### Managing Plant Pathogen Introductions in Large Scale Restoration Sites

Mia Ingolia City and County of San Francisco San Francisco Public Utilities Commission, Water Enterprise Natural Resources and Lands Management Division





Services of the San Francisco Public Utilities Commission





Delivering drinking water every day to 2.6 million residents and businesses in Southern Alameda, Northern Santa Clara, San Mateo and San Francisco counties.

### Stewards of SFPUC Watershed Lands

















Water System Improvement Program (WSIP) **35 Local projects** 46 Regional projects 7 counties \$4.6 Billion

### Large Restorations of SFPUC Watershed Lands



# 2014 Summary

- Outlined equipment, imported materials, and nursery inspections and enforcement program
- Phytophthora detected at multiple sites- 10 species detected – including a federal quarantined species (P. tentaculata)
- Installed 9000 solarization basins at multiple restoration sites
- Prohibited importation of organic materials like mulch, wood chips, and soil
- Only allowing planting from seed or onsite divisions

## **Specifications Changing**

- Change orders to require plants from seed, cutting and divisions
- Seed collection
- Seed storage and treatments
- Seeding rates (viability and germination)
- Seed planting methods (count and depth)

## **Continued Sampling**



## SFPUC Sampling Documented Phytophthora Hosts

#### 2014

- Arbutus menziesii
- Baccharis glutinosa
- Carex barbarae
- Euthamia occidentalis
- Frangula californica
- Heteromeles arbutifolia
- Hordeum brachyantherum
- Juncus balitcus
- Juncus effusus
- Juncus patens
- Diplacus aurantiacus
- Platanus racemosa
- Pseudotsuga menziesii
- Quercus agrifolia
- Scrophularia californica

#### 2015-Present

- Acer macrophyllum
- Artemisia douglasiana
- Eriogonum nudum
- Quercus douglasii
- Quercus lobata
- Umbellularia californica

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Species	#
Phytophthora amnicola x canalensis	1
Phytophthora bilorbang	1
Phytophthora cactorum	1
Phytophthora cambivora	12
Phytophthora chlamydospora	1
Phytophthora chlamydospora x erwinii	1
Phytophthora chlamydospora x drechsleri	7
Phytophthora cryptogea	5
Phytophthora cryptogea complex	5
Phytophthora cryptogea/kelmania	2
Phytophthora erythroseptica	1
Phytophthora gonapodyides	21
Phytophthora gregata x megasperma/canalensis	2
Phytophthora inundata	4
Phytophthora lacustris	9
Phytophthora megasperma	8
Phytophthora ramorum	1
Phytophthora ripara	1
Phytophthora ripara x lacustris	5
Phytophthora riparia x lacustris/cambivora	3
Phytophthora sp.	1
Phytophthora undulata	2
Total positives (from 110 Samples 85%)	94

## UC Berkeley Forest Pathology and Mycology Lab Research Support

- A Review of Phytophthora species Detected from Plants and Streams in Restoration Areas of the Greater San Francisco Bay Area
- Summarizes the available knowledge for many soilborne and waterborne Phytophthora species and presents general principles concerning infection and spread that influence the likelihood of further pathogen movement into natural environments

## UC Berkeley Forest Pathology and Mycology Lab Research Support

- Studies on the susceptibility of key plant host species (California sycamore, coast live oak, and toyon) to Phytophthora tentaculata and P. cactorum
  - CLO susceptible both in roots and stems
  - Toyon roots susceptible but stem lesions rather small
  - Sycamore roots rather resistant (suggesting coevolution) but stems highly susceptible













Photo Credits: H.T. Harvey



## SIEBRING

#### **Tow 'N Dump**

Siebring Manufacturing produces the Tow 'N Dump Aeration Cart specifically with the options requested by the customer to use in their specific application.

The Tow 'N Dump Aeration Cart has the option of a folding rear gate and hydraulic lift or fold down sides and no hydraulic lift. Both carts have a perforated floor and hookups for steam and air equipment.

#### **RUNNING GEAR FEATURES**

- Running gear weight tested at 6400 lbs. (dropped 6" abuse)
- 18 x 8.5" wheels (10 mph non-highway)
- Wheel spindles w/roller bearings

#### **CART SPECIFICATIONS**

- · Cart capacity of 2 cubic yards
- Aeration cart with 40% aerator floor 4' wide x 8' long w/24" sides
- Dump cart with smooth dump floor 4' wide x 8' long w/24" sides
- Canvas cover for aeration carts

#### CART OPTIONS

- Aeration cart with fold down sides for work bench / flat filling
- Aeration cart with fold up rear gate and battery powered hydraulic lift with safety locks
- 10 amp 12 volt battery charger for battery powered hydraulics
- Custom aerator and steam fittings available



The cart with hydraulic lift features an easily operated lift control shown here.

Looking down into the cart shows the specially designed screen panel that supports the soil while allowing the air to pass through.



Locking support arms allow for safe maintenance of the cart.







### What We Know Now

- Restoration design needs to change to reduce the risk of exposure to native habitats and make in-situ treatment more feasible – when necessary
- Specifications outline the prevention measures – only as good as the commitment to inspection and enforcement
- Treatment effectiveness unknown, difficult and destructive

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