

# Optimizing Scientific and Social Attributes of Pharmaceutical Take Back Programs to Improve Public and Environmental Health

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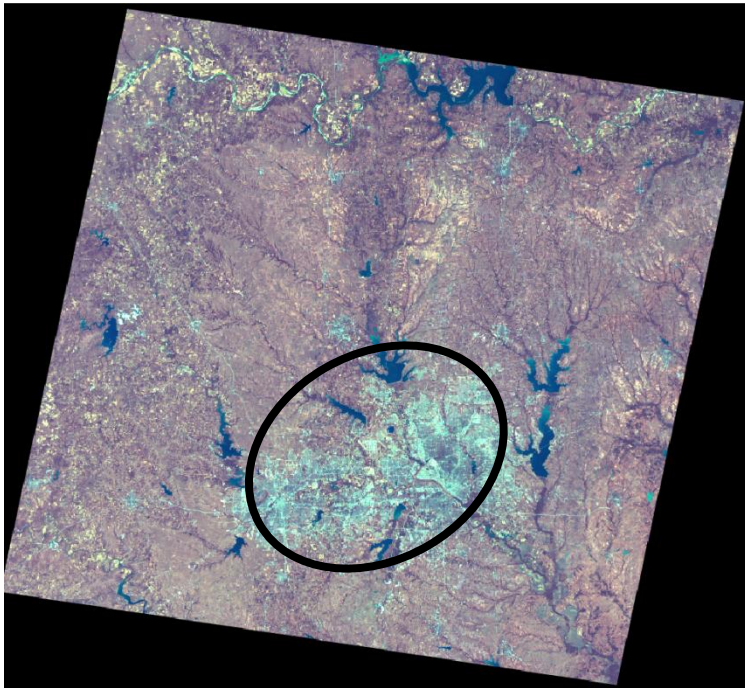
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# Pharmaceuticals in the Environment: Where do the residues come from?



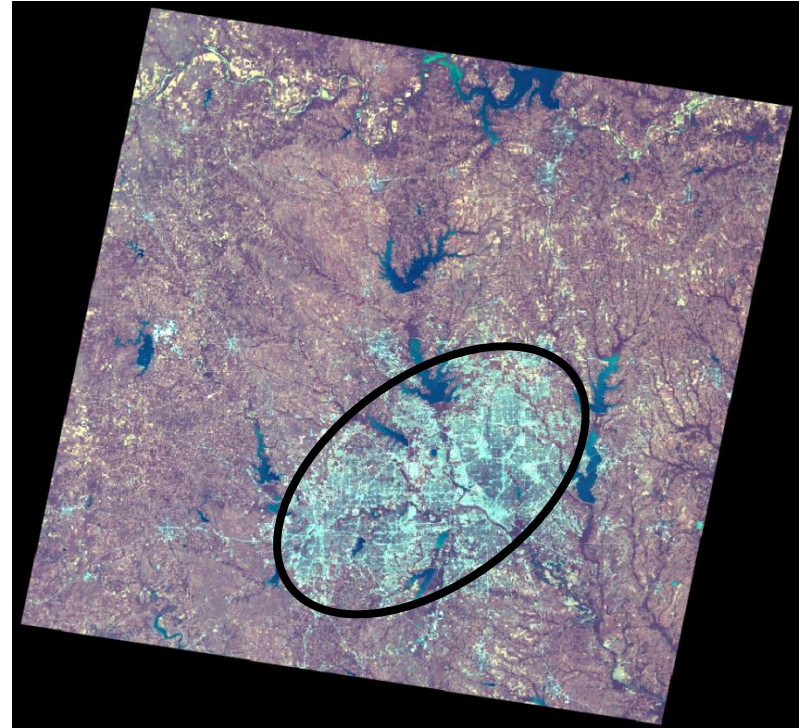
# Accelerating growth: An opportunity for a comprehensive pilot program

DFW 1987



Population: 3.5 million  
Trinity River Flow: 280 cfs

DFW 2005



Population: 5.5 million  
Trinity River Flow: >400 cfs

Population in 2050: 11.5-12 million

# Pharmaceutical Take-Back Program: Objectives

- **Environmental**
  - Proper disposal of medications
  - Protection of environmental resources
- **Social**
  - Prevention of accidental poisoning
  - Prevention of prescription misuse and abuse (“Pharming”)
- **Product Stewardship**

# Pharmaceutical Take-Back Program: Gaps

- Quantifiable measures to determine environmental impact of TBP
  - Biomonitoring and chemical monitoring
- Public Risk Perceptions
  - Public understanding and concern about pharmaceuticals in the environment
  - Disposal practices
  - Possible averting behaviors
- Social Marketing Campaigns
  - Sensitive to specific socioeconomic of the community

# Comparing Take Back Programs

Top 4 Categories of Pharmaceuticals Returned in Safe Medicine Disposal in ME

Category of Pharmaceutical	Percent
Pain/anti-inflammatory	35
Heart, blood, or cholesterol medicines	34
Sleep or anti-anxiety medicines	19
Antibiotics	18

(Illinois-Indiana Sea Grant (IISG), 2007), (Safe Medicine Disposal for ME Program), (U.S. EPA, 2009e), (Crittenden, J.A., et al, 2008)

Categories of Pharmaceuticals Returned in Green Pharmacy Program in Berkeley, CA

Category of Pharmaceutical	Percent
Central nervous system (CSN)	22.62
Nutritional products	14.29
Psychotherapeutic	12.51
Gastrointestinal	8.99
Cardiovascular	8.77
Respiratory	6.00
Anti-infectives	6.00
Alternative medicines	5.69
Hormones	4.60
Immunologic	2.85

(Teleosis Institute, 2007)

# Pharmaceutical Take-Back Program: Measures of Success

## Standard

Amount of medications collected

Participation rates

Measures of success often overlooked or not defined clearly in TBP planning

## Potential

Improved public risk perception and/or community image

- Behavioral modification

Scientific justification

- Computer modeling & biological and chemical monitoring of water quality before and after TBP event

# Current Road Blocks to a Pharmaceutical Take-Back Program

- Legal road blocks
  - Controlled Substance Act (CSA) administered by Drug Enforcement Agency (DEA)
    - Narcotics, Valium, amphetamines, Ritalin, morphine, methadone, oxycodone
  - Law enforcement officers present or deputize select TBP organizers if possible
- Cost
  - Disposal services
  - Advertising/social marketing
  - General staffing
  - Law enforcement agents
  - Pharmacists
  - Science
- Public awareness and support
  - Education and risk communication through social marketing campaign



# H.R. Bill 276:

## The Drug Free Water Act

- Bill currently being considered in the House
  - “Prevent or reduce the detrimental effects caused by introducing such materials [pharmaceuticals] into water systems and for limiting the disposal of unused pharmaceuticals through treatment works”
  - Establish an EPA task force for developing recommendations for proper medicine disposal
  - Develop a public education strategy

# A New Approach

## Project Purpose

- Develop a decision-making framework for an optimized TBP paradigm
- Include scientific and social attributes
- Sustainable solution to the public and environmental health threat of pharmaceuticals

# Hypothesis

- Following the implementation of an optimized TBP, there will be no change in:
  - Public health, as measured by accidental drug poisonings; or
  - Environmental health, as measured by the concentrations of representative drugs in WWTP effluent.

# Objective 1

- *Develop effective methodologies to communicate the public and environmental health risks associated with unused pharmaceuticals.*
  - Surveys 1 & 2 to understand public's perception, disposal practices and 1<sup>st</sup> take back event participation
  - Educational tools to increase public awareness and participation for the second TBP
  - Survey 3 to evaluate success of education strategies

## Objective 2: Determine public health benefits of TBPs

- *Calculate class-specific mass of drugs returned during the TBPs and determine if the TBP was effective in reducing human drug poisonings when compared to data prior to the first TBP.*

# Objective 3: Determine Pharmaceutical loading to WWTP as a measure of environmental health

- *Measure ibuprofen and diazepam concentrations in WWTP influent and effluent*
- *Calculate theoretical loadings of ibuprofen and diazepam to the environment and using the mass of these drugs returned in the TBP determine the theoretical difference in loading.*

# Anticipated Results

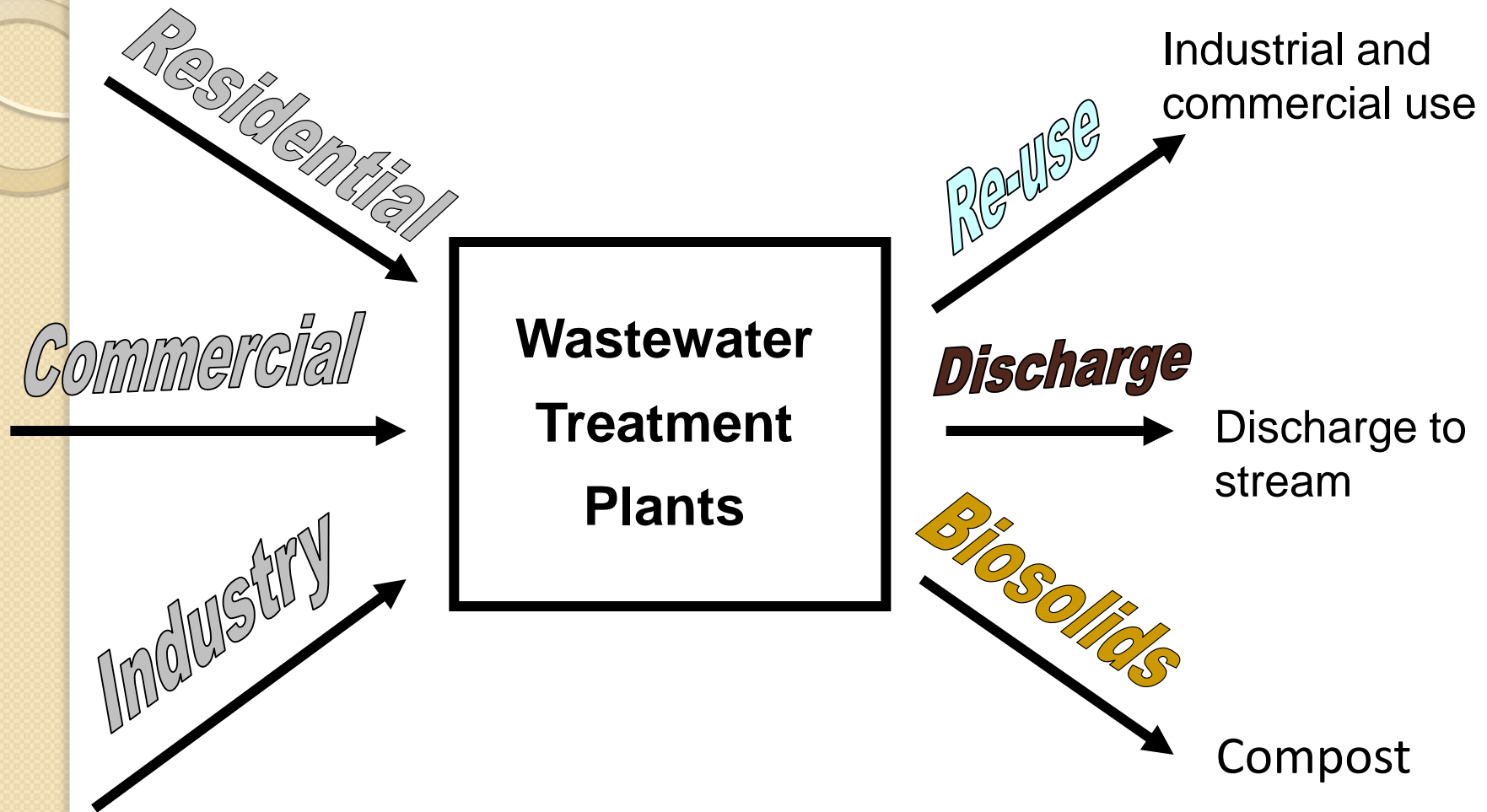
- Develop decision-making framework for an optimized TBP to address gaps in standard TBP model:
  - Incorporate public awareness and risk perception through an education campaign
  - Scientific justification
- Model for future TBPs
- Demonstrate TBP can be a sustainable and proactive strategy for:
  - Promoting waste reduction
  - Addressing public and environmental health threats



Why this is important to the  
**City of Denton**

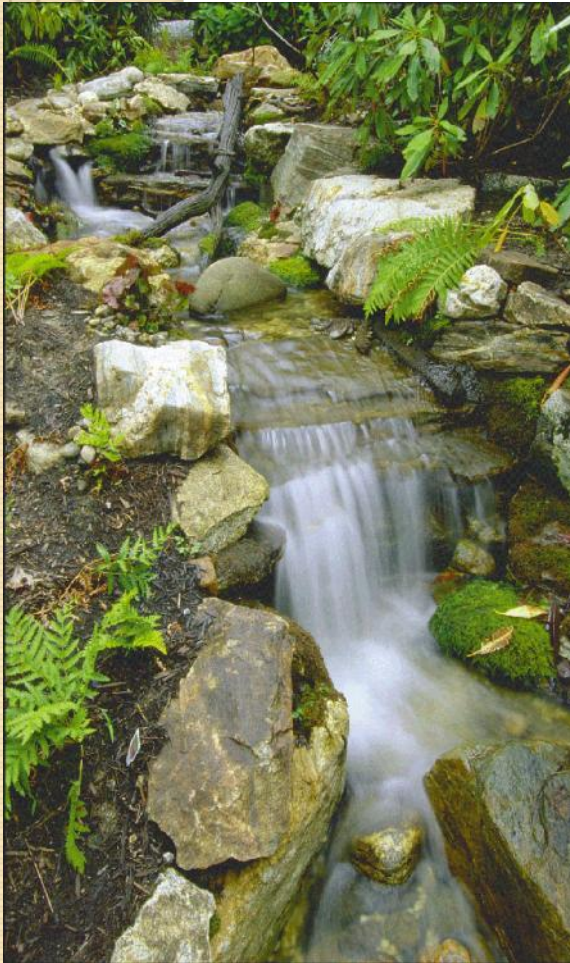


# Wastewater in Denton



Plant is permitted at 21 MGD  
Average discharge ~13 MGD

# Looming Issue: Drugs in Waters



- Not present at therapeutic doses
- Potential adverse impacts:
  - Water quality issues
    - WWTP Effluent
    - Drinking Water?
  - Endocrine disruption (physical, mental, sexual development)
  - Antibiotic resistance
  - Public perception

# Endocrine Disruption

- Endocrine system regulates hormones in the body
- Endocrine disruptors interfere with this system
- Affect reproduction, development, and behavior
- Disruption even at very small concentrations
- Multigenerational effects (DES at therapeutic doses)
- No current evidence of human impacts at low concentrations

# Wastewater Process Considerations

- BOD removal
- Suspended solids removal
- pH neutralization
- N, P removal
- Pathogen removal
- **Processes for removal of pharmaceuticals are not typical**

# Pecan Creek: An Effluent-dominated Stream Denton County, TX



- Vitelligenin (and egg precursor) production and other indicators or possible feminization in male fish) – Jon Hemming
- Beta adrenergic heart medicines and steroids (Duane Huggett)
- Fluoxetine (Prozac) and Sertraline (Zoloft) in Fish Tissue (Bryan Brooks)
- Fluoxetine and Sertraline in tissues of periphyton and benthic macroinvertebrates – (Bryan Brooks)
- Antimicrobials (Triclosan, etc) in algal and snail tissues – Melinda Coogan
- Illicit Drugs in WWTP influent and Effluent (Duane Huggett)