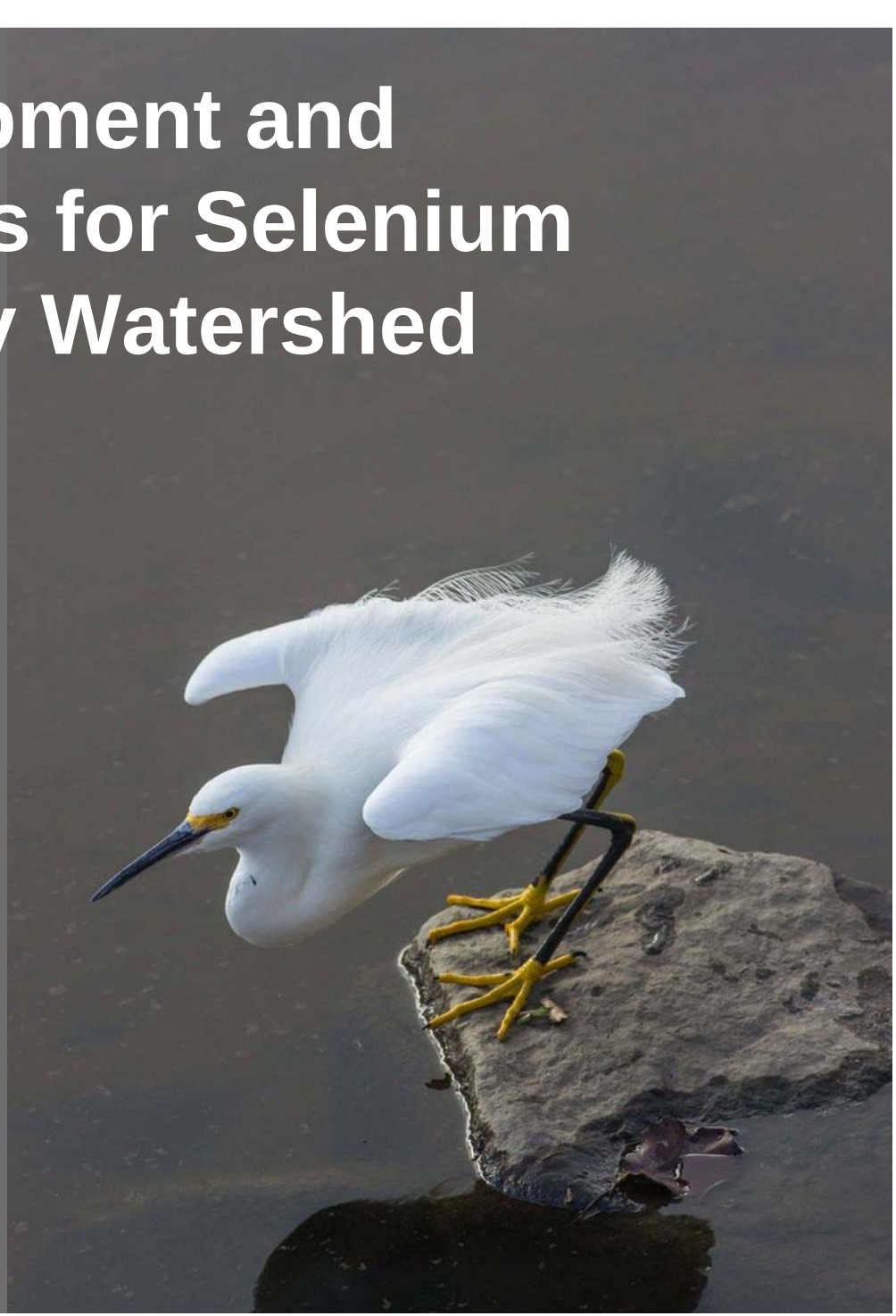
Update on Development and Adoption of TMDLs for Selenium in the Newport Bay Watershed

June 13, 2014



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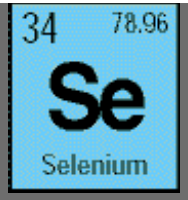
Coastal Waters Planning
Santa Ana Water Board

Outline for Discussion

- Properties of Selenium
- Potential Effects of Selenium
- Water Quality Objectives and Guidelines for Selenium
- Selenium in the Newport Bay Watershed
- Selenium Challenges
- Regulatory Background and History
- NSMP Working Group
- 2009 Draft Selenium TMDLs/SSOs
- Progress Since 2009
- 2014 Final Draft Selenium TMDLs (Karen Cowan, LWA)
- Schedule for TMDLs (and Se SSOs)

Green Heron, PCW



Properties of Selenium

- Naturally occurring trace mineral
  - Found in geologic formations of marine origin
- Highly complex chemistry, significantly affected by site-specific factors (and therefore, a good candidate for SSOs)
- Selenium is a bioaccumulative substance
- Hydrologic retention times, biological productivity, and food web composition play key roles in its bioaccumulation


Great Blue Heron

Properties of Selenium

Selenium is a mineral essential for reproductive health and immune system function in humans, fish and wildlife

- BUT, the margin between nutritionally optimal and detrimental amounts is very narrow
- In aquatic ecosystems, selenium can bioaccumulate in food webs at concentrations that can impair reproduction in sensitive fish and birds

Black-necked Stilt, PCW

Effects of Excessive Selenium in Fish and Wildlife

- Selenium bioaccumulates primarily through diet
  - Se is passed up the food chain to higher level, predatory organisms
  - Which then pass it to their offspring
- Potential Effects from Se:
  - Deformities
  - Stunted growth
  - Reduced hatching
  - Failure to swim up
  - Suppressed immune system function

➢ **Overall result: reduced species viability**

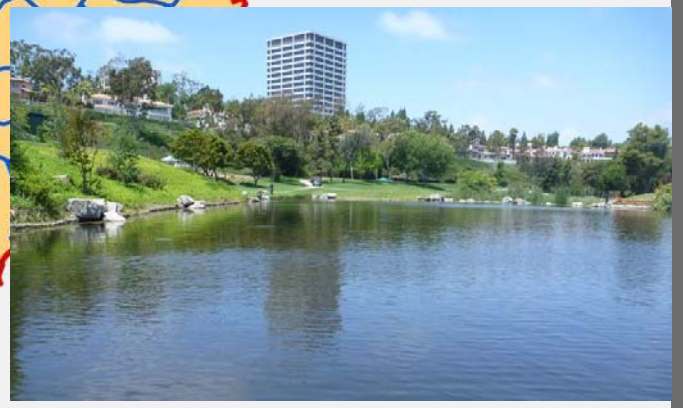
Santa Ana Delhi

San Diego Creek

Upper Newport Bay

Big Canyon Wash

Lower Newport Bay

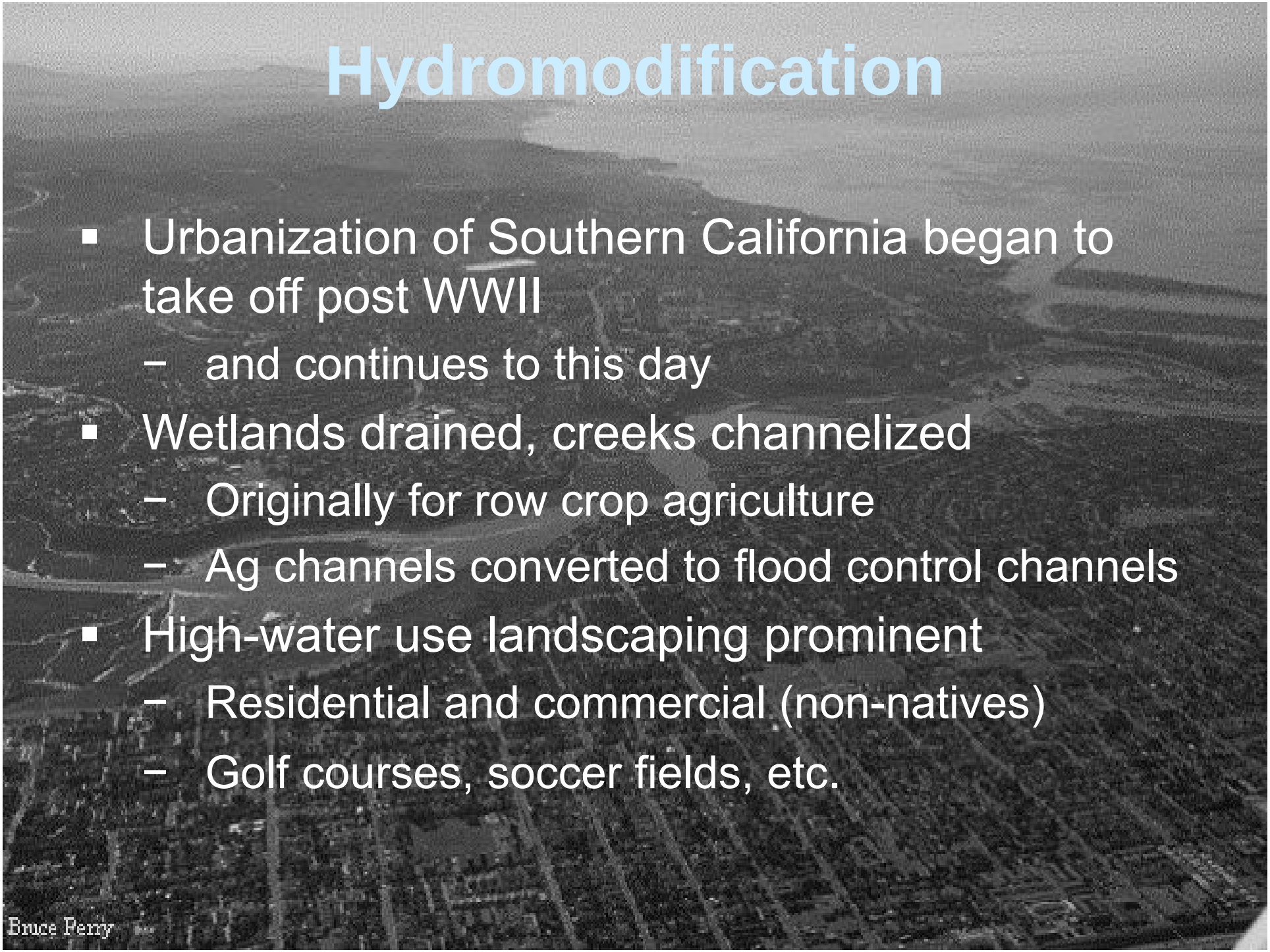


Where is the Selenium Coming From?

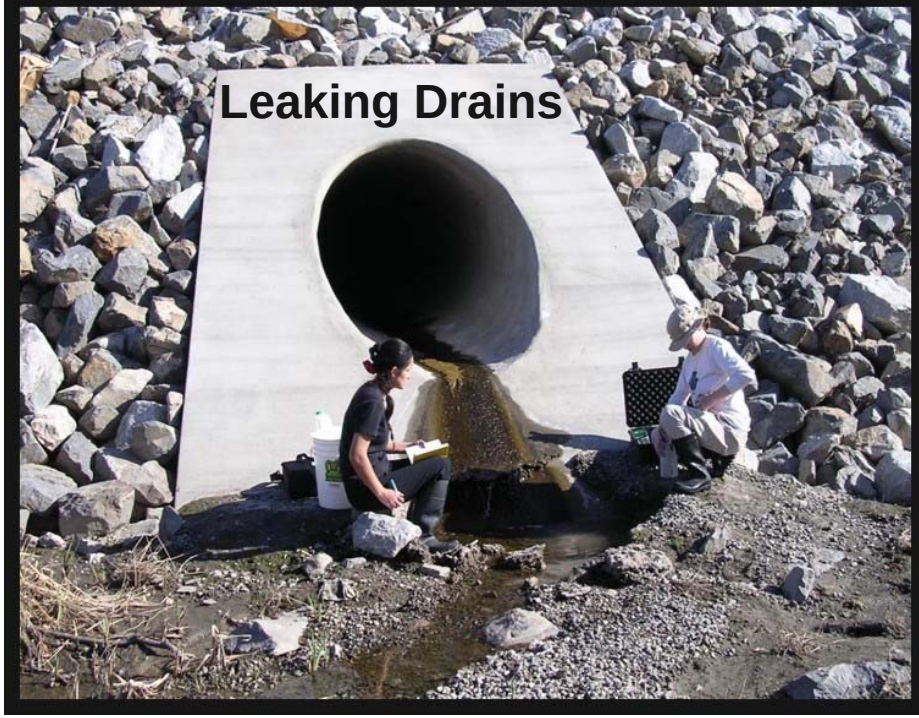
- Southern California geology:
  - Monterey Formation
  - Swamp deposits (e.g., Swamp of the Frogs)
  - Other geologic formations being investigated (e.g. Puente, Topanga, Capistrano)

Hydromodification

- Urbanization of Southern California began to take off post WWII
  - and continues to this day
- Wetlands drained, creeks channelized
  - Originally for row crop agriculture
  - Ag channels converted to flood control channels
- High-water use landscaping prominent
  - Residential and commercial (non-natives)
  - Golf courses, soccer fields, etc.



Groundwater Enters Surface Waters



Selenium and Hydrology

- Hydrologic residence times are important in Se cycling and bioaccumulation
  - The shorter the residence time (as in flowing, or lotic systems) the less chance Se has to convert to more bioavailable forms
  - Longer residence times (lentic systems such as lakes, ponds and marshes) allow for changes in Se species and increased bioaccumulation in aquatic food webs

Narrative and Numeric Objectives

"Toxic substances shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health.

The concentrations of toxic substances in the water column, sediments or biota shall not adversely affect beneficial uses."

- Total Selenium (Se) in Water for Protection of Fish and Wildlife:
  - Freshwater chronic effects, 5 µg Se/L (CTR)
  - Saltwater chronic effects, 71 µg Se/L (CTR)
  - ➢ Newport Bay does not exceed the current CTR chronic criterion in saltwater of 71 µg Se/L

Guidelines for Ecological Risk from Se

2004 GUIDELINES FOR ASSESSING RISK TO AQUATIC LIFE AND AQUATIC-DEPENDENT WILDLIFE ECOLOGICAL RISK THRESHOLDS FOR SELENIUM[1]			
	None	Marginal	Substantive
Freshwater (µg/L)	<2	2–5	>5
Sediment (mg/kg)	<2	2–4	>4
Diet (mg/kg)	<3	3–7	>7
Fish (mg/kg diet) (whole body)	<4	4–6	>6
Avian eggs (mg/kg)	<6	6–10	>10

Note: sediment and tissue guidelines are dry weight values

[1] Presser et al., 2004

Median Selenium Concentrations in the Newport Bay Watershed (2010-2013)

- San Diego Creek Subwatershed:
  - Water = 16.0 µg Se/L
  - Fish Tissue* = 15.3 µg Se/g
  - Bird Eggs = 5.4 µg Se/g

- Big Canyon Wash Creek Subwatershed:
  - Water = 20.0 µg Se/L
  - Fish Tissue = 60.0 µg Se/g
  - Bird Eggs = 40.2 µg Se/g

Bluegill sunfish and Fathead Minnows

* Tissue concentrations are dry weight concentrations

Hydrologic Differences = Different Degrees of Bioaccumulation

Lotic

Lentic

Selenium in the NB Watershed

- Selenium concentrations in freshwater fish are at levels that may cause reproductive harm
- Selenium concentrations in some bird eggs are at levels that may cause reproductive impairment

➢ Selenium has not been found to be impairing beneficial uses in Newport Bay

Selenium Challenges

- Largest source of selenium in the Newport Bay watershed is rising groundwater (non-point source)
  - Approximately 65-70% of selenium inputs to surface waters are from diffuse NPS rising groundwater
  - Only 30-35% of selenium inputs to surface waters are from point source (NPDES-regulated) discharges of groundwater

Selenium Challenges

- No reasonably feasible off-the-shelf treatment technology for Se
  - Requires significant land area to implement
  - High costs both for construction and long term maintenance and operation
- Most technologies create additional challenges:
  - Waste streams, bacteria, low dissolved oxygen
  - Discharge may contain more bioavailable forms of selenium

Regulatory History

USEPA promulgated “technical” TMDLs for Se for San Diego Creek, Upper and Lower Newport Bay in 2002

- TMDLs based on California and National Toxics Rule criteria
  - Water column concentration-based criteria
  - Chronic criterion in freshwater: 5 µg/L (CTR)
  - Acute criterion in freshwater: 20 µg/L (NTR)
- Technical TMDLs do not include an implementation plan or compliance schedule

Order No. R8-2004-0021

- Regulated short-term groundwater dewatering discharges to surface waters in the Newport Bay watershed
  - Se effluent limitations based on CTR criteria for the first time
  - Immediate compliance with Se limit effluent limitations was infeasible
    - No practicable Se treatment technology available
- Triggered the formation of the Nitrogen and Selenium Management Program (NSMP) Working Group

NSMP Working Group

- NSMP Working Group comprised of local agencies and water districts, environmental groups and RB staff
- NSMP Working Group key commitments:
  - Improve understanding of Se in the watershed
  - BMP and technology evaluation
    - Pilot testing
  - Se TMDL/SSO development

➢ Order No. R8-2004-0021 incorporated the NSMP approach

NSMP Achievements

- Key advancements in
  - Understanding the fate and transport of Se
  - Developing a conceptual model of Se in the watershed
  - Filling key data gaps
  - Pilot testing BMPs and treatment technologies
  - Developing TMDLs and Site-Specific Objectives (SSOs)
- Collaborative working relationship with Regional Board, environmental groups, other stakeholders, SWRCB, and several Federal agencies

2009 Draft TMDLs/SSOs

- Joint stakeholder (NSMP) and regulatory agency effort (RB8, SWRCB, USEPA R9, USFWS, USGS)
  - Developed draft SSOs based on fish and bird egg tissue concentrations
  - Adapted USGS biodynamic model to translate tissue concentrations into water
    - To help assess effectiveness of management measures or to use as effluent limits in permits
- Not able to complete TMDLs/SSOs by end of 2009
  - Scientific, technical, regulatory, and legal challenges

Progress Since 2009

Continued work by Regional Board staff and stakeholders to address selenium, including:

- Reassessment of proposed fish tissue targets for Se using new data
- Continued investigation into potential treatment options and BMPs
  - Assess feasibility of diverting high selenium flows to sewer without negatively impacting beneficial uses
  - Pilot testing of new promising treatment technologies

Progress Since 2009

- Development (and early implementation) of a BMP Strategic Plan to address selenium reductions
  - Cienega project
  - **Diversion projects:**
    - **PCW Pipeline**
    - **Santa Ana Delhi Channel**
    - **Big** Canyon **Diversion Project**

➢ **Balance between reducing Se concentrations and reducing flows**

Progress Since 2009

- Development (and early implementation) of a Regional Monitoring Program (RMP) to continue monitoring of selenium in various media throughout the watershed
- Collaborative effort by Regional Board staff and the NSMP Consultant Team to develop Final Draft Se TMDLs & SSOs
  - Led by Larry Walker Associates (LWA)
  - Support from CH2M Hill, RBF, GEI Consultants, Risk Sciences

Questions?

Pair of Mallards and White-faced Ibis, Peters Canyon Wash
- Doug Shibberu, RB staff