EPA Workshop on CAFOs, Aug. 20-22, 2007

CAFOs and Hormones, Overview of ARS Research

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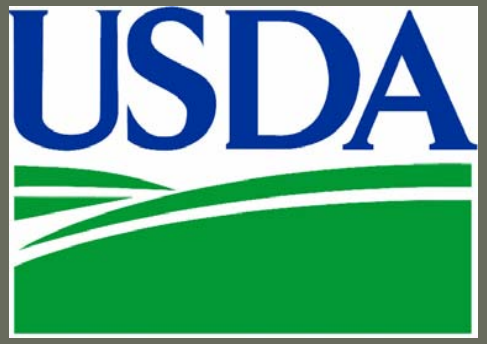


Related Activities on PPCPs

- USDA representative to Pharmaceutical in the Environment workgroup, PiE.
  - Identify topic areas and data needs to better assess human and ecological risk from human and veterinary pharmaceuticals in the environment.
  - Recommend areas for federal collaboration to address those priorities.
- Inventory of activities are compiled and a document is in preparation.
- CAFOs are an important contributor.

Background statements

- Clearly, CAFOs provide elevated releases of EDCs to the environment.
- An important USDA/ARS mission is to develop and evaluate methods for controlling these releases.
- Given the value of animal manure, ARS is committed to developing practices and technologies for safe use of manure w/o endangering public health and the environment.

Focus of research at ARS

- Methods to measure these compounds in complex media (manure, soil, water, air, etc.)
- Develop and evaluate new or existing manure management practices and control technologies to degrade EDCs and/or prevent their movement to water and food sources
- Document the effectiveness and environmental benefits of these practices and technologies
- To develop decision support tools to predict the fate and transport of EDCs.

On-farm treatment options for controlling EDCs.

- Composting (ND- & MD-ARS)
  - Hakk, Milner, and Larsen, JEQ 2005.
- Lagoon storage & wetlands (SC- & ND-ARS, others)-Shappell, et al., ES&T 2007.
- Minimal management – Manure Piling-(CA-ARS, others)
  - Zheng, et al., submitted.

Windrow Composting

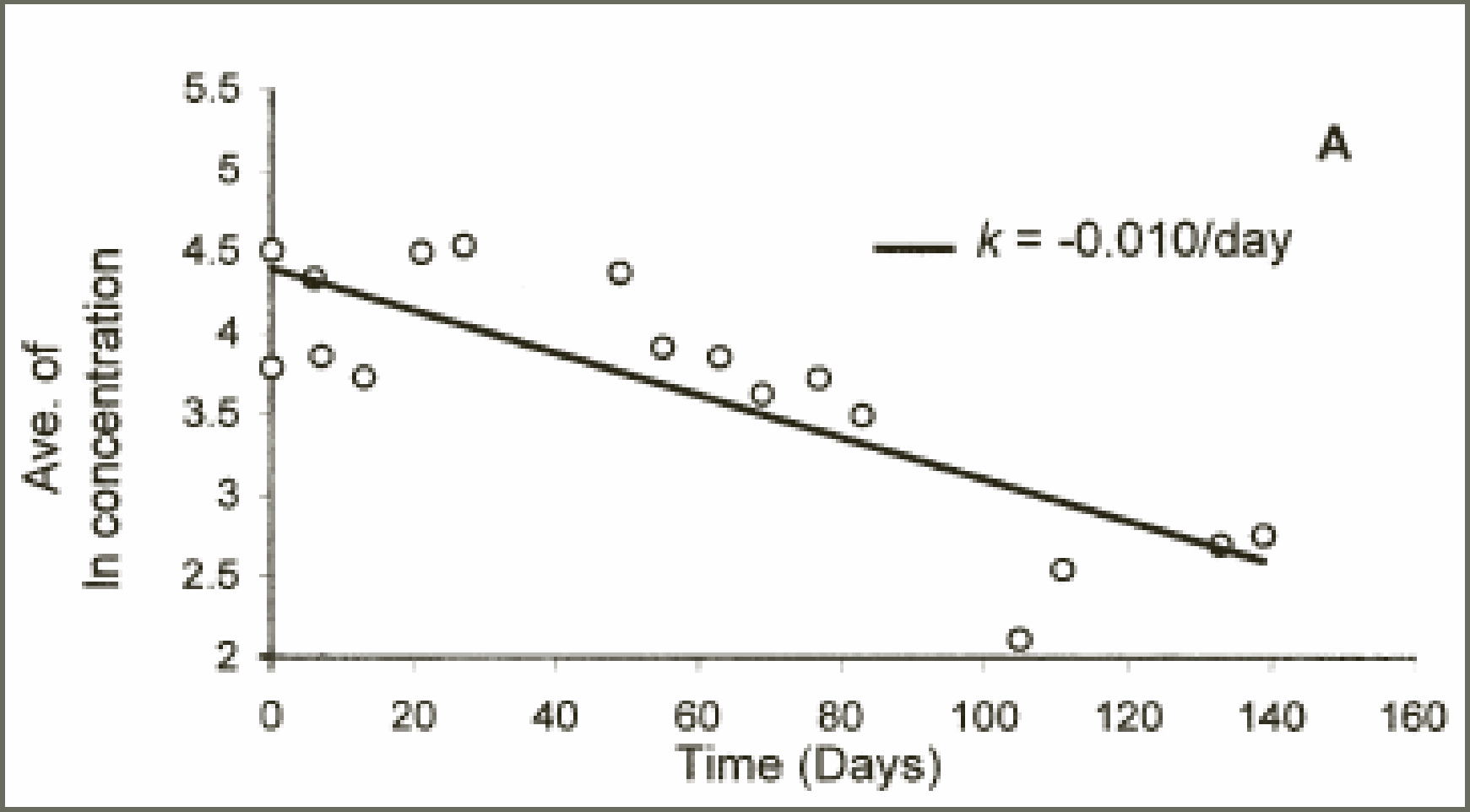
Poultry Litter from a commercial egg-laying operation in Pennsylvania was composted at the ARS Beltsville compost facility to produce soil amendment.

Composting Study

- **Inputs (by volume) included:**
  - » **Poultry layer manure: 3.3 parts**
  - » **Hay, 2 parts**
  - » **Straw: 2 parts**
  - » **Leaves: 4 parts**
  - » **Starter Compost: 2 parts**
- **Handling**
  - » **Moisture initially: 60%**
  - » **Compost duration: 12 weeks**
  - » **Windrows turned weekly for weeks 2-6; bi-weekly for weeks 8-12.**
- **Immunoassay Kits for estradiol and testosterone testing.**

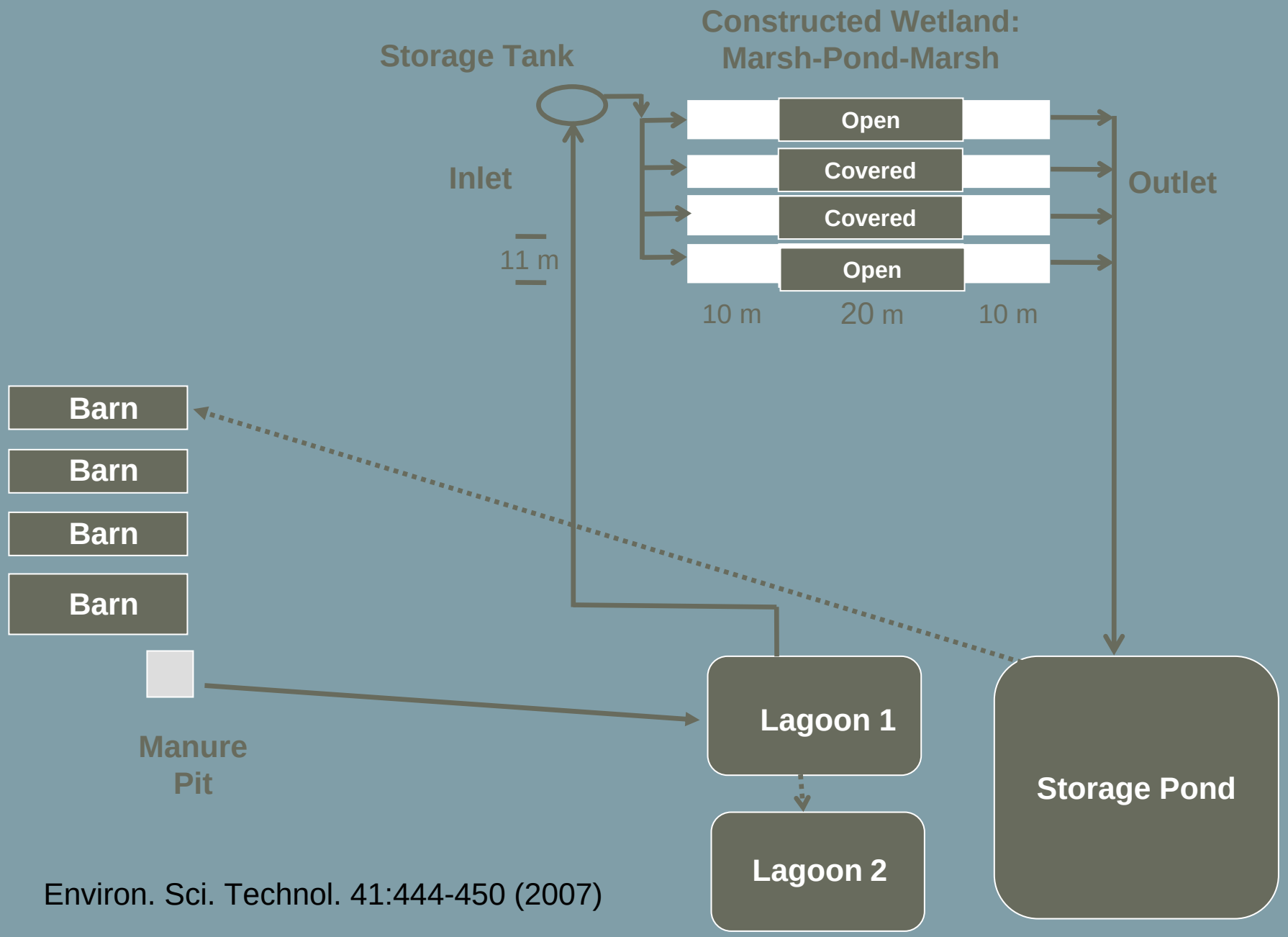
J. Environ. Qual. 34:943-950 (2005)

Mean natural logarithm (ln) of the concentration of water-extractable 17β-estradiol and degradation rate constant.



Composting results for estradiol and testosterone in poultry waste.

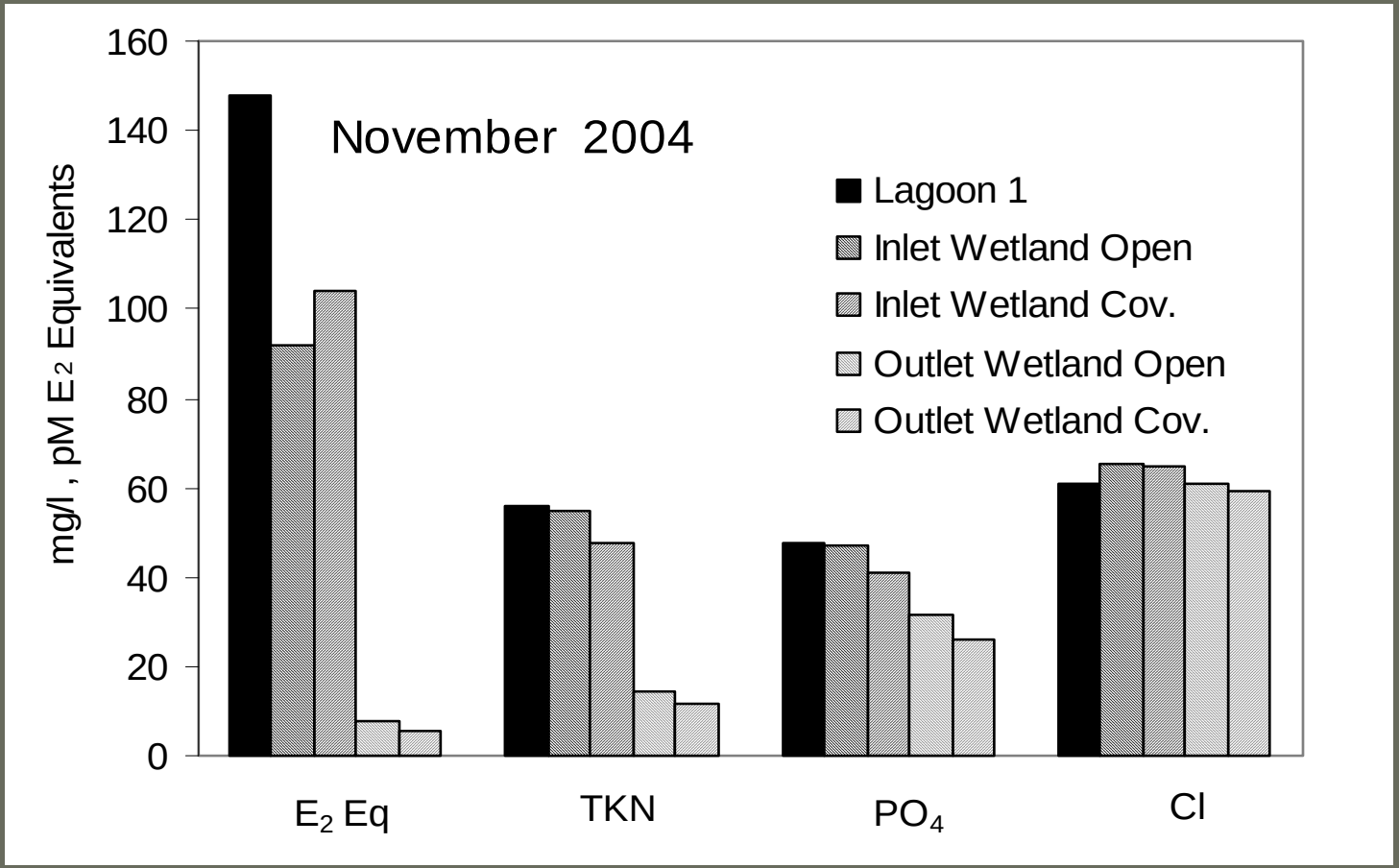
- Half-life estimates for 17β-estradiol and testosterone in compost were 69d and 46 d, respectively.
- **An 84 and 90% reduction**, respectively for 17β-estradiol and testosterone over 139 days.



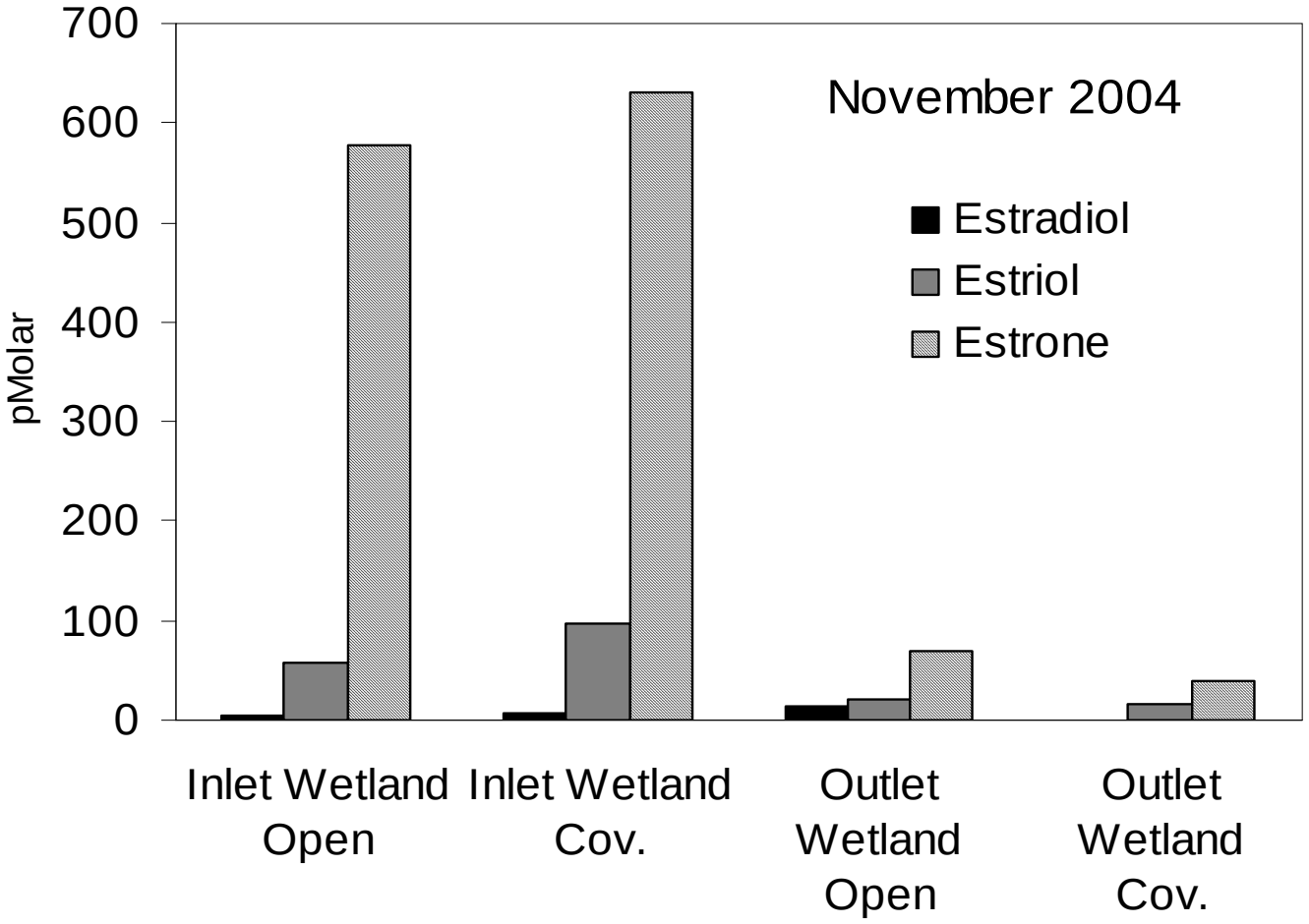
Environ. Sci. Technol. 41:444-450 (2007)

Swine Farrowing Facility, North Carolina A & T University

Wastewater Composition: Lagoon Thru Wetlands



Wetland Water Composition
LC MS-MS



Findings, Lagoon/Wetland Study

- Estrogenic activity of swine wastewater was greatly reduced by the lagoon/constructed wetland system.
- TKN was reduced by the wetland system -- but to a lesser extent than estrogenic activity (60-75 % vs 83-93%).
- There was good agreement between E2 Equivalents obtained by E-Screen and LC MS-MS.
- Estrone was identified as the most persistent estrogenic compound.
- Estradiol equivalents released from the wetlands were always below the Lowest Observed Effect Concentration for estradiol.

Minimal Management
-Manure Piling-

compounds	fresh manure	piled manure
	(μg/kg)	
17α-estradiol	1415.5 ± 103.6	171.8 ± 8.9
17β-estradiol	153.1 ± 25.2	36.7 ± 2.9
estriol	N.D.	N.D.
estrone	534.7 ± 61.6	696.8 ± 82.2
progesterone	< LOQ	195.6 ± 36.6
total	2103.3 ± 123.1	1100.9 ± 93.2

Zheng et al., (submitted)

ARS Fate studies

- Ferrate treatment of dairy lagoon hormone wastes (MD-ARS) - Rice and others, in press.
- Leaching to groundwater and soil column studies (ND State U., ND-ARS, and others) - Casey, Hakk, Larsen, et al., 2003, 2005, 2007
- BMP validation studies on Choptank watershed. Hormone monitoring (MD-ARS, NOAA) - Rice and others, in press.
- Poultry litter, surface runoff studies, pathogen and hormones. (Watkinsville, GA- NRCS) -Jenkins and others, 2005.

ARS, other EDCs

- Alkylphenols
  - Cuyahoga, N. Channel Chicago R. , WWTP impacts - (MD-ARS, USEPA Reg. V and others). Rice et al. 2002, 2004, 2005.
  - Nonylphenol (NP) and NP-ethoxylates in effluent-dominated streams. Fish, ongoing
  - Induction of vtg in male carp by accumulated nonylphenols. Mitchelmore & Rice 2006.