Surface/Ground Water Interface and Radioactive Contaminant Ecological Risk Assessment Using EPA Method in the (F-Area)-Savannah River Site (SRS) Aiken, SC.

Mohammed Albassam (DOE Fellow)
Juan Carlos Morales (DOE Fellow)

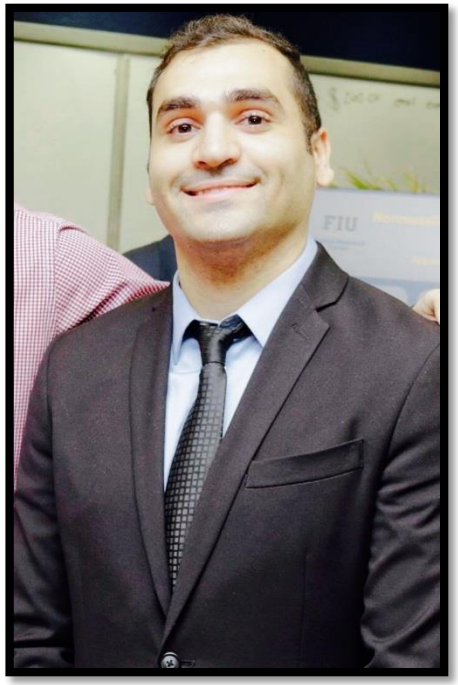
DOE-FIU Science and Technology Workforce Development Program
Applied Research Center
Florida International University

FLORIDA INTERNATIONAL UNIVERSITY

Summer 2017 Internship at DOE-EM HQ

FIU Applied Research Center

Juan Carlos Morales
Ph.D.
Environmental Health Sciences



Mohammed Albassam
Master's
Water Resources Engineering

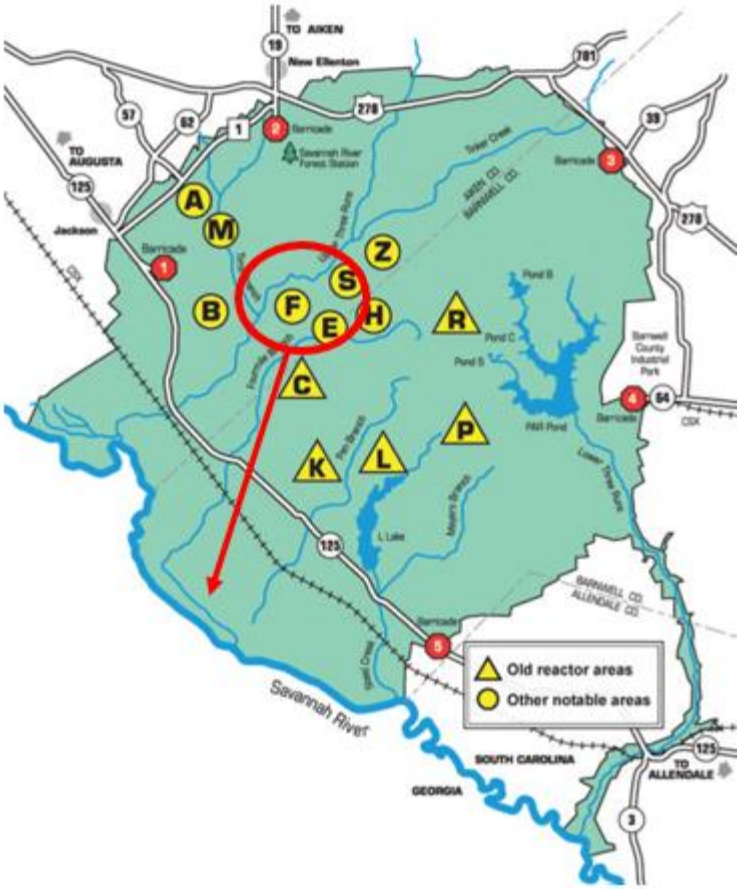
Summer 2017 Internship at DOE-EM HQ

FIU Applied Research Center

Summer mentors:
Skip Chamberlain, Jr and Kurt Gerdes
DOE-HQ
Office of Environmental Management

Background

- Savannah River Site (SRS) Aiken, SC.
- F-Area Located in the central point of the SRS.
- Covers approximate area of 6.5 acres with elevation of 55-90 m.
- From 1955-1988, the F-area discharged radioactive and hazardous metals into seven seepage basins.
- Contamination of the underline grounds and upper aquifers.
- Creation of underground plume that crops out a seeplines along a stream approximately 400-600 m from the basins.



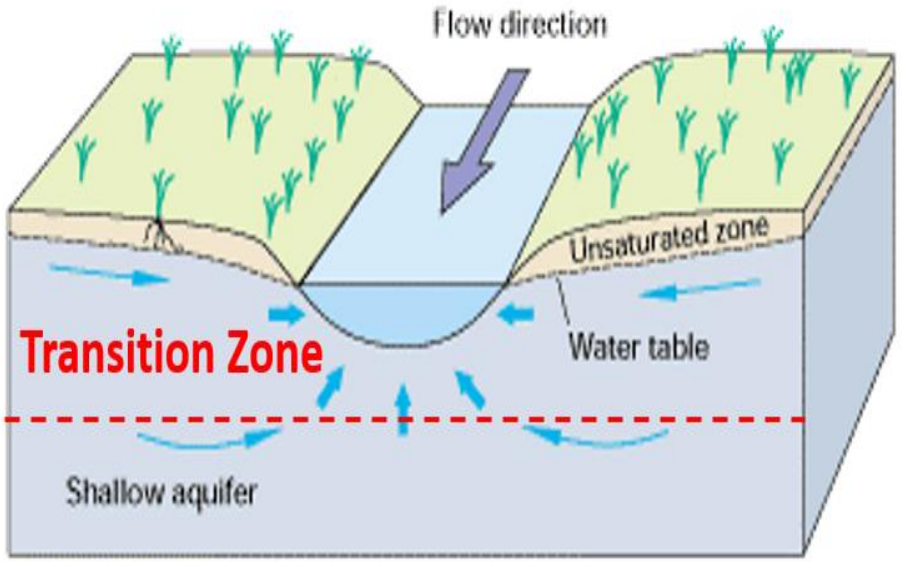
Scope/Objective

1. Understanding the concept of surface water/ground water interface phenomenon in the Savannah River Site (F-Area).
2. Develop a conceptual Ecological Risk Assessment for the Savannah River Site (F-Area).

Method / Approach

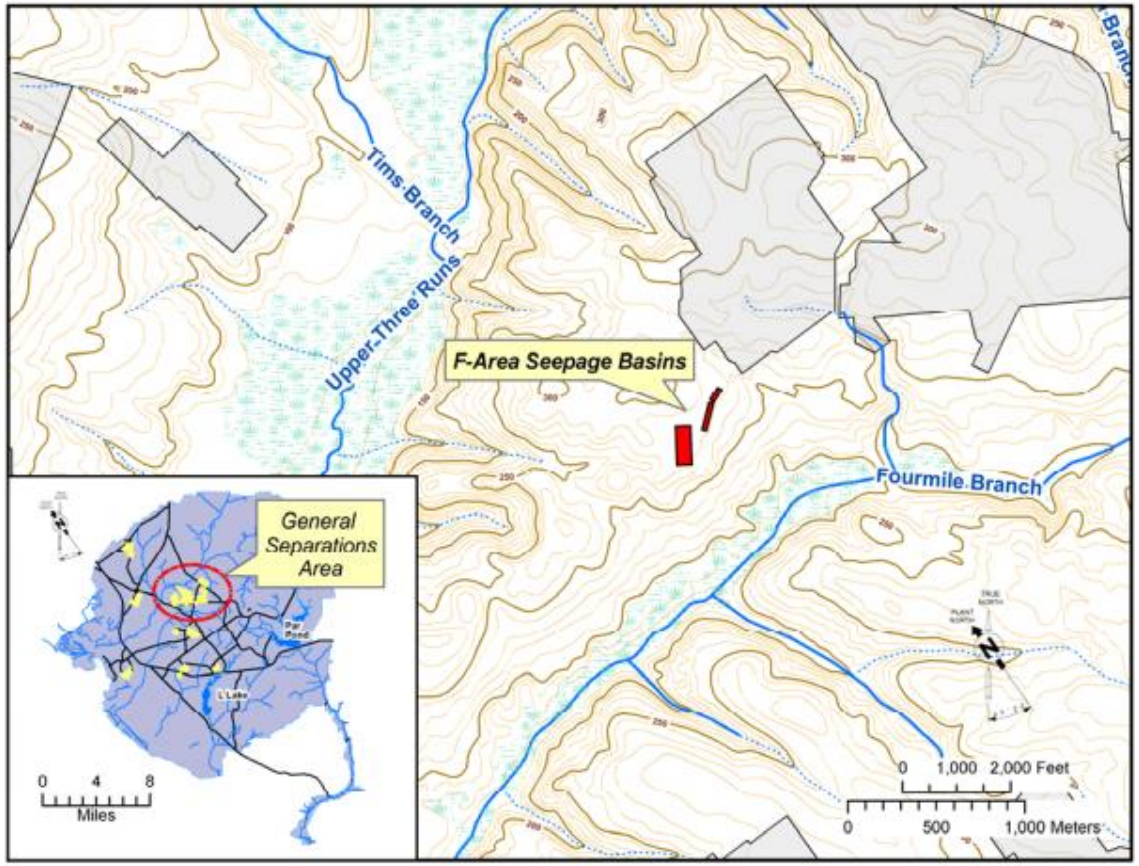
Surface water/ground water interface:

- Most surface water bodies such as lakes, rivers, and wetlands systems are connected to ground water.
- Transition zone is an ecological community with important ecosystem functions affecting several trophic levels from microbes to fish.
- The interchange of this phenomena in a hydrological system may develop a possible contamination of surface water especially if the ground water system contains a plume of contaminants.



Method / Approach

- The F-area is located above the Atlantic Coastal Plain aquifer.
- The main recharge source for the Atlantic Coastal Plain aquifer is precipitation.
- Based in the location of the F-area, the surface-water/ground-water interface is most likely to occur since the plume is still active and the area is located near to two main surface water bodies which are the Upper-Three Runs and the Fourmile-Brach streams.



Method / Approach

Ecological Risk Assessment:

1. Definition and History
2. How can ERA help SRS- FASB
3. Methodology
4. Problem
5. Receptor
6. Toxicity Assessment
7. Risk Characterization

Why use an ERA

Project Conception

- Evaluation of design options/ process scenarios
- Technical supporting documentation for project approval documents

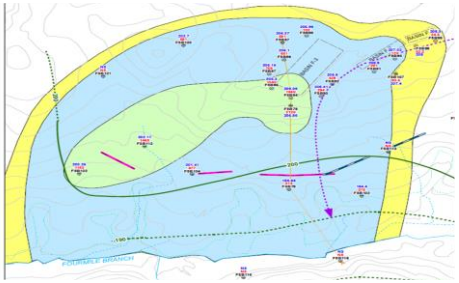
Project Operations

- Design of monitoring programs
- Guidance on controls required to meet environmental goals during remediation

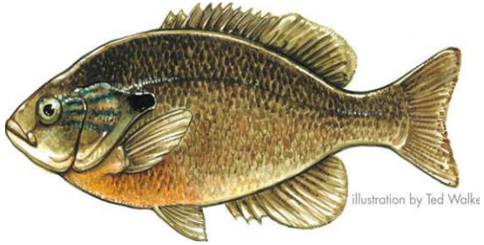
Closure

- Design of post closure monitoring programs
- Guidance for environmental controls during closure stages
- Evaluation of different closure options

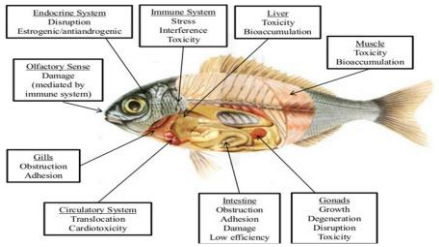
Methodology



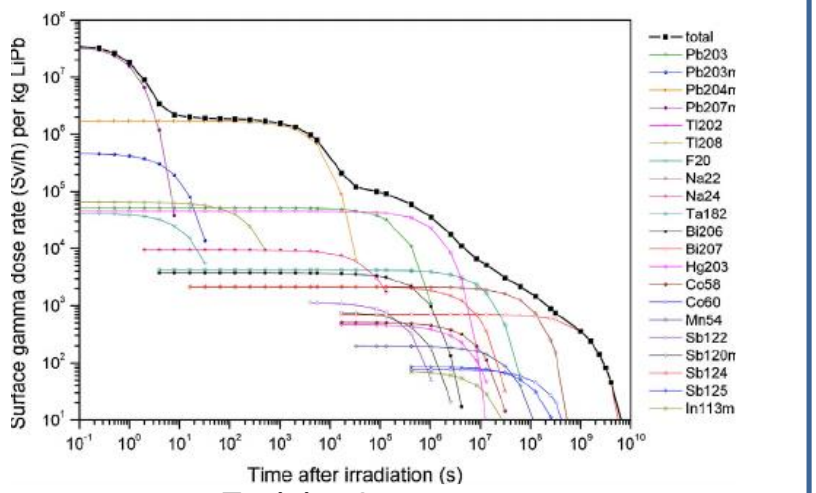
Problem Identification



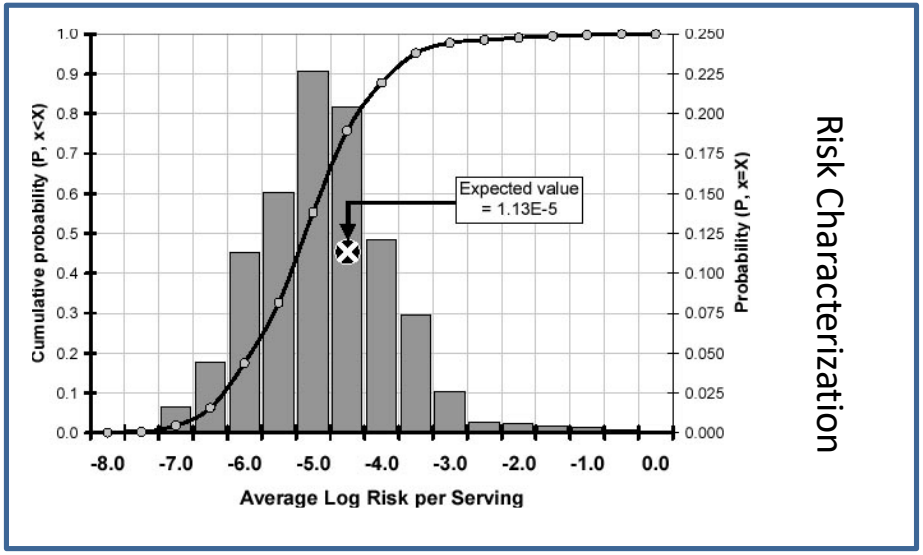
Receptor Identification



Exposure Assessment



Toxicity Assessment



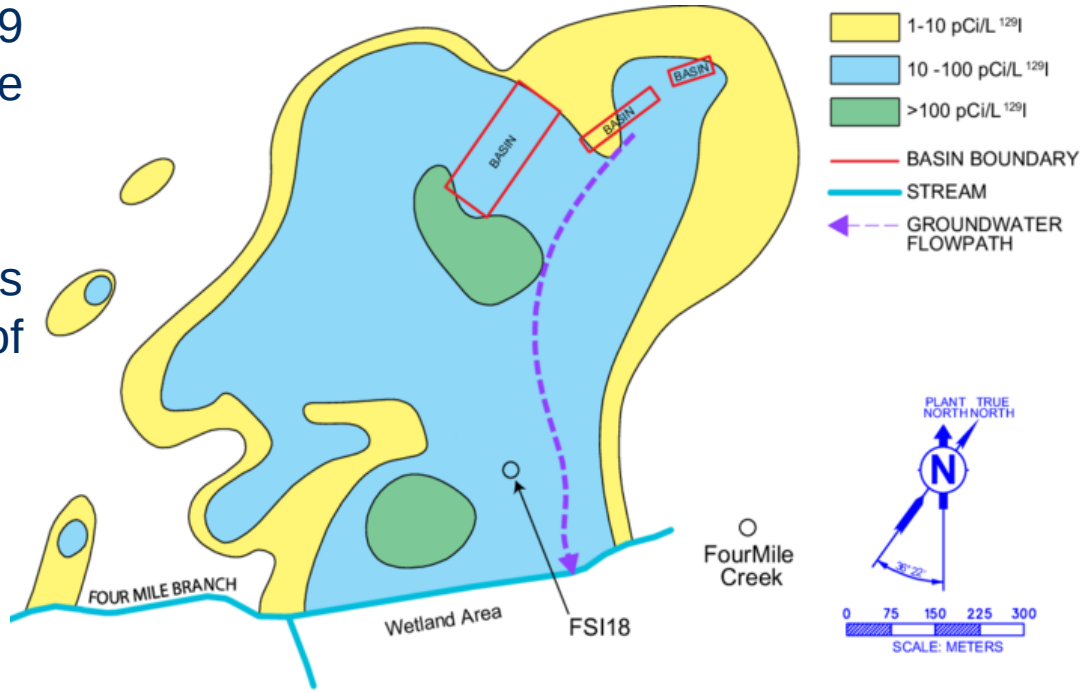
Risk Characterization

Site-specific Ecological Risk Assessment

FIU Applied Research Center

- Groundwater is contaminated with I-129, U-234/238, and Tc-99 because of past operations in the (F-area)

- Migration of contaminants was characterized by a number of environmental investigations
  - Soil acidic
  - Surface/groundwater interface



Receptor of Concern

- Criteria for selecting surrogate receptors included:
  - Known to occur or is likely to occur at the site
  - Is representative of an important taxonomic group/ trophic level
  - Ecological information in readily available
  - Considered to be radiosensitive

- Species-specific exposures factors were used to model radiation exposures
  - Obtained from literature sources
  - Derived using allometric equations
  - Data was extrapolated closely to the related species
  - (lepomis auritus) RedBelly Sunfish

Dose Rate Modeling

- Both external and internal radiation were considered
- Internal dose was calculated with tissue concentration
  - Ingestion of different food sources (plants/ insects)
- Calculate the Maximum tissue concentration within the lifetime
  1. Radiological decay and biological decay
- Screening Analysis
  - Bioaccumulation factors
  - The dose rate for gross gamma (γ) and gross beta (β) isotopes.
- $BAF = \frac{C_{fish}}{C_{medium}}$
- $D_\gamma = 5.76\ x\ 10^{-4} E_\gamma n_\gamma (1 - \Phi) C_S R$ $\mu Gy\ h^{-1}$ (external dose)
- $D_\beta = 5.76\ x\ 10^{-4} E_\beta n_\beta C_0$ $\mu Gy\ h^{-1}$ (internal dose)

Risk Characterization

- HQ= Dose total / dose limit
- 0.04 $\mu Gy\ h^{-1}$ = 1rad per day (USDOE)

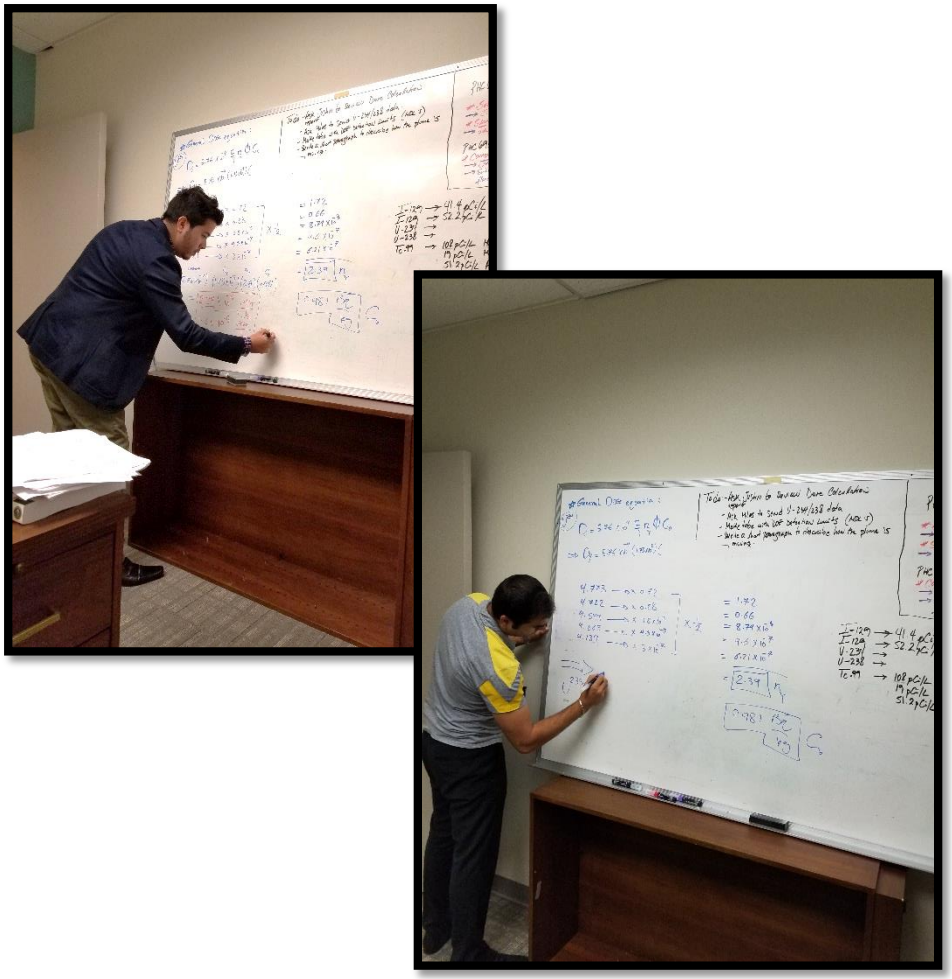
- $HI = HQ_{U-234} + HQ_{U-238} + HQ_{I-129} + HQ_{Tc_{99}}$

HI < 1, no unacceptable risks

HI > 1, potential for unacceptable risks

Expected Results

- Potential radiation exposures in current conditions in Fourmile branch will be below levels that could result in potentially unacceptable risks.
- Further evaluation is needed to warrant the remediation to monitor the aquatic organisms .
- Plume remediation can expect to decrease ecological exposures and potential risks to even lower levels than those identified in this risk assessment.



Acknowledgements

- **Summer Mentors**
  - Kurt Gerdes, OD (Program Director DOE-EM)
  - Skip Chamberlain, Jr (Program Manager, DOE-EM)
  - Dr. Miles Edwin Denham (Research Scientist SRNL)
  - Dr. Carol Eddy-Dilek (Env. Scientist SRNL)
  - Dr. James Poppiti (Chm. Engineer DOE-EM)

- **FIU ARC Mentors**
  - Dr. Leonel Lagos (Program Director ARC)
  - Dr. Mehrnoosh Mahmoudi (ARC)
  - Angelique Lawrence (ARC)

- **DOE-FIU Science and Technology Workforce Development Program**
- **Sponsored by the U.S. Department of Energy, Office of Environmental Management, under Cooperative Agreement #DE-EM0000598.**