Effluent polishing in constructed wetlands in the United States

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Presented by Ruud Kampf

Dear Ruud

I am now a victim of our Homeland Security act. I went to get on the plane in San Francisco an hour ago and was questioned by the check-in staff who then called over TSA staff. They questioned me on my three trips to Cuba the last two years and my trip to El Salvador this summer. I told them I was in route to give a paper in the Netherlands and that my professional activities as researcher and professor take me to this locations, all of which are legal entry for US citizens.

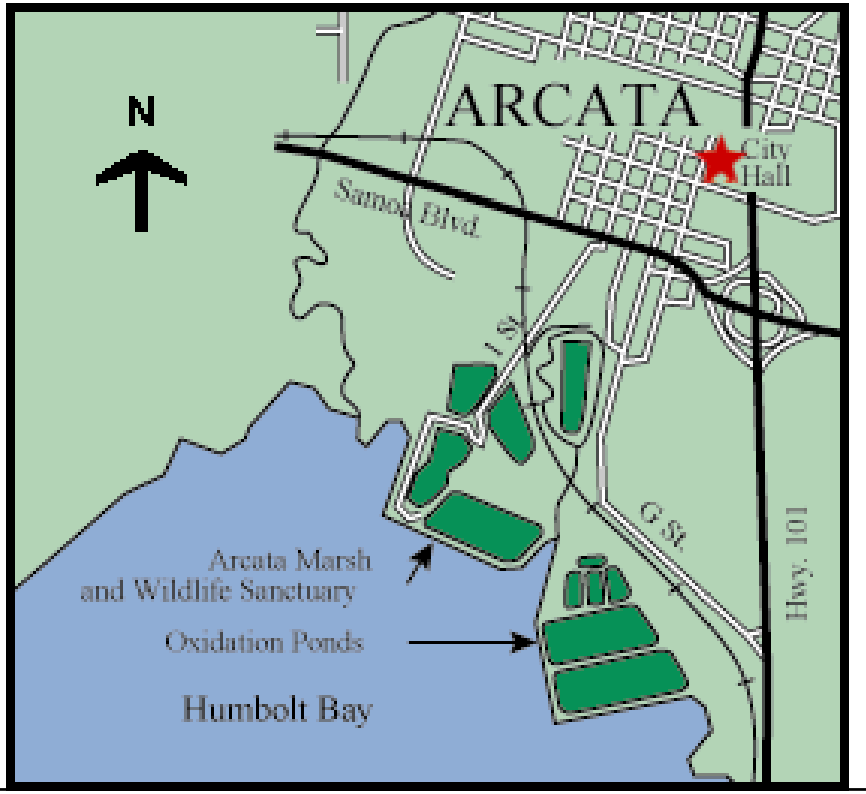
I found the whole experience, the first in my 35 years of international traveling totally unacceptable and non-deserving for a US citizens or for any peace loving citizen. As a result of my remarks and their newly found authority I was detained and questioned for several hours. I have missed by flight, (departed at 11AM today) and have scurried around for an alternative. Al options at this point were $2000 or more with not credit for my $1100 ticket. As a result, I will not be able to attend the conference and present my paper. I am presently trying to figure out a way to get information to you. I am sorry about this hitch and apologize for the US's policies regarding their definition of a "Patriot". I am pursuing administrative appeals on this matter as I am typing this e-mail.

Yours,

Bob

Arcata Residents

"Flush With Pride"

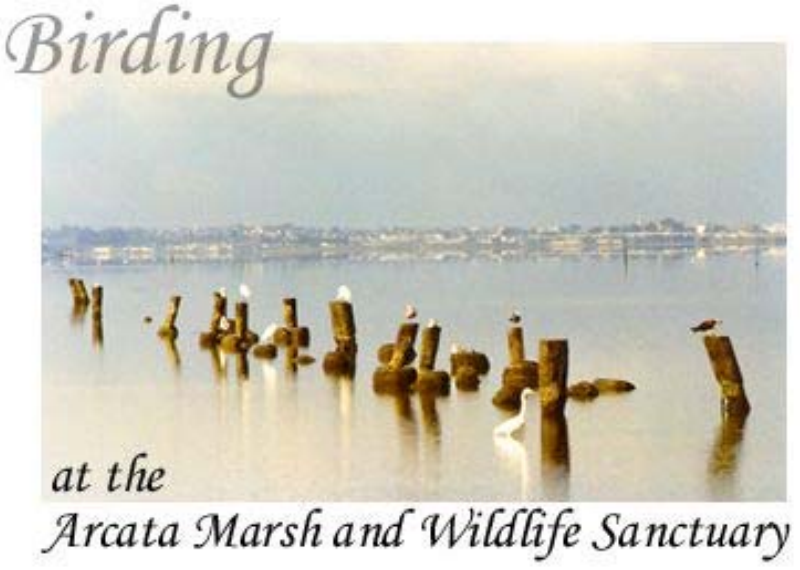


ARCATA MARSH

INTERPRETIVE CENTER

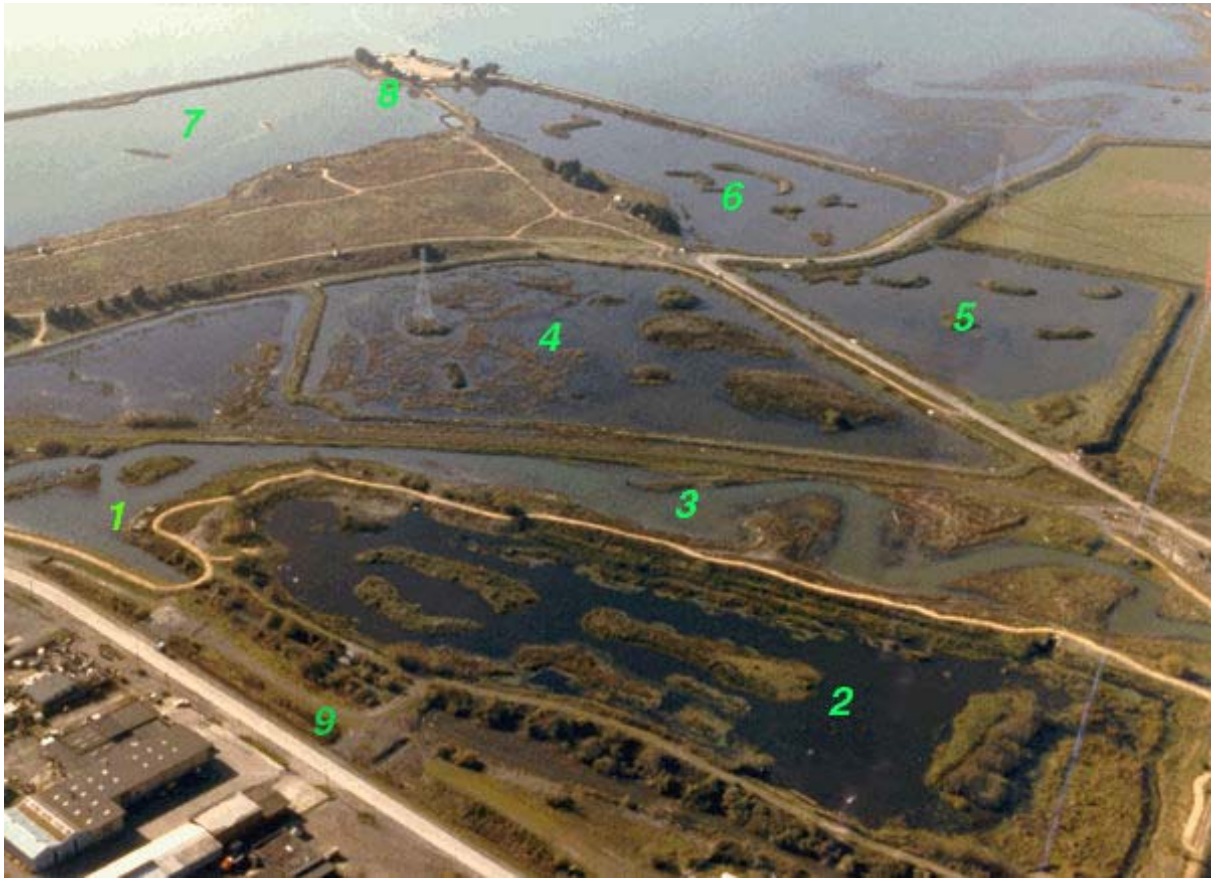
to stimulate understanding of the Arcata Marsh Wildlife Sanctuary, it's relationship with Arcata's integrated wastewater treatment system…….

Arcata Welcomes Birders




Godwits at the Arcata Marsh

Arcata Marsh, aerial view

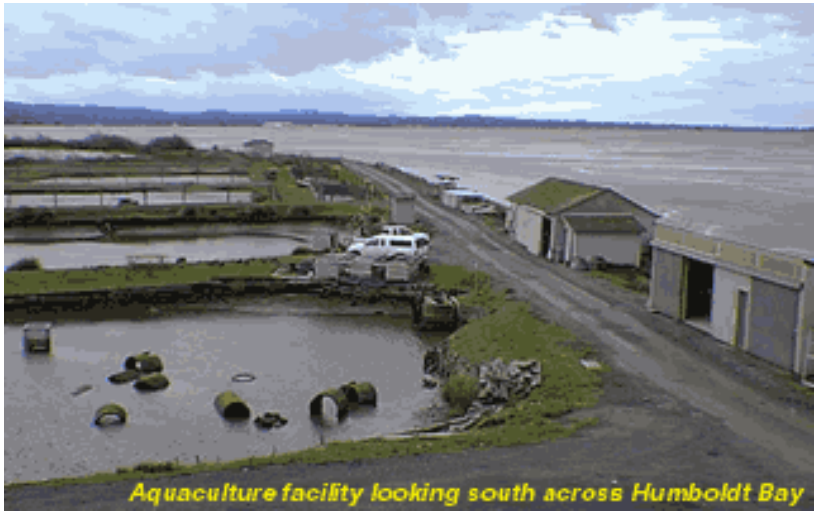



ARCATA MARSH AND WILDLIFE SANCTUARY
Welcome to the Arcata Marsh and Wildlife Sanctuary
RULES AND REGULATIONS
Visit the Arcata Marsh Interpretive Center
Open 9 am to 5 pm daily

Arcata Aquaculture Project

City of Arcata, Humboldt State University

THE BENEFITS OF WASTEWATER



This paper will present examples of the various applications of Free Water Surface (FWS) constructed wetlands to produce high quality effluents in the United States (USA). The utilization in the USA of constructed wetlands to meet advance and tertiary discharge/reuse standards fall into several categories.

Examples of some of the over 150 applications of polishing constructed wetlands in the USA

Great Swamp Effluent Management System Beaufort-Jasper Water & Sewer Authority Beaufort, South Carolina (400 Acres-3 MGD)

Arcata Marsh and Wildlife Sanctuary, Arcata, California, (40 acres 2.7 MGD)

National Wildlife Visitor Center (U.S. Fish and Wildlife Service), Laurel, Maryland. (6 acres-13,000 gpd)

Tres Rios, Phoenix, Arizona (60 acres demonstration, 1MGD))

Orange County Water District -Prado Wetlands, Orange County California (425 acres 2 MGD)

1.

Free surface constructed wetlands are preceded by municipal secondary treatment systems.

And are being used to meet high TSS and BOD effluent discharge standards to meet Total mass discharge limits (TMDL) to receiving waters.

Discharge levels of less than 10 mg/l met 99 % of the time is typical of this application.

2a.

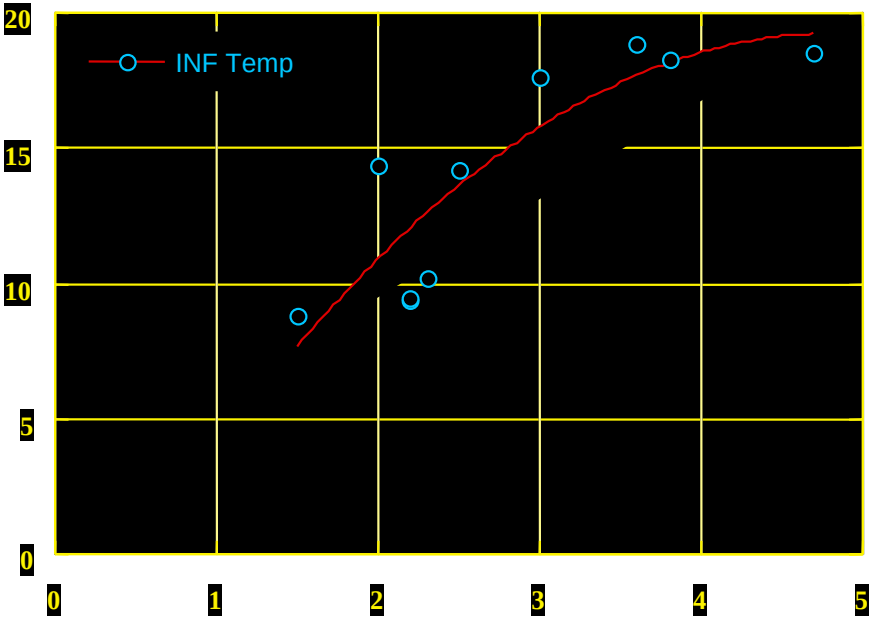
A second category of FWS constructed wetland application is in reducing nitrogen forms, ammonia, nitrate nitrogen, and in a few cases phosphorus forms for variety of receiving water benefits.

In those areas in the USA where toxicity and/or temperature sensitive fish population are found (anadramous, etc.) ammonia toxicity is an issue.

FWS constructed wetland are being used to both reduce discharge thermal inputs and to reduce ammonia toxicity. The total nitrogen level is reduced due to plant uptake of ammonia nitrogen and the denitrification of nitrates. FWS constructed wetland have been shown to produce ammonia nitrogen levels of less than 1 mg/l in several applications

2b.

The temperature of the effluent in hot summer conditions have been shown to be reduced by as much as 3 to 4 degrees centigrade due to solar input interception and black body effects.



3.

Phosphorus removal is a third category of advance treatment application for FWS constructed wetlands. These applications require significant land area and relatively low levels of phosphorus entering the system. There has been some successful application for use of FWS constructed wetlands to meet seasonal phosphorus standards (summer period) when receiving waters are reactive to phytoplankton stimulation by phosphorus.

Applications

A growing application for FWS constructed wetlands in water short states, specifically California, Arizona, Nevada, Florida, and Colorado, are being used to meet direct and indirect water reuse standards.

These reuse standards generally require TSS, BOD, total nitrogen, to be less than 1 mg/l with turbidity levels of 1.0 NTU's or lower.

Several large communities in the US Southwest, Phoenix, Arizona, Orange County Sanitation District, California, and Albuquerque, New Mexico are utilizing FWS constructed wetlands for reuse purposes.

There are more FWS constructed wetlands in Florida than any other state in the United States. The majority of these systems are producing a tertiary effluent and are being used to directly and indirectly augment water supplies i.e. Orlando, Lakeland, Palm Beach Country Regional, and others.

Issues that need to be resolved to further the application of the use of constructed wetland to polish domestic effluents

Operation and Maintenance

- **Vector control-mosquitoes**
- **Vegetation harvesting-planting**
- **Odor problems**
- **Burrowing mammals**

Wetland Processes

- Removal and internal load mechanisms for BOD, ammonia, and phosphorus
- Role of different function types of vegetation- floating, submergents, and emergents-oxygen transfer, uptake, etc.
- Role of settling, autoflocculation and anaerobic breakdown of solids
- Evapotranspiration processes-plant types/coverage, size of system, climate, etc.
- Porosity, short circuiting, resistance (head loss), etc.

Design Considerations

design approach
design equations
assumptions
North American Database-evaluation
background constituents

- Aspect ratio, number of cells, shape, etc.
- Long term operation-performance, life cycle, etc.
- Open water (floating/submergent) vs closed water (emergent)
- Inlet/outlet type-location

Permitting/Policy

- Waters of the United States vs treatment area
- Once a wetland always a wetland-wetland policy
- Attractive nuisance-Endangered Species Act
- Natural system effluent variation-discharge requirements
- Conversion of degraded wetlands-enhancement
- Leaky (infiltration) wetlands groundwater

Water Quality

- Dissolved organic carbon compounds
- Refractory organics
- Low level virus titers
- Perchlorates

Conclusions

- A wide range of applications and treatment levels
  - Habitat enhancement
  - Groundwater recharge
  - Fisheries protection
  - High public use passive recreation
  - Aquaculture
- Limitation of treatment level dependent on internal factors related to the wetland plants, soils, biological activity, etc.
- The fusing of polished effluent with background water quality is a goal-
- Psychological effect of using natural systems (constructed wetlands) as a barrier between effluent processing and water quality benefits is significant in reuse i.e., drinking water, Native American fisheries, etc.