# Integrated R Shiny App Code with Piper Plot

# Integrated R Shiny App with GPKG Upload, WQI Calculation, and Piper Plot  
  
library(shiny)  
library(shinydashboard)  
library(shinyWidgets)  
library(plotly)  
library(leaflet)  
library(dplyr)  
library(magrittr)  
library(ggplot2)  
library(sf)  
library(DT)  
library(smwrGraphs)  
library(smwrBase)  
library(readr)  
library(tidyr)  
library(rmarkdown)  
library(shinycssloaders)  
  
calculate\_wqi <- function(gpkg\_path) {  
 layer\_name <- st\_layers(gpkg\_path)$name[1]  
 water\_sf <- st\_read(gpkg\_path, layer = layer\_name, quiet = TRUE)  
 if (sf::st\_crs(water\_sf)$epsg != 4326) {  
 water\_sf <- st\_transform(water\_sf, 4326)  
 }  
 if (!all(st\_is\_valid(water\_sf))) {  
 water\_sf <- st\_make\_valid(water\_sf)  
 }  
 if ("NA" %in% names(water\_sf)) {  
 names(water\_sf)[names(water\_sf) == "NA"] <- "Sodium"  
 }  
  
 standards <- list(  
 TDS = list(St = 1000, Wi = 0.121),  
 EC = list(St = 2500, Wi = 0.121),  
 NITRATE = list(St = 50, Wi = 0.152),  
 SULPHATE = list(St = 250, Wi = 0.121),  
 CHLORIDE = list(St = 250, Wi = 0.093),  
 BICARBONATE = list(St = 500, Wi = 0.152),  
 FLUORIDE = list(St = 1.2, Wi = 0.030),  
 CA = list(St = 100, Wi = 0.060),  
 MG = list(St = 50, Wi = 0.060),  
 Sodium = list(St = 200, Wi = 0.060),  
 K = list(St = 20, Wi = 0.030)  
 )  
  
 water\_sf$WQI <- NA\_real\_  
 param\_names <- names(standards)  
 for (param in param\_names) {  
 if (!param %in% names(water\_sf)) {  
 water\_sf[[param]] <- 0  
 } else {  
 water\_sf[[param]][is.na(water\_sf[[param]])] <- 0  
 }  
 }  
  
 for (param in param\_names) {  
 qi\_col <- paste0("qi\_", param)  
 sli\_col <- paste0("SLi\_", param)  
 water\_sf[[qi\_col]] <- water\_sf[[param]] / standards[[param]]$St  
 water\_sf[[sli\_col]] <- water\_sf[[qi\_col]] \* standards[[param]]$Wi  
 }  
  
 sli\_cols <- paste0("SLi\_", param\_names)  
 sli\_values <- st\_drop\_geometry(water\_sf)[, sli\_cols]  
 sli\_values[] <- lapply(sli\_values, as.numeric)  
 water\_sf$WQI <- rowSums(sli\_values, na.rm = TRUE)  
  
 water\_sf$Quality <- cut(  
 water\_sf$WQI,  
 breaks = c(-Inf, 0.5, 1, 2, 3, Inf),  
 labels = c("Excellent", "Good", "Poor", "Very Poor", "Unsuitable"),  
 right = FALSE  
 )  
  
 return(water\_sf)  
}  
  
ui <- dashboardPage(  
 dashboardHeader(title = "Ground Water Assessment Dashboard"),  
 dashboardSidebar(  
 sidebarMenu(  
 menuItem("Upload", tabName = "upload", icon = icon("upload")),  
 menuItem("Chemistry", tabName = "chemistry", icon = icon("flask"))  
 )  
 ),  
 dashboardBody(  
 tabItems(  
 tabItem(tabName = "upload",  
 fileInput("gpkg\_upload", "Upload GPKG", accept = ".gpkg"),  
 actionButton("load\_data", "Load Data"),  
 verbatimTextOutput("file\_info")  
 ),  
 tabItem(tabName = "chemistry",  
 withSpinner(plotOutput("piper\_plot", height = "700px"), type = 6)  
 )  
 )  
 )  
)  
  
server <- function(input, output, session) {  
 data\_storage <- reactiveValues(csv\_data = NULL, sf\_data = NULL)  
  
 observeEvent(input$load\_data, {  
 req(input$gpkg\_upload)  
 water\_sf <- calculate\_wqi(input$gpkg\_upload$datapath)  
 data\_storage$csv\_data <- st\_drop\_geometry(water\_sf)  
 data\_storage$sf\_data <- water\_sf  
 })  
  
 output$file\_info <- renderPrint({  
 req(data\_storage$csv\_data)  
 cat("Rows:", nrow(data\_storage$csv\_data), "Columns:", ncol(data\_storage$csv\_data))  
 })  
  
 output$piper\_plot <- renderPlot({  
 req(data\_storage$sf\_data)  
 df <- st\_drop\_geometry(data\_storage$sf\_data)  
 PD <- df %>%  
 mutate(  
 Ca.meq = conc2meq(CA, "calcium"),  
 Mg.meq = conc2meq(MG, "magnesium"),  
 Na.meq = conc2meq(Sodium, "sodium"),  
 Cl.meq = conc2meq(CHLORIDE, "chloride"),  
 SO4.meq = conc2meq(SULPHATE, "sulfate"),  
 HCO3.meq = conc2meq(BICARBONATE, "bicarb"),  
 SS = row\_number()  
 )  
  
 piperPlot(PD$Ca.meq, PD$Mg.meq, PD$Na.meq,  
 PD$Cl.meq, PD$HCO3.meq, PD$SO4.meq,  
 Plot = list(name = PD$SS, color = setColor(PD$SS)),  
 zCat.title = "Sodium",  
 xAn.title = "Chloride",  
 yAn.title = "Bicarbonate")  
 })  
}  
  
shinyApp(ui, server)