New Mexico's approach to continuous data management and quality control using Excel Macros

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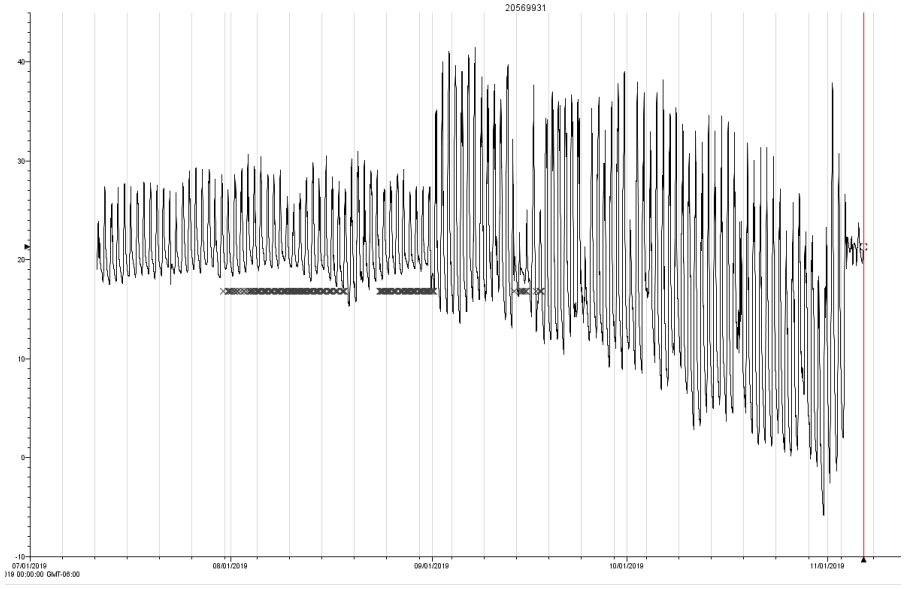
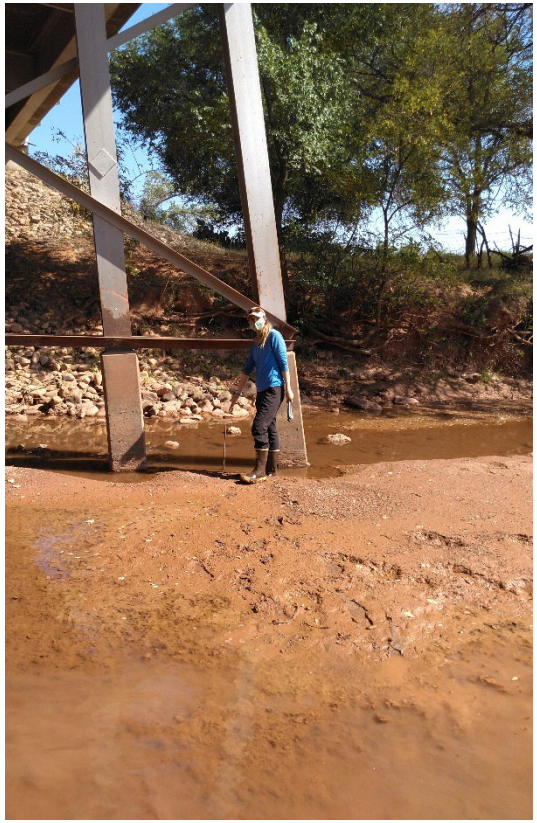
Continuous (LTD) temperature data

- Loggers used: Hobo WTP or Tidbit (where stream drying and logger exposure suspected)
- A typical two-year watershed survey will result in 80-140 temperature logger deployments
- Lots of data – efficient processing, QA/QC and upload method needed



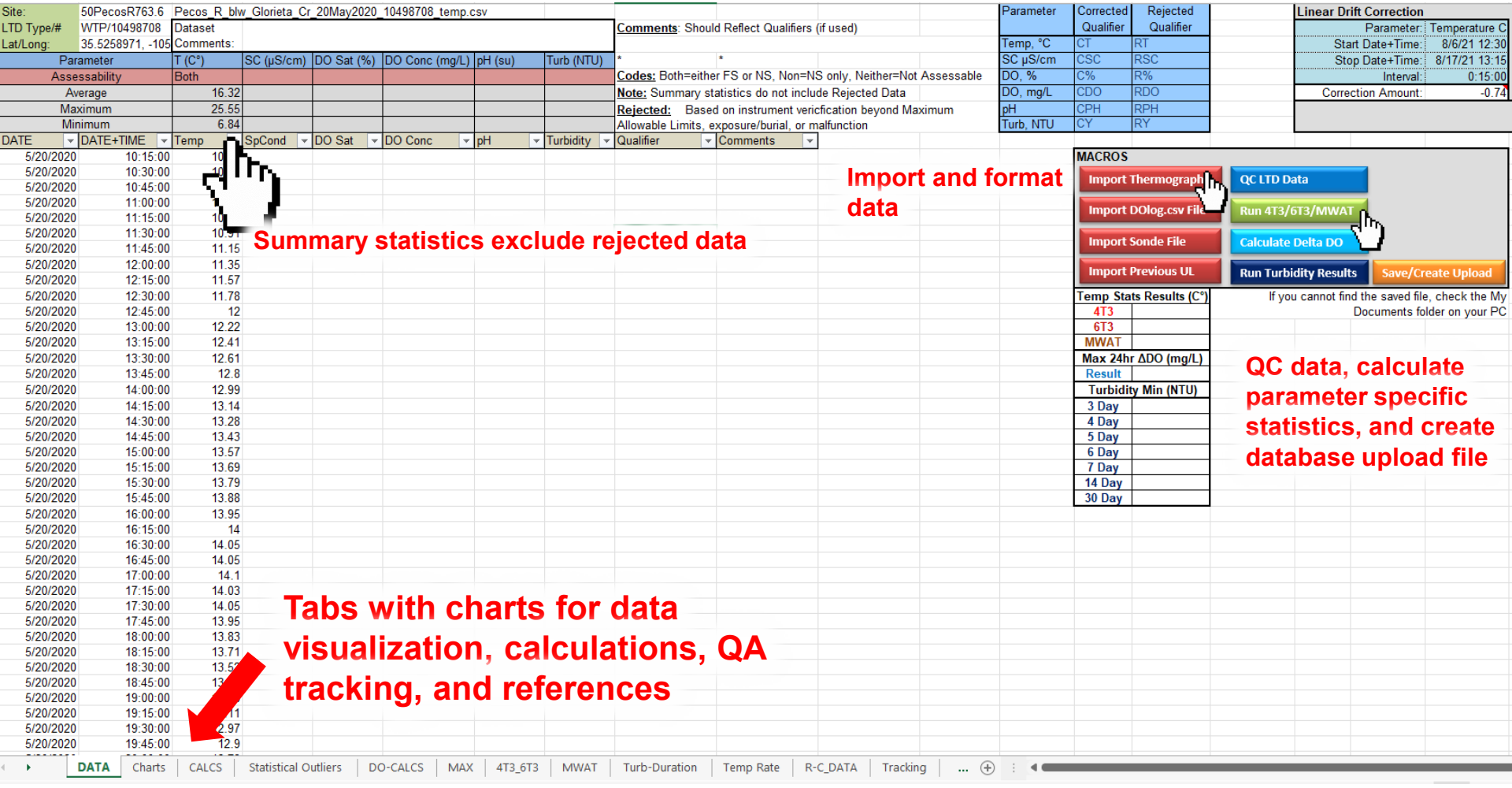
Processing temperature data

- Main challenges:
  - Time intensive “processing” data for upload and assessment– including cleaning up, cropping, QA process
  - Determining whether logger data is representative of ambient conditions (and thus assessable):
    - Submerged in area with adequate flow for duration of data recording period
    - Not buried in sediment, covered with debris, or exposed
    - Data with these characteristics, or otherwise not indicative of ambient conditions are not used for assessment



Continuous monitoring data management

Solution: Macro-enabled template spreadsheet with VBA scripts for importing time series, QA/QC, drift correction, calculating statistics for assessment, formatting for database upload



Site:	50PecosR763.6	Pecos_R_blw_Glorieta_Cr_20May2020_10498708_temp.csv
LTD Type/#	WTP/10498708	Dataset
Lat/Long:	35.5258971, -105	Comments:

Comments: Should Reflect Qualifiers (if used)

Parameter	T (C°)	SC (µS/cm)	DO Sat (%)	DO Conc (mg/L)	pH (su)	Turb (NTU)
Assessability	Both					
Average	16.32					
Maximum	25.55					
Minimum	6.84					

Codes: Both=either FS or NS, Non=NS only, Neither=Not Assessable
Note: Summary statistics do not include Rejected Data
Rejected: Based on instrument vericfication beyond Maximum Allowable Limits, exposure/burial, or malfunction

Parameter	Corrected Qualifier	Rejected Qualifier
Temp, °C	CT	RT
SC µS/cm	CSC	RSC
DO, %	C%	R%
DO, mg/L	CDO	RDO
pH	CPH	RPH
Turb, NTU	CY	RY

Linear Drift Correction	
Parameter:	Temperature C
Start Date+Time:	8/6/21 12:30
Stop Date+Time:	8/17/21 13:15
Interval:	0:15:00
Correction Amount:	-0.74

DATE	DATE+TIME	Temp	SpCond	DO Sat	DO Conc	pH	Turbidity	Qualifier	Comments
5/20/2020	10:15:00	10							
5/20/2020	10:30:00	10							
5/20/2020	10:45:00								
5/20/2020	11:00:00								
5/20/2020	11:15:00	10							
5/20/2020	11:30:00	10.9							
5/20/2020	11:45:00	11.15							
5/20/2020	12:00:00	11.35							
5/20/2020	12:15:00	11.57							
5/20/2020	12:30:00	11.78							
5/20/2020	12:45:00	12							
5/20/2020	13:00:00	12.22							
5/20/2020	13:15:00	12.41							
5/20/2020	13:30:00	12.61							
5/20/2020	13:45:00	12.8							
5/20/2020	14:00:00	12.99							
5/20/2020	14:15:00	13.14							
5/20/2020	14:30:00	13.28							
5/20/2020	14:45:00	13.43							
5/20/2020	15:00:00	13.57							
5/20/2020	15:15:00	13.69							
5/20/2020	15:30:00	13.79							
5/20/2020	15:45:00	13.88							
5/20/2020	16:00:00	13.95							
5/20/2020	16:15:00	14							
5/20/2020	16:30:00	14.05							
5/20/2020	16:45:00	14.05							
5/20/2020	17:00:00	14.1							
5/20/2020	17:15:00	14.03							
5/20/2020	17:30:00	14.05							
5/20/2020	17:45:00	13.95							
5/20/2020	18:00:00	13.83							
5/20/2020	18:15:00	13.71							
5/20/2020	18:30:00	13.5							
5/20/2020	18:45:00	13							
5/20/2020	19:00:00								
5/20/2020	19:15:00	11							
5/20/2020	19:30:00	2.97							
5/20/2020	19:45:00	12.9							

Summary statistics exclude rejected data

Import and format data

MACROS

- Import Thermograph
- QC LTD Data
- Import DOlog.csv File
- Run 4T3/6T3/MWAT
- Import Sonde File
- Calculate Delta DO
- Import Previous UL
- Run Turbidity Results
- Save/Create Upload

Temp Stats Results (C°)	
4T3	
6T3	
MWAT	
Max 24hr ΔDO (mg/L)	
Result	
Turbidity Min (NTU)	
3 Day	
4 Day	
5 Day	
6 Day	
7 Day	
14 Day	
30 Day	

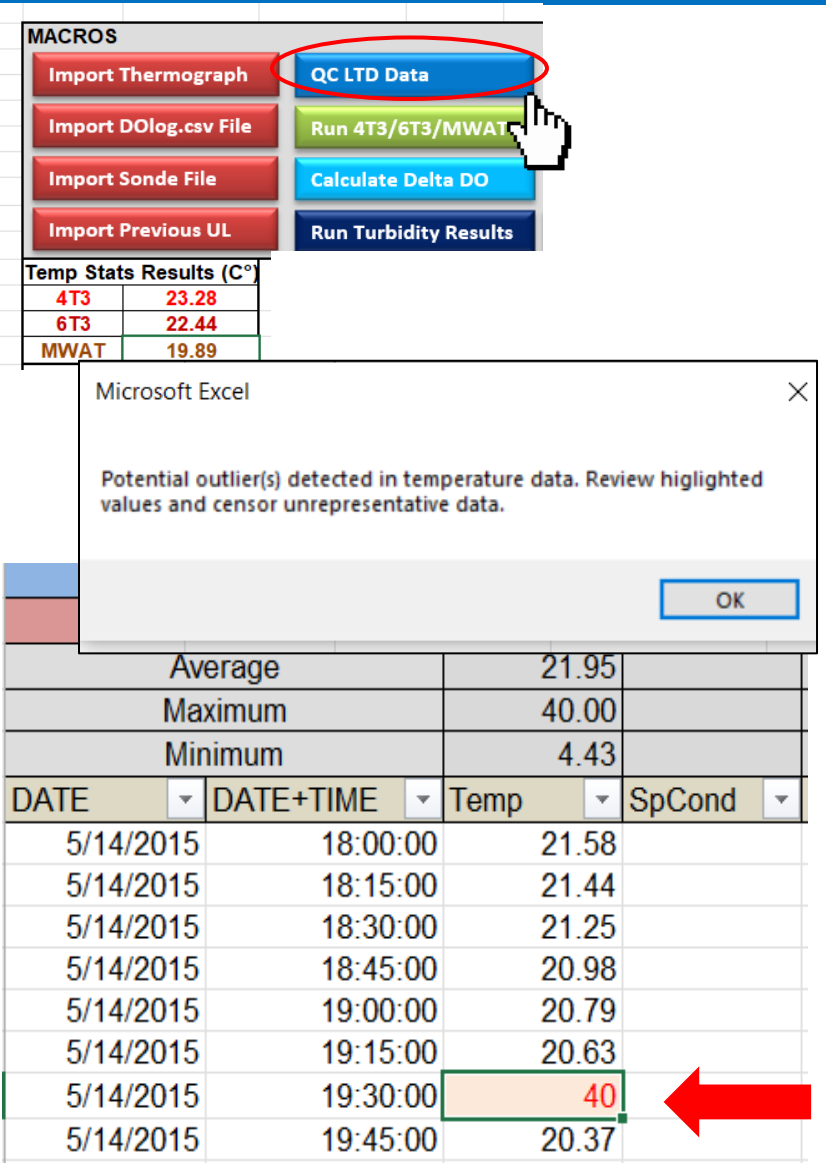
If you cannot find the saved file, check the My Documents folder on your PC

QC data, calculate parameter specific statistics, and create database upload file

Tabs with charts for data visualization, calculations, QA tracking, and references

DATA | Charts | CALCS | Statistical Outliers | DO-CALCS | MAX | 4T3_6T3 | MWAT | Turb-Duration | Temp Rate | R-C_DATA | Tracking | ...

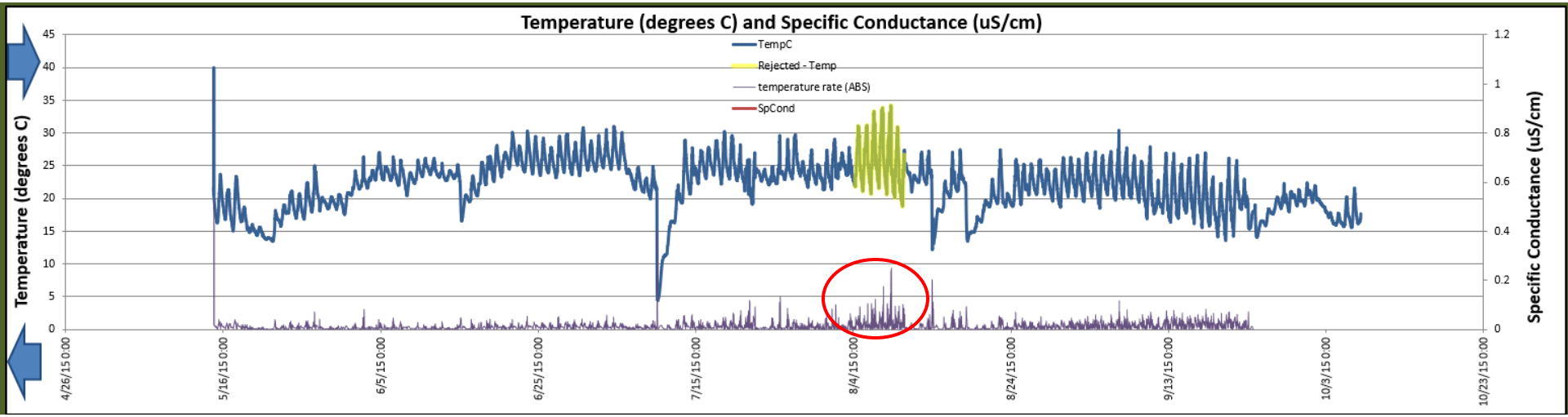
Data QA/QC



- "QC LTD data" – creates graphs with QC features and scans for statistical outliers
- Outliers (temps >75th %tile of measured daily maximum temps +3x IQR)
  - Highlighted, manually reviewed/censored as needed
  - Intended to:
    - reduce influence from autocorrelation of continuous data (independence)
    - demonstrate repeatability of an observation
    - consider potential anomalies in dataset due to extreme air temperatures deviating from seasonal norms/other anomalous events such as runoff from catastrophic fire areas, or instrument errors
  - Data not representative of ambient conditions and non-assessable data are omitted from calculations to generate final assessment dataset

Data QA/QC (continued)

- "Charts" tab displays thermograph (top, blue) along with the absolute 1 hr. temperature difference (bottom, purple)
- Often, exposure indicated by >3 degree C change in temperature within an hour or less
- Data qualifier of "RT" (rejected temperature) added, graph displays rejected data in yellow, data not included in any assessment statistics



Data QA/QC (continued)

Drift Correction Tool

Linear Drift Correction	
Parameter:	SpCond uS
Start Date+Time:	9/11/18 13:28
Stop Date+Time:	9/25/18 11:28
Interval:	0:15:00
Correction Amount:	10

pH4 =	3.50
pH7 =	7.00
pH10 =	10.20
mmHg:	650
Count:	1337.00
Slope:	0.00748

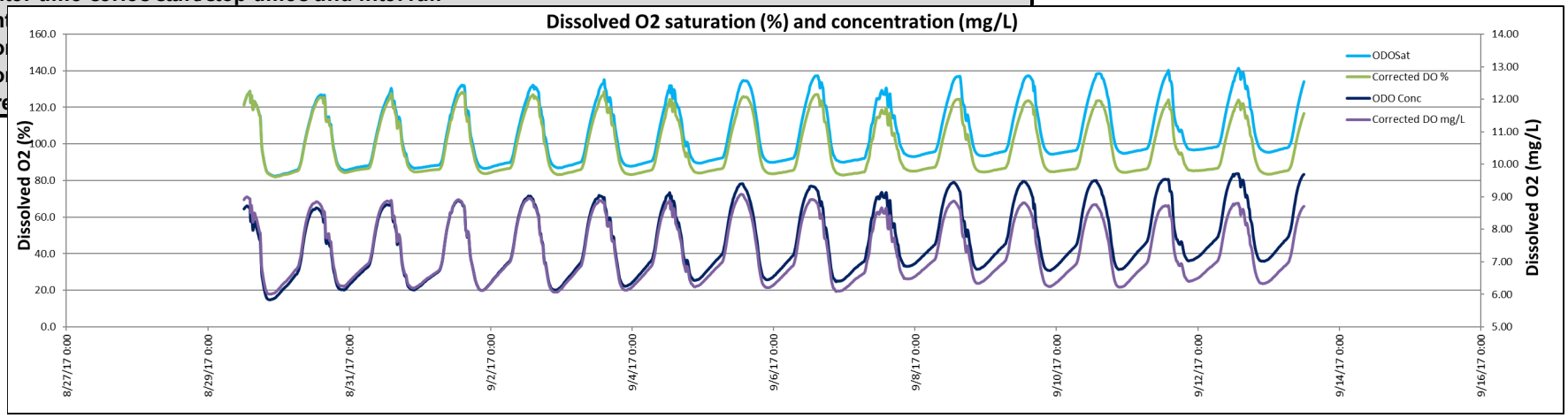
Turbidity Standard	Turbidity Reading
0	0.44
126	
1000	1230.2

Correct!

Drift Correction Instructions

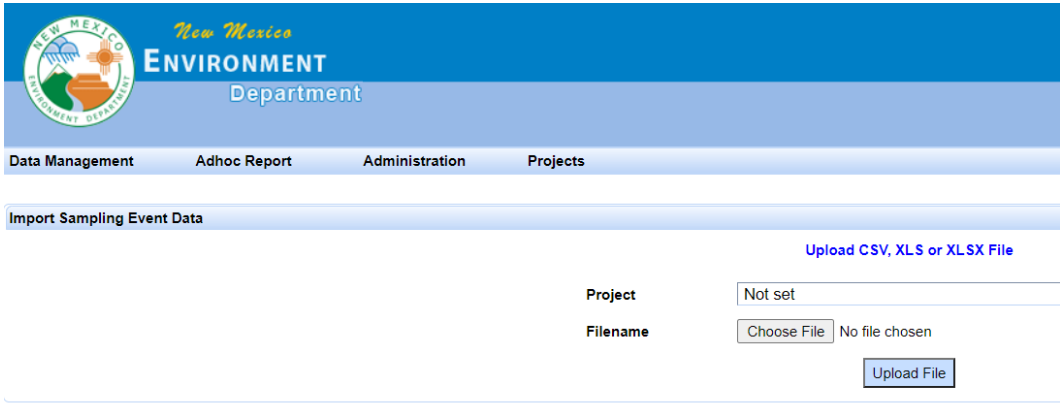
1. Copy and paste data into the data fields to the left.
2. Select parameter from drop down list (Cell S2).
3. Enter time series start/stop times and interval.
4. Ent
5. Fo
6. Fo
7. Pre

Example drift corrected DO dataset



Data management and assessment

- LTD template “save/create upload” macro creates upload file in .csv file format with QA/QC’ed dataset, summary statistics and information needed for assessment
- Archive raw and processed files on server
- “Processed” upload file uploaded into database
- Database can generate “LTD Assessment Report” spreadsheet using summary stats from Excel



- Future improvements: program spreadsheet functions into the database, or switch to R if summary statistic calculations are developed.

Resources

- Long Term Data Management Spreadsheet- Hourly Data
  Long Term Data Management Spreadsheet– 15-Minute Data
- QA Examples

Contacts

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