down.
- **Washing** and **disposing** of brushes and paint products, contaminating **waterways**, **stormwater**, and **landfills**.

3. Outdoor Environment

PFAS are persistent in the environment and do not break down completely.

PFAS released to the **outdoor environment** enter:

- **Air**.
- **Water**.
- **Soil**.
- **Sediment**.

4. Impact on Sensitive Species

PFAS are toxic and bioaccumulate in **sensitive species**, including:

- **Aquatic (water-based) organisms**.
- **Livestock and game animals**.

5. Human Exposure

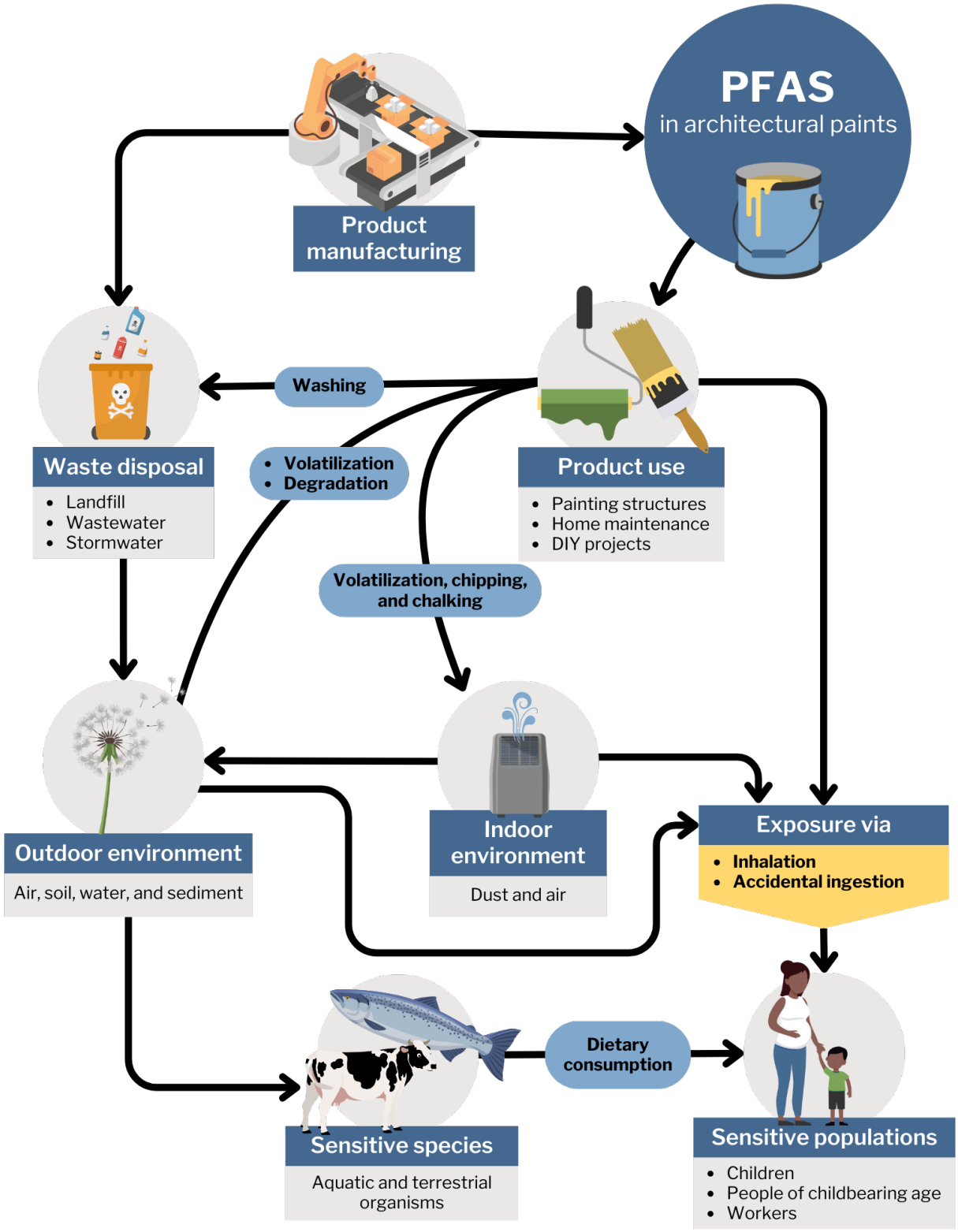
Humans can be exposed to PFAS through:

- **Inhalation** (for example, **breathing** in fumes).
- **Accidental ingestion**.
- **Dermal (skin) contact**.
- **Dietary consumption** of contaminated species.

6. Sensitive Populations

This exposure is especially concerning for:

- **Children**.
- **People of childbearing age**.
- **Workers**.


PFAS
in architectural paints
Product manufacturing
Washing
Waste disposal
Landfill
Wastewater
Stormwater
Volatilization
Degradation
Product use
Painting structures
Home maintenance
DIY projects
Volatilization, chipping, and chalking
Outdoor environment
Air, soil, water, and sediment
Indoor environment
Dust and air
Exposure via
Inhalation
Accidental ingestion
Dietary consumption
Sensitive species
Aquatic and terrestrial organisms
Sensitive populations
Children
People of childbearing age
Workers

APEs in Architectural Paints

1. Introduction and Use in Architectural Paints

Exposure to **APEs in architectural paints** may occur during **product manufacturing** and **product use**.

APEs are used to help paint spread evenly, mix well, and stay stable.

2. Product Use and Disposal

During and after use, APEs can be released through:

- **Product use** leading to **indoor air releases** and **dust buildup** due to paint chipping or chalking.
- **Outdoor air releases** when paint breaks down.
- **Washing** and **disposing** of paint products, leading to APEs entering **wastewater** and **landfills**.

3. Outdoor Environment

APEs released to the **outdoor environment** enter:

- **Air**.
- **Soil**.
- **Water**.

4. Impact on Sensitive Species

APEs and their breakdown products are toxic in **sensitive species**, including:

- **Aquatic (water-based) organisms**.
- **Livestock and game animals**.

5. Human Exposure

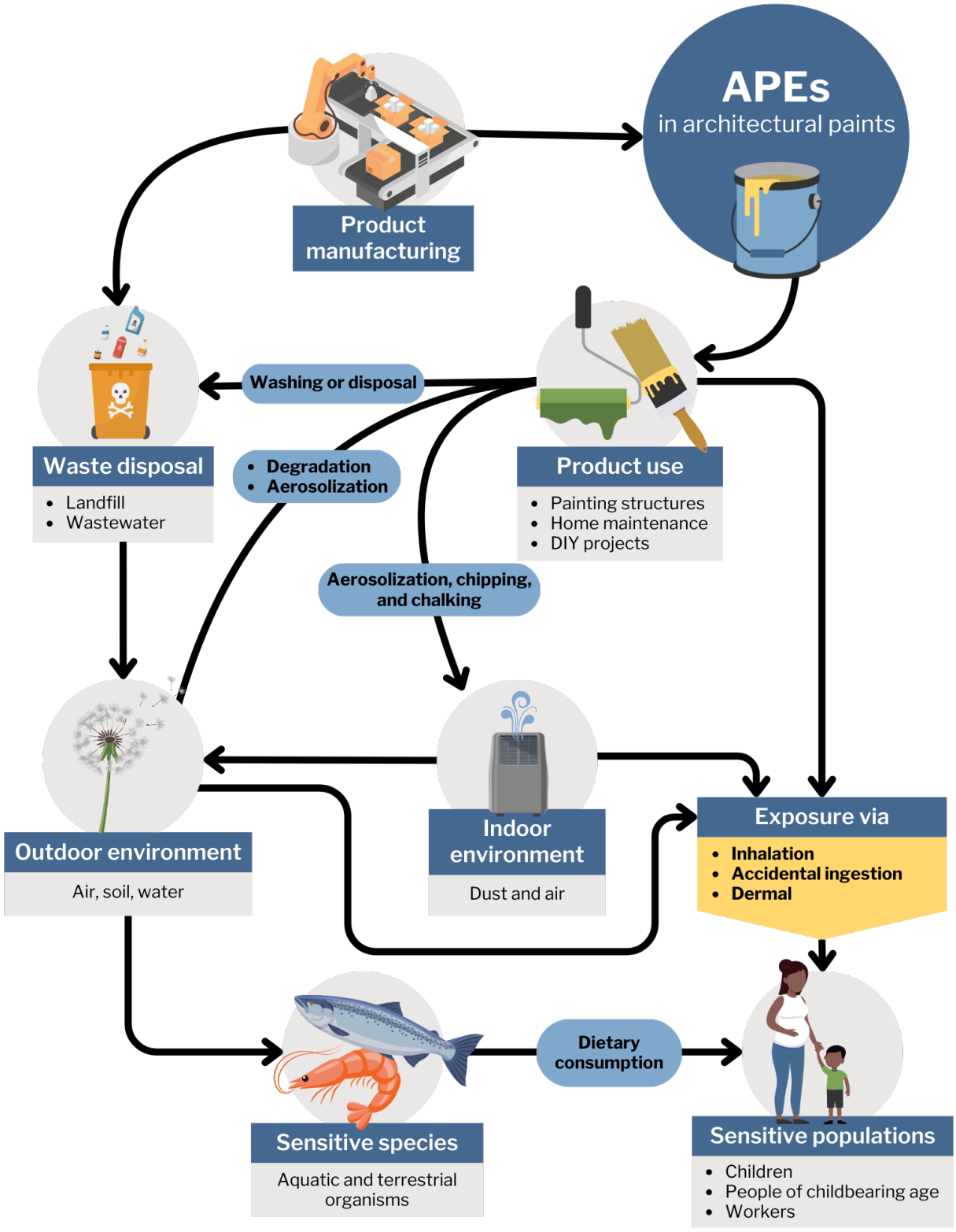
Humans may also be exposed to APEs through:

- **Inhalation**.
- **Accidental ingestion**.
- **Eating** contaminated species or **drinking** contaminated water.

6. Sensitive Populations

This exposure is especially concerning for:

- **Children**.
- **People of childbearing age**.


APEs
in architectural paints
Product manufacturing
Washing or disposal
Waste disposal
Landfill
Wastewater
Degradation
Aerosolization
Product use
Painting structures
Home maintenance
DIY projects
Aerosolization, chipping, and chalking
Outdoor environment
Air, soil, water
Indoor environment
Dust and air
Exposure via
Inhalation
Accidental ingestion
Dermal
Dietary consumption
Sensitive species
Aquatic and terrestrial organisms
Sensitive populations
Children
People of childbearing age
Workers

PVC and PVDC in Plastic Packaging

1. Introduction and Use in Plastic Packaging

Exposure to **PVC** and **PVDC in plastic packaging** may occur in the **product manufacturing phase** or during **product use**.

PVC and PVDC are used in packaging for **consumer goods**, **food and drink containers**, and **pharmaceuticals** to protect products.

2. Use and Disposal of Products

PVC and **PVDC** can enter the environment during **product use** and **waste disposal**.

- Exposures occur when plastic packaging breaks down into **microplastics in indoor air** and **dust**.
- Disposed products found in **landfills**, along with **incineration** and **illegal burning** can lead to environmental releases.

3. Outdoor Environment

As PVC and PVDC are released, they contaminate **outdoor environments** in the form of:

- **Microplastics**.
- **Dioxins** when burned.
- **Additives**.

4. Impact on Sensitive Species

PVC and PVDC may impact sensitive species including:

- **Aquatic (water-based) organisms** like fish.
- **Terrestrial (land-based) organisms**.

5. Human Exposure

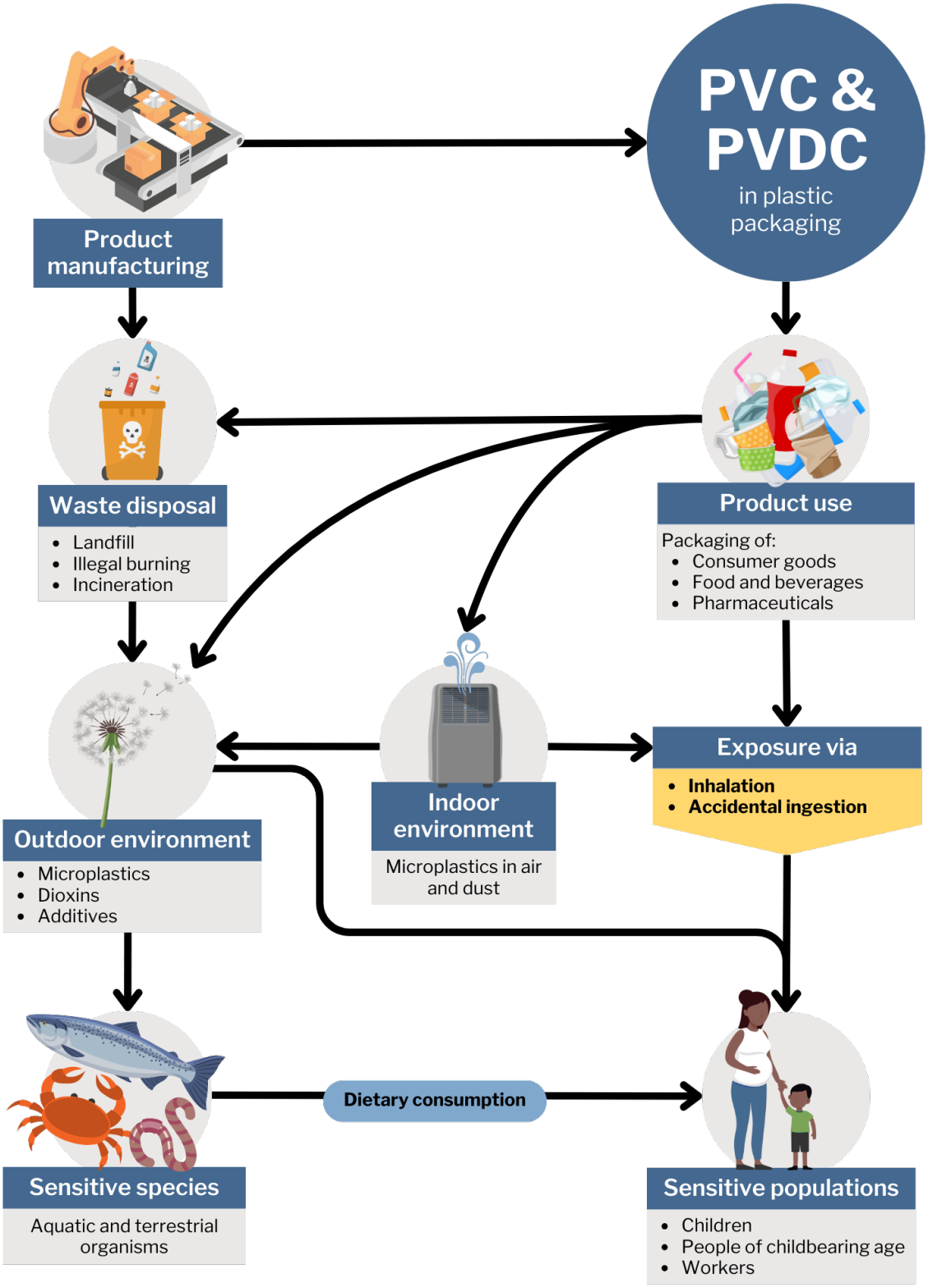
Humans may also be exposed to PVC and PVDC **microplastics** through:

- **Inhalation**.
- **Accidental ingestion**.

6. Sensitive Populations

This exposure is a concern for:

- **Children**.
- **People of childbearing age**.
- **Workers**.


PVC & PVDC
in plastic packaging
Product manufacturing
Waste disposal
Landfill
Illegal burning
Incineration
Product use
Packaging of:
Consumer goods
Food and beverages
Pharmaceuticals
Outdoor environment
Microplastics
Dioxins
Additives
Indoor environment
Microplastics in air and dust
Exposure via
Inhalation
Accidental ingestion
Dietary consumption
Sensitive species
Aquatic and terrestrial organisms
Sensitive populations
Children
People of childbearing age
Workers

Phthalates in Sealants, Caulks, and Adhesives

1. Introduction and Use in Sealants, Caulks, and Adhesives

Exposure to **phthalates in sealants, caulks, and adhesives** may occur in the **product manufacturing phase** or during **product use**.

2. Use and Disposal of Products

Phthalates can enter the environment during **product use** and **waste disposal**.

- Phthalates are released during and after use **in construction, home maintenance, and DIY projects**.
- Phthalates are also released when products and chemicals are disposed of in **landfills, wastewater, and stormwater**.
- These processes result in **environmental releases of phthalates**, leading to potential exposures in sensitive species and people.

3. Chemical Releases from Products

As sealants, caulks, and adhesives break down over time, phthalates are released to **outdoor** and **indoor environments**.

- Phthalates released to **outdoor environments** enter **soil, water, air, and sediment**.
- Phthalates are released to **indoor environments** in **air** and build up in **dust**.

4. Impact on Sensitive Species

Phthalates may impact sensitive species including **aquatic (water-based)** and **terrestrial (land-based) organisms**.

5. Human Exposure

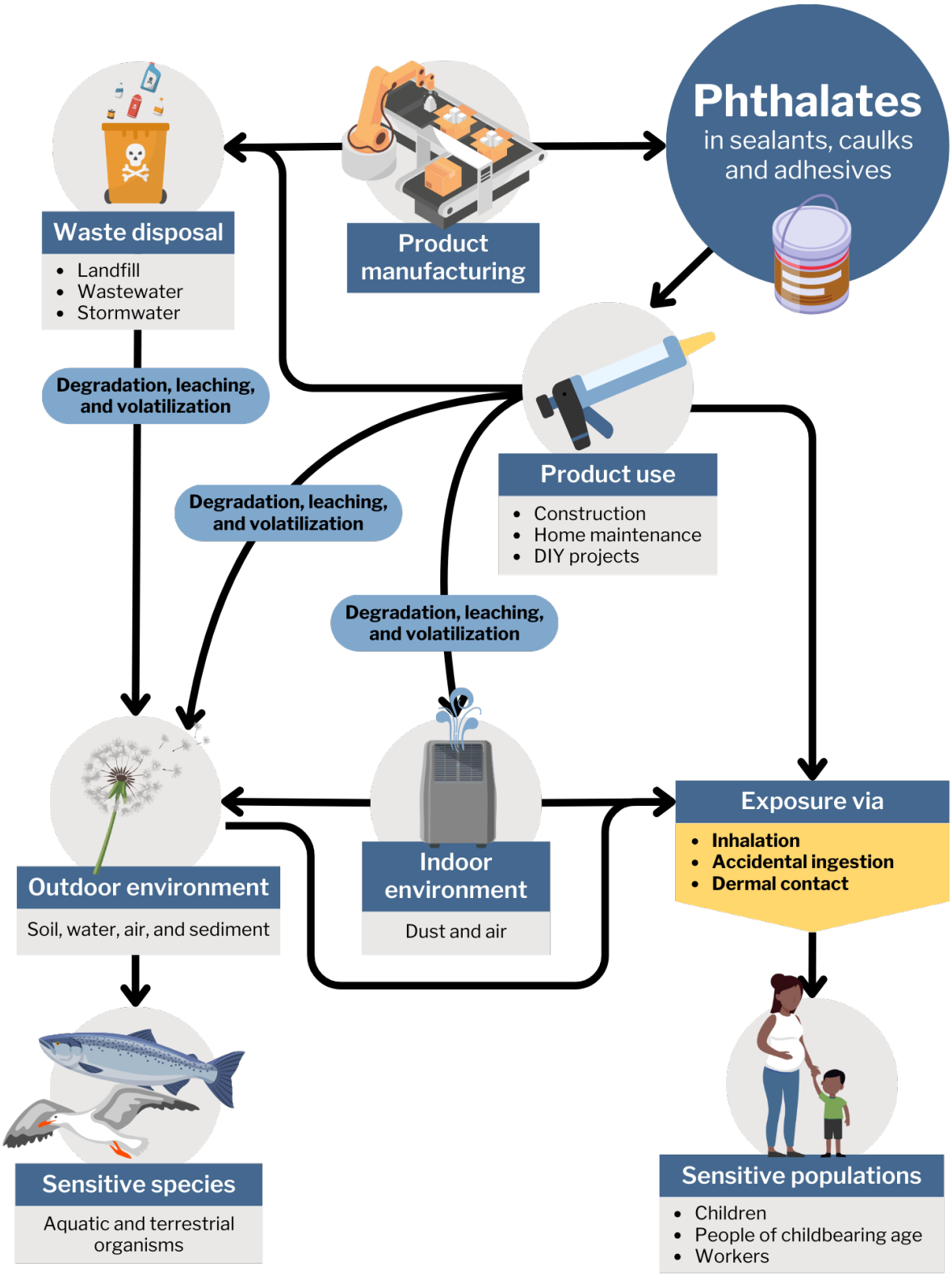
Humans may also be exposed to phthalates through:

- **Inhalation**.
- **Accidental ingestion**.
- **Dermal (skin) contact**.

6. Sensitive Populations

This exposure is a concern for:

- **Children**.
- **People of childbearing age**.
- **Workers**.


Phthalates
in sealants, caulks and adhesives
Waste disposal
Landfill
Wastewater
Stormwater
Product manufacturing
Degradation, leaching, and volatilization
Degradation, leaching, and volatilization
Degradation, leaching, and volatilization
Product use
Construction
Home maintenance
DIY projects
Outdoor environment
Soil, water, air, and sediment
Indoor environment
Dust and air
Exposure via
Inhalation
Accidental ingestion
Dermal contact
Sensitive species
Aquatic and terrestrial organisms
Sensitive populations
Children
People of childbearing age
Workers

1,4-dichlorobenzene in Solid Deodorizers

1. Introduction and Use in Solid Deodorizers

Exposure to **1,4- dichlorobenzene in solid deodorizers** may occur in the **product manufacturing phase** or during **product use**.

2. Use and Disposal of Products

1,4- dichlorobenzene is released during **product use** and **waste disposal**.

- **Urinal blocks, room deodorizers, and garbage/diaper pail deodorizers** release chemicals into the air and in wastewater.
- Disposed products found in **landfills** and **wastewater** can lead to outdoor environmental chemical releases.

3. Chemical Releases from Products

As solid deodorizers break down over time, 1,4-dichlorobenzene enters **outdoor** and **indoor environments**.

- 1,4-dichlorobenzene released to **outdoor environments** enter **air, water, soils, and sediment**.
- 1,4-dichlorbenzene is released **indoor environments** through **air** and builds up in **dust**.

4. Impact on Sensitive Species

1,4-dichlorobenzene may affect sensitive species including **aquatic (water-based) organisms** and **plants**. Over time, this chemical builds up in species.

5. Human Exposure

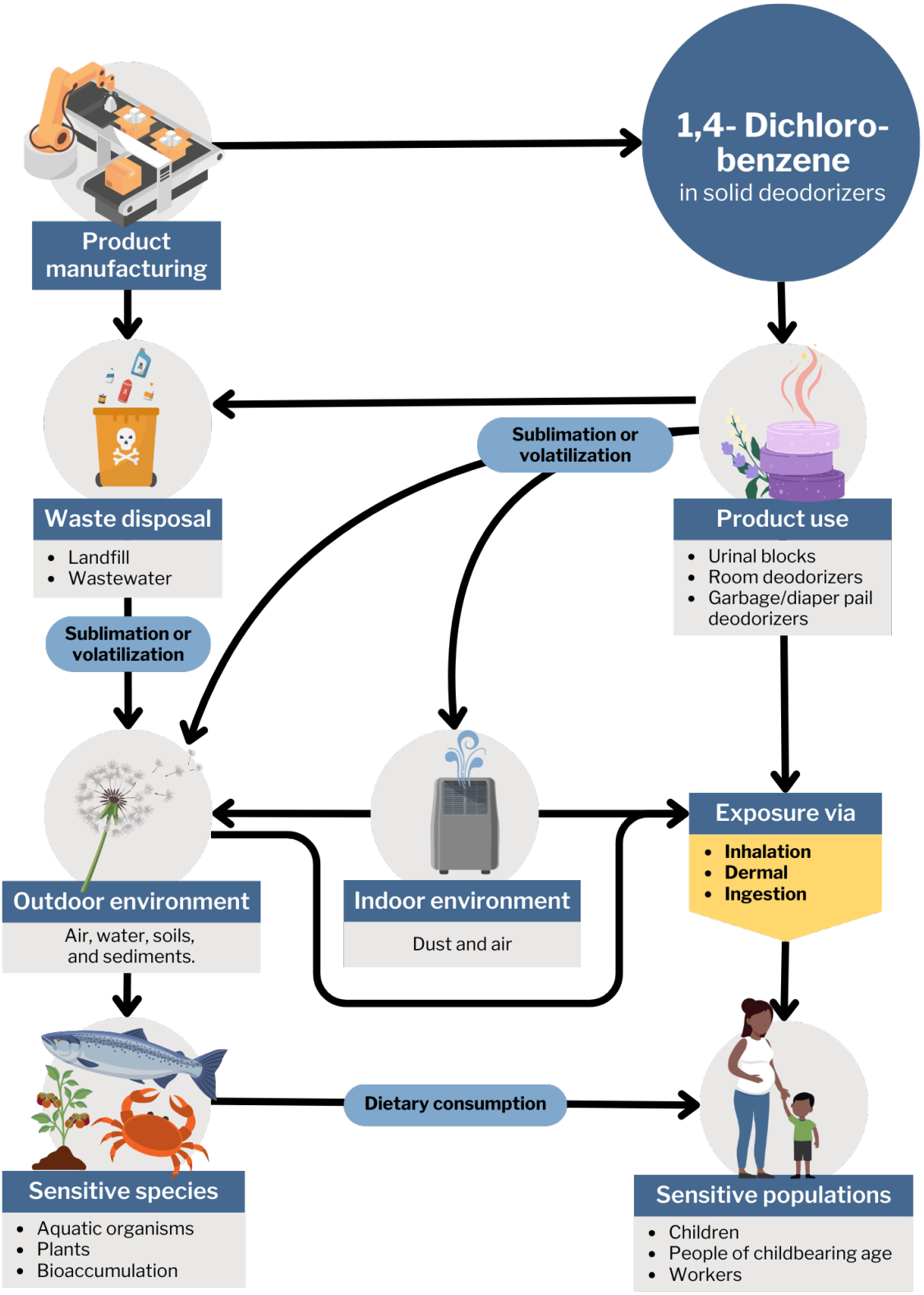
Humans may also be exposed to 1,4-dichlorobenzene through:

- **Inhalation**.
- **Dermal (skin) contact**.
- **Ingestion**.
- **Eating** contaminated species or **drinking** contaminated water.

6. Sensitive Populations

This exposure is a concern for:

- **Children**.
- **People of childbearing age**.
- **Workers**.


1,4- Dichloro-benzene
in solid deodorizers
Product manufacturing
Waste disposal
• Landfill
• Wastewater
Sublimation or volatilization
Sublimation or volatilization
Product use
• Urinal blocks
• Room deodorizers
• Garbage/diaper pail deodorizers
Outdoor environment
Air, water, soils, and sediments.
Indoor environment
Dust and air
Exposure via
• Inhalation
• Dermal
• Ingestion
Dietary consumption
Sensitive species
• Aquatic organisms
• Plants
• Bioaccumulation
Sensitive populations
• Children
• People of childbearing age
• Workers

Contact us

Washington State Department of Ecology
Hazardous Waste and Toxics Reduction Program
Phone: 360-407-6700
Email: SaferProductsWA@ecy.wa.gov
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