

An aerial sketch of an urban industrial zone. The background is a light gray grid representing streets. White rectangular shapes represent industrial buildings. Two large green areas are highlighted: one in the upper right and one in the lower left. The green area in the lower left is divided into sections of different shades of green, suggesting different types of vegetation or landscaping. Small green circles and lines are scattered throughout the grid, representing trees and pedestrian paths.

# A Bouquet of Benefits

Floriculture and Ecosystem Gifts in  
an Urban Industrial Zone

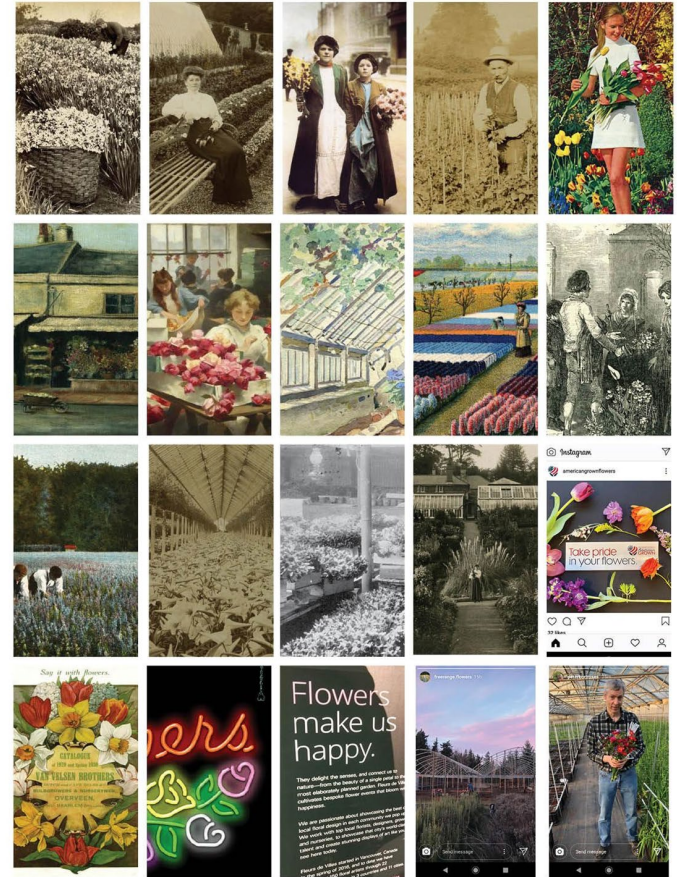
- **Background**
- **Methods and Analysis**
- **Design**
- **Reflection**
- **Q and A**

Elizabeth Housley  
2020 UW Landscape Architecture  
Thesis Presentation  
[ehousley@uw.edu](mailto:ehousley@uw.edu)

# Guiding Questions

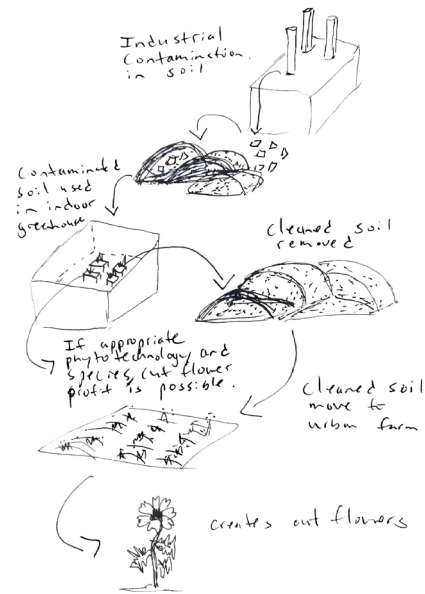
Does phytoremediation research data from field-applications of ornamental species support the possibility of offsetting remediation costs with cut-flower profits?

And then, how would a proposed “Flower District” in Seattle’s Georgetown neighborhood provide an economic and social structure for a “phyto-to-market” system while improving surrounding ecosystem health?



# Design Research: Early Investigations

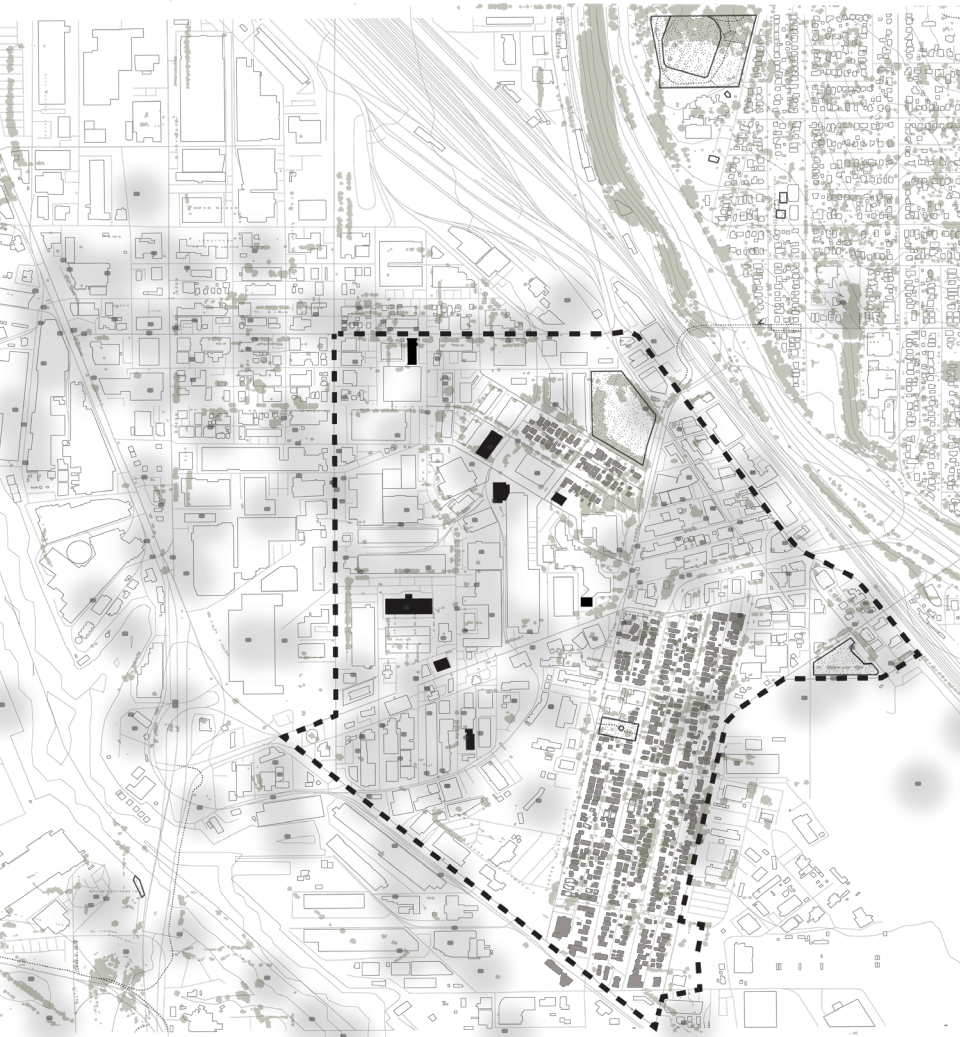
- Diagramming
- Mapping
- Walking Interviews
- Tactile Analysis
- Data Analysis
- Modeling
- Rendering
- Experiencing
- Synthesis



What do floral farmers think about a phyto-to-market system?

- Public perception of the pollinator benefits from floral industry is needed
- Increased public knowledge of the mental health benefits of floral products is needed
- Phyto Flowers must be marketable and desired
- Customer surveys must be done to know desire
- Would customers pay more for phyto flowers? Info needed.
- Urban phyto floral farmers should receive a tax subsidy
- Flowers must be pollinator friendly
- Hardy urban plants require little or no Irrigation





COMPOST FACILITY, 1 mile away



8 of 10 Wholesale  
Floral Warehouses  
are in Georgetown

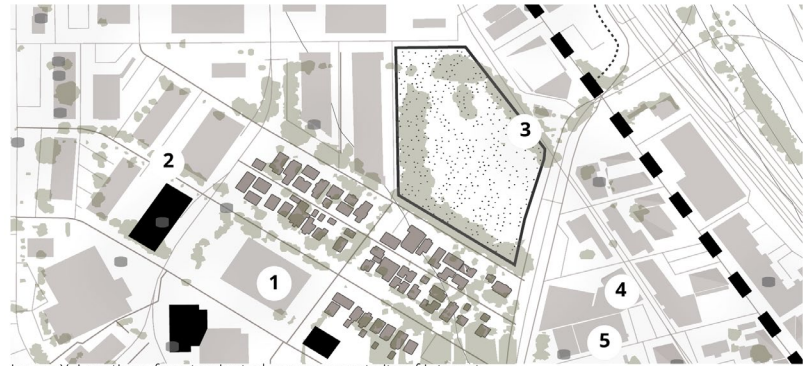


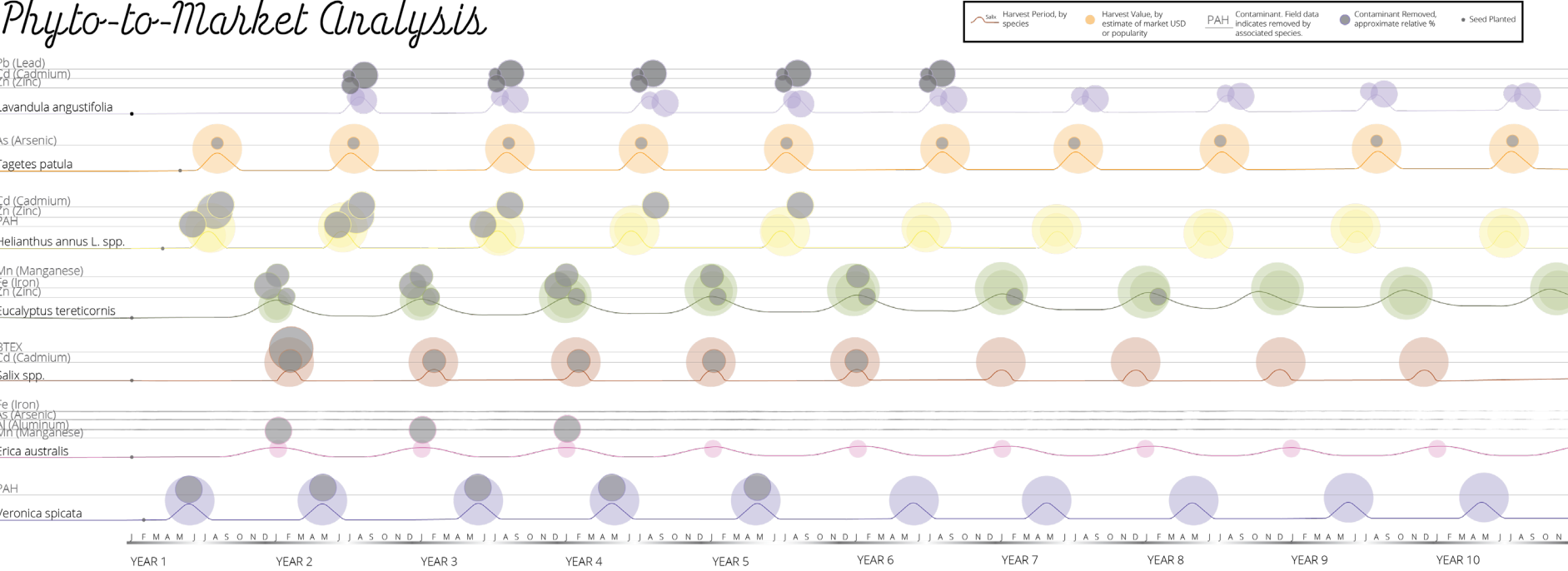
Image X. Location of contaminated areas nearest site of interest.



1. PNB Building: PAH, Pb, Hg,
2. American Dry Ice Orcas: TIER2
3. Pioneer Enamel Manufacturing:  
Cd, Cr, Pb, Zn
4. Sonn Property: PAH, BETX
5. Mail Dispatch: PAH



# Phyto-to-Market Analysis



# Veronica spicata

Spike Speedwell

Action

Type

Time



PAH

Spike Speedwell is a profitable cut-flower product and can remove petroleum contamination from the soil in 6-10 years. It is used as an accent in a floral arrangement; popping out and towards the sky.

Products



Blooms April to August  
Bees, Butterflies  
Dim: 60 x 60 cm  
Root Depth: 12 cm  
Perennial  
Region 1-9, 14-21  
Vase Life: 6-10 days

Weakness

Needs



## Phyto Plant Cards

**Erica australis**  
Southern Heath

**Action**  
Type  
Time

This flowering shrub, also known simply as heath, is used in flower bouquets to add texture. It can be formed into a hedge or used as an accent. It is a perennial consumer safe after exposure for 10 years and a phytoremediator for cadmium, lead, and PCBs. It is a good choice for high winds soils. Although phytoremediation data exists for limited species, findings suggest may fit a scenario may require an additional contaminant.

**Products**

**Weakness**

**Needs**

Blooms April to August  
Bees, Butterflies  
Dim: 20 x 20 cm  
Root Depth: 12 cm  
Perennial  
Region 1-9, 14-21

**Eucalyptus tereticornis**  
Forest Red Gum

**Action**  
Type  
Time

Eucalyptus can be grown in temperate zones on a Rural Farm with branches pruned for cut-flower use in floral arrangements. It also has multiple products such as timber and essential oils. Findings indicate remediation is less than 2 years for most soil and water contaminants.

**Products**

**Weakness**

**Needs**

Blooms April to August  
Bees, Butterflies  
Dim: 20 x 20 cm  
Root Depth: 12 cm  
Perennial  
Region 1-9, 14-21

**Helianthus annuus L. sp.**  
Sunflower

**Action**  
Type  
Time

This iconic species is in the top five domestic cut flower products and USDA (2018) crop datasets. It has a long vase life and is also a low cost export product. It is known for phytoremediation, phytomedicine, and phytobiotic bioprocess and organic concentration. Soil amendments require field scale remediation. A phyto market system would need to ensure the use of seeds from previous phytoremediation substrates. Source: USDA (2018) and USDA (2018) crop datasets.

**Products**

**Weakness**

**Needs**

Blooms April to August  
Bees, Butterflies  
Dim: 100 x 100 cm  
Root Depth: 12 cm  
Perennial  
Region 1-9, 14-21

**Lavandula angustifolia**  
English Lavender

**Action**  
Type  
Time

Lavender is rich in cultural and economic uses. In addition, Lavender is known to extract metals through the process of phytoremediation. Lavender should be grown for soil and water remediation. Lavender is a perennial consumer safe after exposure for 10 years and a phytoremediator for cadmium, lead, and PCBs. It is a good choice for high winds soils. Although phytoremediation data exists for limited species, findings suggest may fit a scenario may require an additional contaminant.

**Products**

**Weakness**

**Needs**

Blooms April to August  
Bees, Butterflies  
Dim: 20 x 20 cm  
Root Depth: 12 cm  
Perennial  
Region 1-9, 14-21

**Salix alba L. Britzensis**  
Coriarian Willow

**Action**  
Type  
Time

This shrubby, weedy plant has a bright yellow color. It can be used similarly to Eucalyptus in floral arrangements. It also has multiple products such as timber and essential oils. Findings indicate remediation is less than 2 years for most soil and water contaminants. It has a long vase life and is also a low cost export product. It is known for phytoremediation, phytomedicine, and phytobiotic bioprocess and organic concentration. Soil amendments require field scale remediation. A phyto market system would need to ensure the use of seeds from previous phytoremediation substrates. Source: USDA (2018) and USDA (2018) crop datasets.

**Products**

**Weakness**

**Needs**

Blooms April to August  
Bees, Butterflies  
Dim: 20 x 20 cm  
Root Depth: 12 cm  
Perennial  
Region 1-9, 14-21

**Tagetes patula**  
French Marigold

**Action**  
Type  
Time

The spring French marigold is most commonly used in cultural and religious ceremonies in South and Asia. It is a perennial consumer safe after exposure for 10 years and a phytoremediator for cadmium, lead, and PCBs. It is a good choice for high winds soils. Although phytoremediation data exists for limited species, findings suggest may fit a scenario may require an additional contaminant.

**Products**

**Weakness**

**Needs**

Blooms April to August  
Bees, Butterflies  
Dim: 20 x 20 cm  
Root Depth: 12 cm  
Perennial  
Region 1-9, 14-21



# Design Research: Site Investigations

- **Diagramming**
- **Mapping**
- **Walking Interviews**
- **Tactile Analysis**
- **Data Analysis**
- **Modeling**
- **Rendering**
- **Experiencing**
- **Synthesis**



# Proposed Phyto-to-Market System

## Traditional Floral Industry

planted → grown → cut → conveyed → boxed → trucked → flown → trucked → ordered → sold → transported → gifted → experienced → **discarded**  
**20% wasted**

## Traditional Phytotechnology

planted → grown → tested → removed → **100% disposed**

## Emerging Floral Industry

ordered → planted → grown → cut → arranged → boxed → trucked → experienced → **discarded** → trucked → **composted**  
**15% wasted**

BTEX  
Cd (Cadmium)  
Salix spp.

## Proposed Phyto-to-Market

planted → grown → tested → removed → above and below ground parts separated



safe parts sold as cut flowers →



**waste composted**

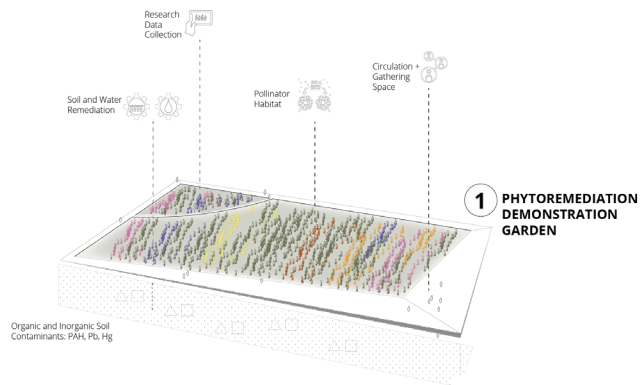
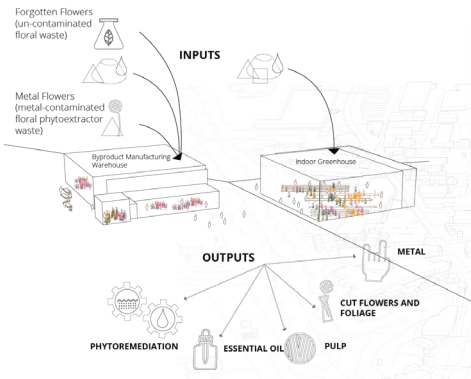


heavy-metal parts sold as byproducts

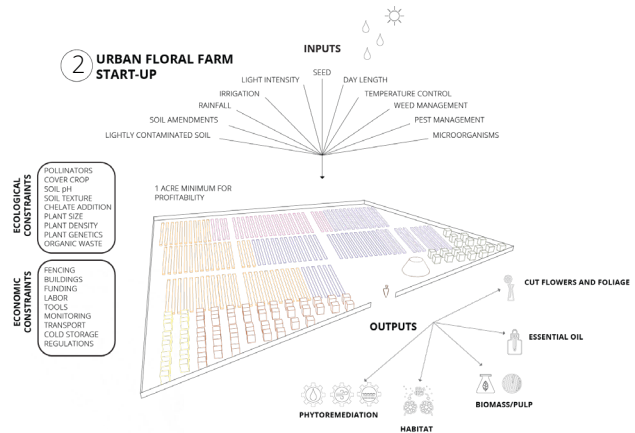


# Resource Exchange

## 4 EX-SITU FILL + BYPRODUCT SITES



## 2 URBAN FLORAL FARM START-UP

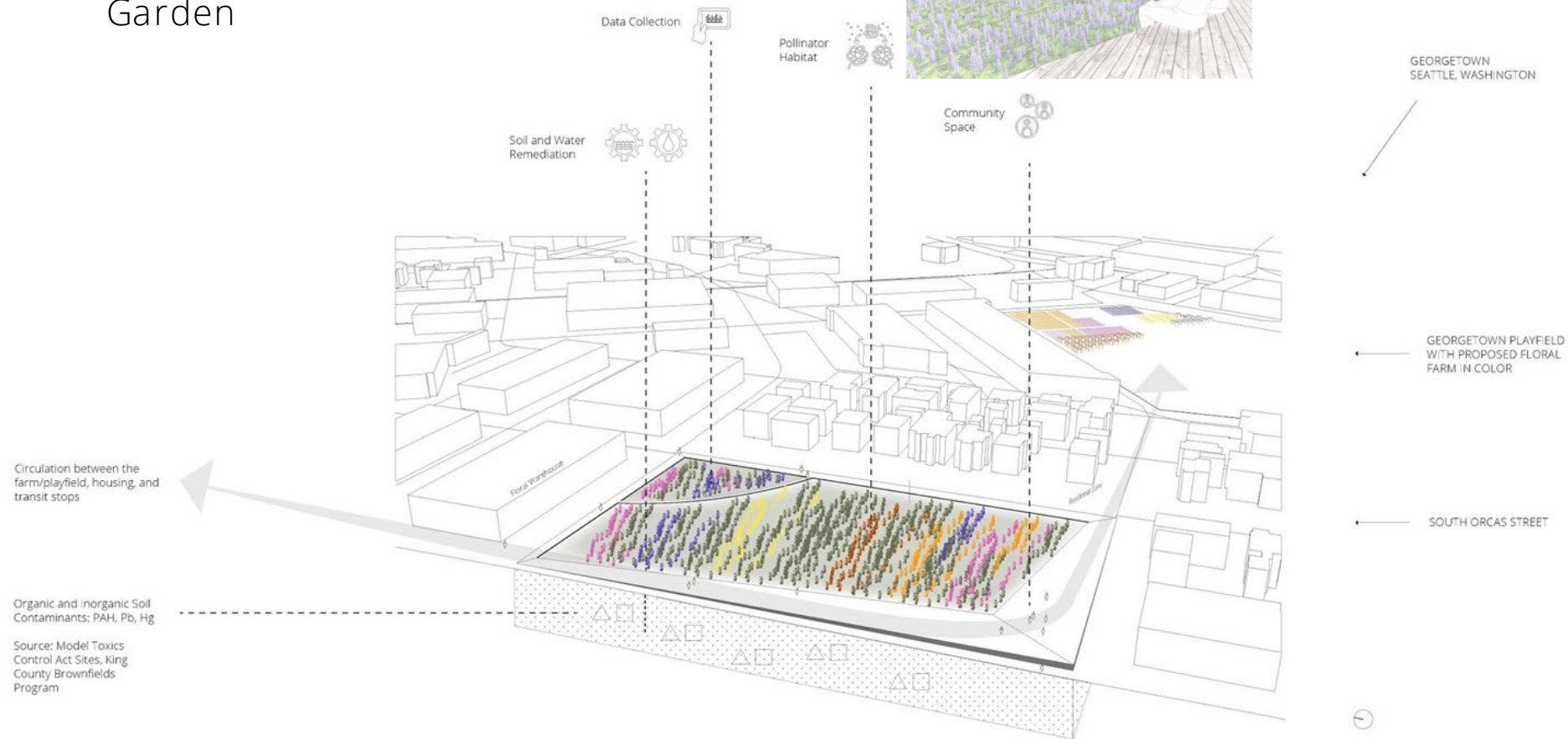


## 5 COMPOST FACILITY



1

# Phytoremediation Demonstration Garden







Indoor Greenhouse  
Remediation



Phyto Testing and  
Demonstration:  
*Tagetes patula*  
*Salix alba* L. 'Britzensis'  
*Helianthus annuus* L. sp.  
*Veronica spicata*



Waste ByProduct  
Production



Pedestrian Circulation  
Gathering Space



Pollinator Habitat



[Click to view online video](#)



1

# Phytoremediation Demonstration Garden: Phyto-to-Market Testing



Image X. The Demonstration Garden is situated near the Indoor Greenhouses and Byproduct Facilities.



1

Phytoremediation  
Demonstration Garden:  
Circulation and Gathering Space



Image X. Elevated pathways through the garden.

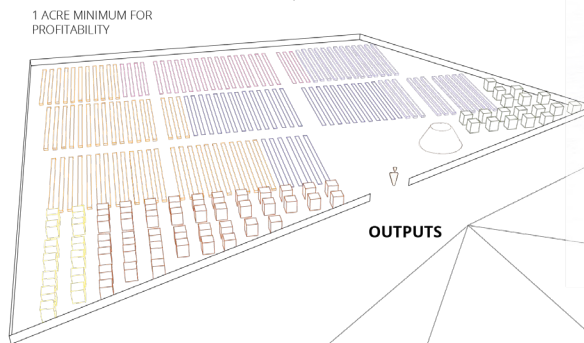
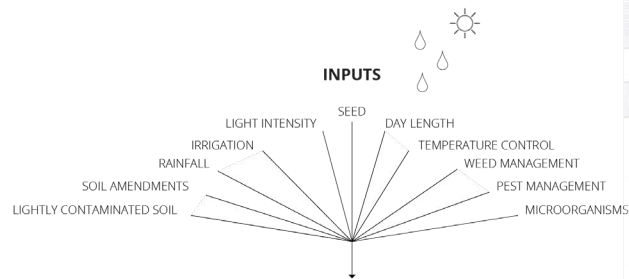


ECOLOGICAL  
CONSTRAINTS

POLLINATORS  
COVER CROP  
SOIL pH  
SOIL TEXTURE  
CHELATE ADDITION  
PLANT SIZE  
PLANT DENSITY  
PLANT GENETICS  
ORGANIC WASTE

ECONOMIC  
CONSTRAINTS

FENCING  
BUILDINGS  
FUNDING  
LABOR  
TOOLS  
MONITORING  
TRANSPORT  
COLD STORAGE  
REGULATIONS



NOTE: FIELD DATA FOR SELECTED CUT FOLIAGE AND OIL SPECIES INDICATE CONTAMINANTS DO NOT TRANSFER TO ABOVE GROUND PARTS OR OIL IN DANGEROUS LEVELS.

\* CONTAMINATED ROOTS MUST BE SEPARATED FROM ABOVE GROUND PARTS, BUT COST IS OFFSET BY FLORAL AND BY-PRODUCT SALES.

**REMEDIATED SOIL**

SELECT SPECIES REMOVE ORGANIC AND INORGANIC CONTAMINATION FROM SOIL

**HABITAT**

ORNAMENTAL PLANTS PROVIDE FOOD AND SHELTER TO INSECTS. DATA IS UNCLEAR ON WHETHER CONTAMINATION IS TRANSFERRED TO POLLINATORS VIA PLANTS.

**BIOMASS/PULP**

SALIX SPP. GROWN IN Cd CONTAMINATED SOIL IS SOLD AS BIOMASS.

HELIANTHUS ANNUUS GROWN IN Cd OR Zn CONTAMINATED SOIL IS SOLD AS OIL OR BIOMASS \*.

EUCALYPTUS GROWN IN Fe, Mn, Zn CONTAMINATED SOIL IS SAFELY PROCESSED FOR SALE AS CUT FOLIAGE, OIL, AND PULP.

OIL FROM LAVANDULA ANGUSTIFOLIA GROWN IN Pb, Cd, OR Zn SOIL IS SAFELY PROCESSED FOR SALE.

**ESSENTIAL OIL**

TAGETES PATULA FLOWERS GROWN IN As CONTAMINATED SOIL IS PROCESSED FOR SALE \*.

HELIANTHUS ANNUUS GROWN IN N OR PAH SOIL IS SAFELY SOLD AS A CUT FLOWER.

VERONICA SPICATA GROWN IN PAH CONTAMINATED SOIL IS SAFELY SOLD AS CUT FOLIAGE.

SALIX SPP. GROWN IN BTEX AND CYANIDE CONTAMINATED SOIL IS SAFELY SOLD AS CUT FOLIAGE.

EUCALYPTUS TERETICORNIS GROWN IN Fe, Mn, Zn CONTAMINATED SOIL IS SAFELY PROCESSED FOR SALE AS CUT FOLIAGE, OIL, AND PULP.

ERICA AUSTRALIS GROWN IN Al, As, Fe AND Mn CONTAMINATED SOIL IS SAFELY SOLD AS CUT-FOLIAGE \*.

[Click to view online video](#)

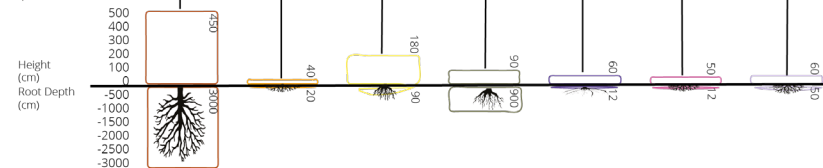


# Urban Floral Farm: Example Species

- Market potential
- Tolerates contamination
- Stores contamination in roots
- Adequate root depth
- Cut-flower products: organic contamination only
- Byproducts: heavy-metal ok



Species Dimensions



Site Appropriate Species:  
Economic Gifts



OUTPUTS

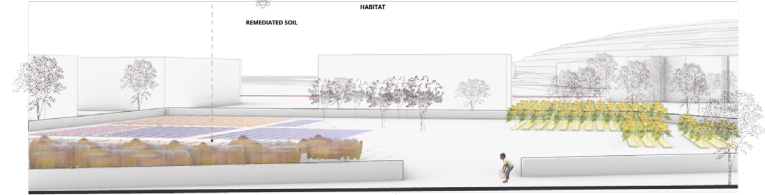
CUT FLOWERS AND FOLIAGE

ESSENTIAL OIL

BIOMASS/PULP

REMEDATED SOIL

HABITAT



**Lavandula angustifolia**  
\$1000 acre/yr  
\$105 oil/acre

**Tagetes patula**  
\$30,000 acre/yr.

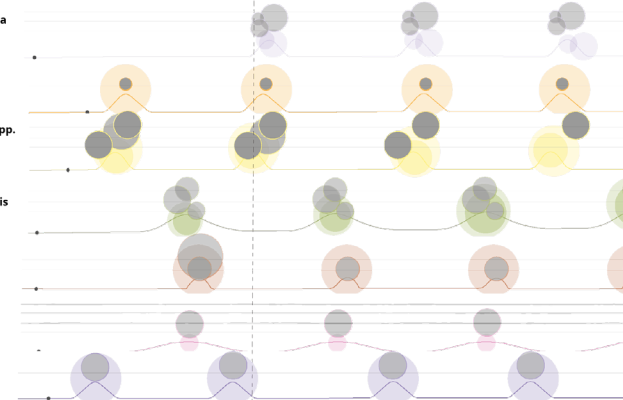
**Helianthus annuus L. spp.**  
\$60,000 acre/yr  
\$182 oil/acre  
\$1 a stem

**Eucalyptus tereticornis**  
\$12,000 acre/yr  
Harvest increases  
by 15% 2-4th yr

**Salix spp.**  
\$56,000 acre/yr.  
\$1.50 a stem.

**Erica australis**  
\$6000 acre/yr  
\$1.60 a stem

**Veronica spicata**  
\$3.20 a stem





3

## Pedestrian and Pollinator Pathways

1

DEMONSTRATION  
GARDEN

2

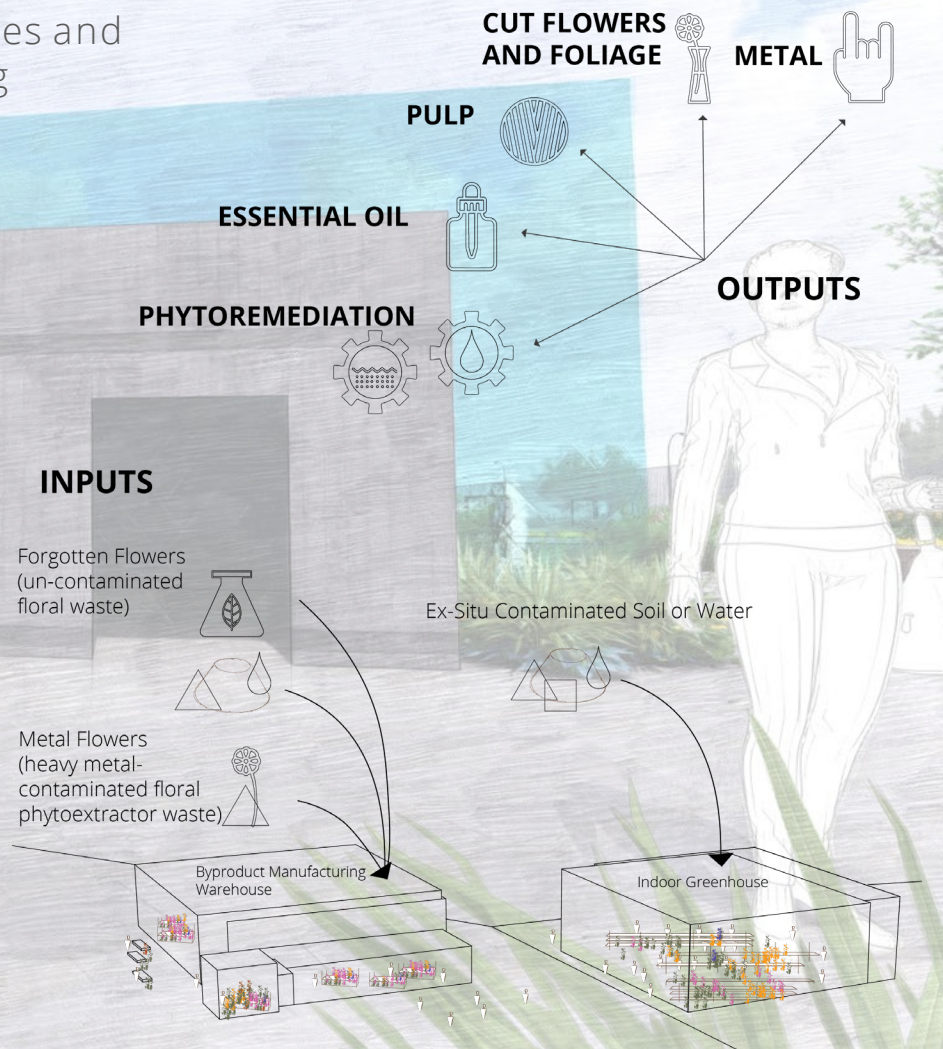
FLORAL FARM



In 2017, Seattle Parks Foundation led stakeholders in a community charrette to document their needs and desires for the future of Georgetown. Residents requested several improvements in the immediate blocks surrounding the floral warehouses in this thesis. Their requests include safe pedestrian and bicycle crossings, street plantings and habitat, pedestrian conversion of the defunct rail spur and a primary walking/bike route connecting Georgetown Playfield with 1st avenue (Seattle Parks Foundation, 2017). This design takes their requests into account by connecting the proposed urban farm (on the corner of the playfield) with the garden via a pedestrian corridor between residential buildings. The design includes raised beds with pollinator habitat plant species. The garden itself serves as a pedestrian corridor onwards to 1st avenue.

4

## Ex-Situ Indoor Greenhouses and Byproduct Manufacturing





#### Indoor Greenhouse Remediation



Contaminated fill from off site is used as soil medium in tolerant ornamental species.

#### Waste ByProduct Production



Warehouse floral waste, urban farm floral waste, and ex-situ (off site) phytoextractors can be converted into pulp, metal aggregate, and essential oils. Light manufacturing such as essential oil production are best suited for this flower district.

Existing markets exist to process waste into compost and byproducts. Plants contaminated with heavy-metals are heated or combusted to break down and aggregate metals for a variety of markets. This is called phytomining. Plant waste from ex-situ contaminated sites can be safely converted into pulps and fibers to create furniture, baskets, mats.

Contaminated soil can be transferred out of a contaminated site (as is a common practice) and "dumped" into an urban greenhouse for use as a soil medium. Contamination tolerant ornamental plants grown in contaminated soil could produce cut-flowers or essential oils (Pandey and Baudh 2019).

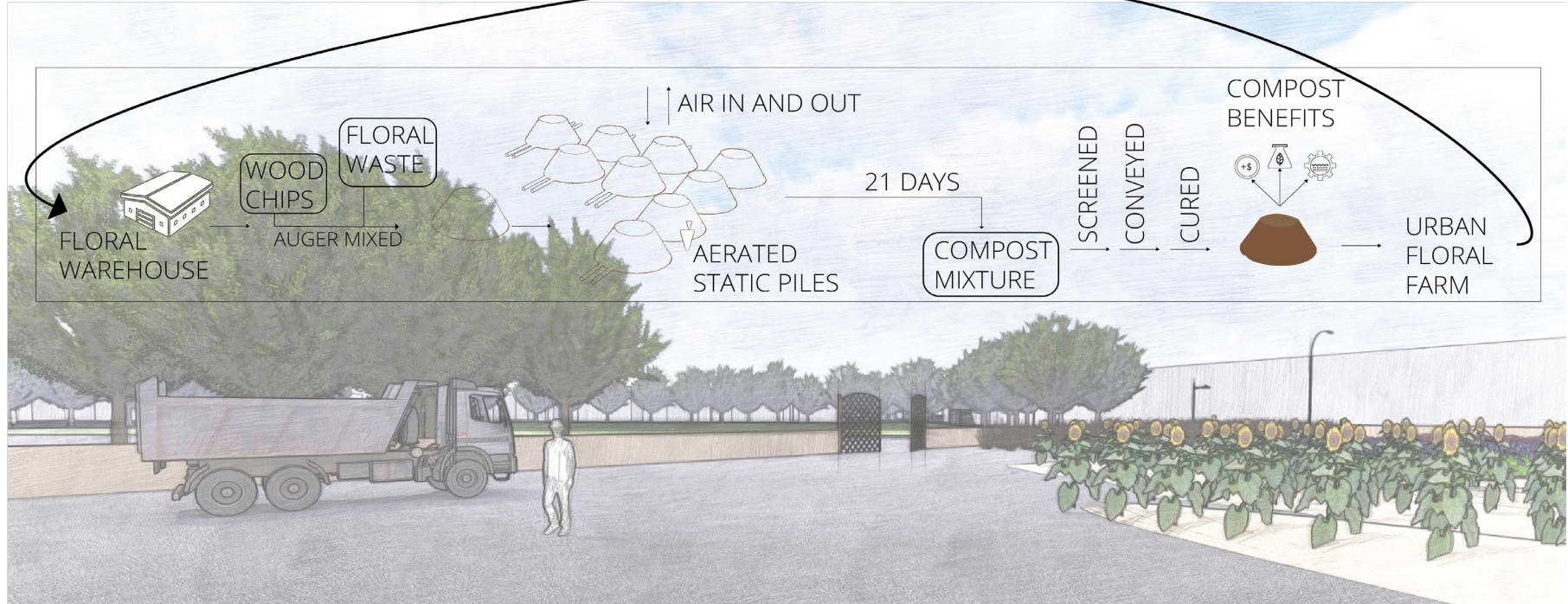
For metal contaminated soil, there is a strong post-remediation potential of ornamental plants for perfume production. Perfume obtained through distillation was found to be safe for human use and met criteria for essential oil certification (Nakbanpote et. al. 2016; Asgari Lajayer et. al. 2017a).





5

## Compost Facility and the Floral Waste Cycle





- ① Phytoremediation Demonstration Garden
- ② Urban Floral Farm Start-Up
- ③ Pedestrian and Pollinator Pathway
- ④ Ex-Situ Fill + Byproduct Sites
- ⑤ Compost Facility



# Reflection

- Value of design collaboration
- Floral industry response to Covid-19
- Relevance to landscape architecture and remediation firms

Thank you for this opportunity!

**Elizabeth Housley**

ehousley@uw.edu

## A Bouquet of Benefits

Floriculture and Ecosystem Gifts in an Urban Industrial Zone

