

# **Enter by Batch:** a new way to document laboratory QC results in LabCal

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# Montgomery County Environmental Services

MCES provides drinking water distribution and wastewater collection and treatment for a large part of the county surrounding the City of Dayton. It operates 2 drinking water distribution systems and 2 water reclamation facilities with over 80,000 customers serving about 250,000 people.

- The Drinking Water Systems distribute about 6.6 billion gallons of water annually
- The Water Reclamation Facilities treat approximately 6 billion gallons of wastewater annually
- Customers are about 90 % residential and 10 % industrial



# Montgomery County Environmental Services

## Centrally located standalone government laboratory

- Knowledgeable lab staff of 6 averaging 25+ years experience
- Analyze drinking water, wastewater, monitoring well water, and biosolids samples
- Offer Microbiological, Metals and Wet Chemistry Testing
- In 2021, the lab performed just over 34,000 tests on 12,000 samples
- Testing is split equally between drinking water and wastewater operations
- A new 10,000 sf lab facility is underway and we hope to move in September 2023



# Montgomery County Environmental Services

## LIMS/WIMS History

- Had an in-house LIMS software that IT Department could no longer support
- In-house software was only easily accessible from the lab
- Moved to WIMS and Lab Cal early 2019
- RIO (previously Claros Collect) and Hach's DR300s are used to collect field data from 128 drinking water locations
- 3 Interfaced Databases
- Lab uses LabCal as a LIMS – receiving samples, printing labels, tracking status, reporting, and invoicing



# Problem/Project

The Lab had this great new system for recording and tracking samples results in WIMS/LabCal and sharing electronically with our internal customers, but after a couple of years of bringing this online we needed ....

- A better way to electronically document, organize, and track all our QC Tests
- A way to generate sample specific and batch specific QC reports
- A way to electronically manage our QC program
- A way to capture ongoing Method Detection Limit sample results and calculate new limits following the 2016 procedure



# Problem/Project

The problem (s)...

- We could create hundreds of variables for different quality control samples but adding them to LabCal for easy entry was problematic
- We already had 10,000 + variables in WIMS and 2000 + sample definitions in Labcal
- Sample specific QC (Duplicates, Matrix Spikes, Matrix Spike Duplicates) would be challenging with current structure
- No easy way to tie the associated samples to the QC samples that were analyzed

It became apparent we needed “**Enter by Batch**” with the ability to add QC tests. We partnered with Scott Dorner and the AQI Team on this project



# Location Setup

- We created a new Location called 'QC' and a sublocation for each one of the tests that we wanted to track QC

The screenshot shows the 'Location Setup' application window. On the left is a tree view of the location hierarchy. The 'QC' folder is expanded, showing a list of sublocations. 'Alkalinity' is selected and highlighted in blue. On the right, the 'Alkalinity' location details are shown. A table lists 10 variables with their IDs, names, units, and a 'Quick Var Info' button for each.

VarNum	Name	Units	D
1	906040 Alkalinity Blank Input	mg/L	Quick Var Info
2	906043 Alkalinity Blank	mg/L	Quick Var Info
3	906046 Alkalinity Duplicate (RPD Calc) Input	mg/L	Quick Var Info
4	906049 Alkalinity Duplicate (RPD Calc)	mg/L	Quick Var Info
5	906052 Alkalinity QCS Input	mg/L	Quick Var Info
6	906055 Alkalinity QCS	mg/L	Quick Var Info
7	906058 Alkalinity Matrix Spike (%RC) Input	mg/L	Quick Var Info
8	906061 Alkalinity Matrix Spike (%RC)	mg/L	Quick Var Info
9	906064 Alkalinity Matrix Spike Dup Input	mg/L	Quick Var Info
10	906067 Alkalinity Matrix Spike Dup	mg/L	Quick Var Info

OPSSYS\_BD (2/18/2022 9:21:29 PM) LOCATION.LOCID: 2017

# Variable Setup

- We created QC Variables for everything we wanted to track. These are set up as minutely variables. Each QC has an **'Input'** variable and a **'Calc'** variable
- Input QC Variables are used to enter raw values into LabCal
- Calc QC Variables are used to store the calculated results from the QC Variables
- We also needed to add information the new **QC** tab in **Test Setup**
- This information included the QC Name we wanted to call it as well as the default spike or QC concentration



# QC Tab in Test Setup

Test Setup

Navigation: First, Prev, Next, Last, ... Browse, New, Del, Copy, [Icons]

Name: TSS

Description: Total Suspended Solids

Analysis Method: SM20 2540D

Prep Method: [Dropdown]

Acronym: TSS

Basis: [Text Box]

Record Status: Active  Inactive

Buttons: Save & Close, Add Tests From Library, Exit

Tabs: Misc., **QC**, Notes, User Defined, Format

Buttons: Add QC Var, Del QC Var

QC Name	QC Type	Spike Conc / Std Conc	QC Input Variable	QC Calc Target Variable
Blank	Blank		906840 - TSS Blank Input	906843 - TSS Blank
CCV	Standard	1000	906846 - TSS CCV Input	906849 - TSS CCV
Duplicate	Duplicate (RPD)		906852 - TSS Duplicate (RPD Calc) Inp	906855 - TSS Duplicate (RPD Calc)

# Enter by Batch

- A new tab called **Enter by Batch** has been added to LabCal home screen. This feature allows user to enter QC and samples as a run batch
- Similar to **Enter Results** tab but allows user to use a template to insert default QC such as blanks and standards that is in every batch
- It allows us to assign sample specific QC such as Duplicates and Spikes
- Results/QC are tracked by a unique analytical batch number
- Standards and spike amounts can be edited if they vary from the default values
- QC is automatically calculated, and user can see if limits are met as they are entered



# Enter by Batch Tool Bar

Create a new Prep Batch

Save Batch

BATCH

The screenshot shows a software interface for a 'BATCH' tool bar. It contains 15 icons with corresponding labels below them. The icons are: a plus sign in a square (New), a pencil (Prep), a folder (Open), a floppy disk (Save), a printer (Print), a checkmark in a square (Set Status), a floppy disk with a plus sign (Save as Template), a flask with a plus sign (Add Sample/Test Batch), a flask with a minus sign (Remove Sample/Test Batch), an upward arrow (Move Up), a downward arrow (Move Down), a trash can (Clear Cells), a location pin (Approve Data), a document with a plus sign (Add Info), a flask (Blank), a flask with a plus sign (Standard), a flask with a minus sign (Dup), a flask with a lightning bolt (Spike), and a flask with a lightning bolt and a plus sign (Spike Dup). A vertical line separates the first 13 icons from the last 5. Below the last 5 icons is the text 'QC Tests'. Red callout boxes point to the 'New', 'Prep', 'Open', and 'Save' buttons.

New	Prep	Open	Save	Print	Set Status	Save as Template	Add Sample/Test Batch	Remove Sample/Test Batch	Move Up	Move Down	Clear Cells	Approve Data	Add Info	Blank	Standard	Dup	Spike	Spike Dup
-----	------	------	------	-------	------------	------------------	-----------------------	--------------------------	---------	-----------	-------------	--------------	----------	-------	----------	-----	-------	-----------

QC Tests

Create a new Analytical Batch

Open an existing batch

# Enter by Batch Tool Bar

Set Status of Batch as Open or Closed

BATCH

The screenshot shows a horizontal toolbar with a dark blue header labeled 'BATCH'. Below the header, there are 15 icons in a row, each with a corresponding label below it. The icons are: a document with a plus sign, a pencil, a folder, a floppy disk, a printer, a checkmark, a floppy disk with a plus sign, a flask with a plus sign, a flask with a minus sign, an upward arrow, a downward arrow, a trash can, a location pin, and a document with a plus sign. The labels are: New, Prep, Open, Save, Print, Set Status, Save as Template, Add Sample/Test Batch, Remove Sample/Test, Move Up, Move Down, Clear Cells, Approve Data, and Add Info. To the right of these icons is a vertical line, followed by five more icons: a flask, a flask with a checkmark, a flask with a lightning bolt, a flask with a lightning bolt and a checkmark, and a flask with a lightning bolt and a checkmark. Below these icons are the labels: Blank, Standard, Dup, Spike, and Spike Dup. Below the 'Spike Dup' label is the text 'QC Tests'.

New Prep Open Save Print Set Status Save as Template Add Sample/Test Batch Remove Sample/Test Move Up Move Down Clear Cells Approve Data Add Info

Blank Standard Dup Spike Spike Dup

QC Tests

Allows you to print a completed Batch Report or Bench Sheet or Work Sheet

Allows you to save the Default QC and order as a Template to use on future batches

# Example of TSS/TVSS Worksheet (Batch Report)

## TSS, TVSS (SM 2540 D, E)

Analyst \_\_\_\_\_ Analysis Date \_\_\_\_\_

0.10 g Weight \_\_\_\_\_ (0.0998 - 0.1002g)  
 1.0 g Weight \_\_\_\_\_ (0.9998 - 1.0002g)

Run Batch \_\_\_\_\_ B220823-02

TSS Oven #1 #2 #3

Time In			
Time Out			

TVSS Furnace #1 #2 #3

Time In			
Time Out			

Filter #	Volume (mL)	Filter (g)	Sample +	Sample +	Sample +
			Filter (g) Initial	Filter (g) Second	Filter (g) Third
Blank	1000				
Standard (mg)	100				
TV=					

Dried Sample + Filter (g)	Volatilized Sample + Filter (g)	Volatilized Sample + Filter (g)	Volatilized Sample + Filter (g)
	Initial	Second	Third

Sample ID	Description					
220823-0012	WR-DIV BOX C					
220823-0012	WR-DIV BOX C					
220823-0013	WR-RAS					
220823-0014	WR-1ST EFF C					
QC						
220823-0021	WR-2ND EFF C					


Miscellaneous Samples/QC

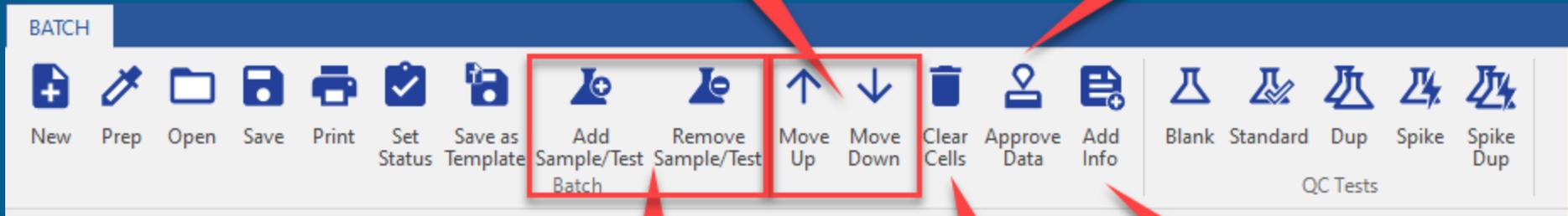




# Enter by Batch Tool Bar

Change the order that samples and QC are displayed

Set Approval Level



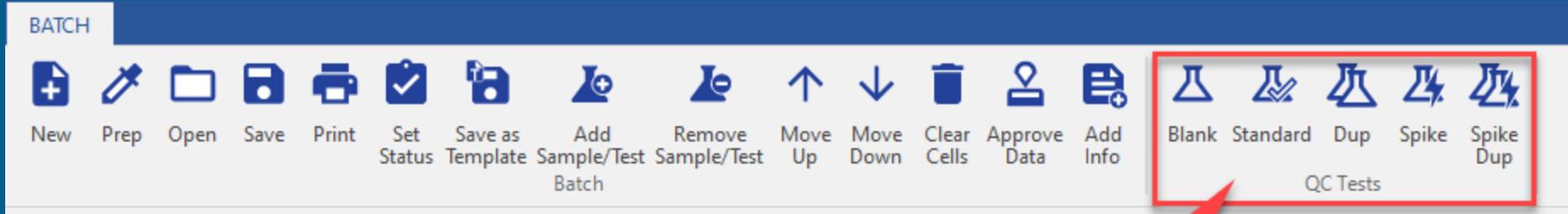
Add or remove samples and QC from a batch as needed

"Erase"

Opens Additional Info Window



# Enter by Batch Tool Bar



Allows the addition of Batch QCV such as Standard and Blanks as well as allows the assignment of sample specific QC such Duplicates and Spikes

# Example of a Completed Batch Entry

**BATCH**

New Prep Open Save Print Set Status Save as Template Add Sample/Test Batch Remove Sample/Test Move Up Move Down Clear Cells Approve Data Add Info

Blank Standard Dup Spike Spike Dup

Analytical Batch # **B220819-04** Name Fluoride Notes

Batch Start Date: 08/19/2022 08:30 AM Start Analyst: End Analyst: Karen Hellmund

Batch End Date: 08/19/2022 09:30 AM

**Test Info - Fluoride**  
 Sample Loc: Lab QC Input Var: 906416 - Fluoride CCV Input QC Calc Var: 906419 - Fluoride CCV

QC Type: STD Standard Value: 1

**Unique Batch #**

**Editable STD/QC amounts**

Sample #	Sample Name	Test	Method	Result	Units	QC Calc	Analysis Date Complete	Analysis Time Complete h:mm AM/PM	Analyzed By	Result Comment	Variable	Sample Date/Time
1	QC	CCVS (1.0 mg/L)	Fluoride	SM20 4500F-C	0.964 mg/L	96 % Rec	08/19/22	09:30 AM	Karen Hellmund		906419 - Fluoride CCV	
2	220817-0041	S1-C*08 SS 2502 Hingham Ln	Fluoride	SM20 4500F-C	0.91 mg/L		08/19/22	09:30 AM	Karen Hellmund		93027 - Fluoride	8/17/2022 9:39:00 AM
3	220817-0044	S1-C*09 SS 1315 E. Alex Bell Rd	Fluoride	SM20 4500F-C	0.86 mg/L		08/19/22	09:30 AM	Karen Hellmund		94027 - Fluoride	8/17/2022 9:59:00 AM
4	220817-0046	S1-C*06 SS 195 Johanna Dr	Fluoride	SM20 4500F-C	0.84 mg/L		08/19/22	09:30 AM	Karen Hellmund		91027 - Fluoride	8/17/2022 10:20:00 AM
5	220817-0048	S1-C*07 SS 1465 E. Seminary Vlk	Fluoride	SM20 4500F-C	0.84 mg/L		08/19/22	09:30 AM	Karen Hellmund		92027 - Fluoride	8/17/2022 10:41:00 AM
6	220817-0051	S1-C*12 SS 400 Southbrook Dr	Fluoride	SM20 4500F-C	0.83 mg/L		08/19/22	09:30 AM	Karen Hellmund		97027 - Fluoride	8/17/2022 11:10:00 AM
7	220817-0053	S1-C*13 PS Alex-Bell (M-4)	Fluoride	SM20 4500F-C	0.84 mg/L		08/19/22	09:30 AM	Karen Hellmund		98027 - Fluoride	8/17/2022 11:39:00 AM
8	220817-0055	S1-C*14 SS 6330 Karlsridge Dr	Fluoride	SM20 4500F-C	0.83 mg/L		08/19/22	09:30 AM	Karen Hellmund		99027 - Fluoride	8/17/2022 12:04:00 PM
9	QC	Duplicate (220817-0055)	Fluoride	SM20 4500F-C	0.830 mg/L	0.000 % RPD	08/19/22	09:30 AM	Karen Hellmund		906425 - Fluoride Duplicate (RPD Calc)	
10	QC	Matrix Spike (220817-0055)	Fluoride	SM20 4500F-C	2.688 mg/L	93 % Rec	08/19/22	09:30 AM	Karen Hellmund		906437 - Fluoride Matrix Spike (%RC)	

**Sample Specific QC**

**Automatically calculated QC**

# QC Calculations Available

Currently QC calculations are set up for the following:

- Blanks
- Standards (Default Concentrations can be prepopulated)
- Duplicates – Sample specific (Calc RPD)
- Spike – Sample specific (Calc % Rec) (Default Concentrations can be prepopulated)
- Spike Dup – Sample specific (Calc RPD)

Note: You can have as many different “standards” as needed. Each just has to have their own Input and calculated variables and a unique name



# Other QC Tracking Possibilities?

- % Slope For Ion Selective Electrode Methods
- Correlation Coefficients
- Column Efficiency Checks (Nitrate-Nitrite)
- Weight verifications (Gravimetric based tests)
- MDL spikes
- Reporting Limit or Linear Range Checks



# MDL Studies

We also wanted a way to use our new QC variables to capture information required for MDLs Studies that was updated by EPA in December 2016

We were worked with Scott to set up WIMS to capture and calculate the MDL studies for us

Variables for ongoing blanks (existing run blanks) and low-level spiked samples (reporting limit checks) were set up

Scott created a new spread function to generate the Student's T-value required for the MDL calculation

Current report can handle the last 200 blanks results and the last 32 spike samples



# MDL Study Example (Page 1)

## Ongoing MDL Calculation and Validation Worksheet

Laboratory:	Montgomery Co. Environmental Lab	Date of MDL Study:	8/22/2022
Analyte:	As	Method:	EPA 200.5
Instrument:	Optima 4300	Matrix:	Water
Spike Concentration:	3.0	Units:	mg/L

### Spiked Blanks

(include all data generated within the last 2 years)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Date	5/27/22	6/6/22	6/21/22	6/27/22	7/7/22	7/11/22	7/18/22									
Concentration	3.01	3.10	2.77	2.85	3.30	2.16	3.70									
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Date																
Concentration																

Count:	7
Average:	2.9843
Standard Deviation:	0.4777
Student's t-value to use:	3.1427
Calculated MDLs:	1.5014

Method Blanks > existing MDL	0
% Blanks > Existing MDL	0.0
% Blanks OK (<3%)?	YES
% Spiked Blanks < 0	0.0
New MDL Range (Low/High)	0.0500 0.2000
New MDL in Range?	YES

Existing MDL:	0.1
Can the existing MDL be left unchanged?	YES
Spike level okay (<5% spiked blanks <0)?	YES

Calculated MDLs:	1.5014
Calculated MDL:	1.5014

### NOTES:

- Recalculate MDLs and MDLb at least every 13 months.
- Include spiked blank data generated within the last 2 years as long as the data all used the same spike level (include initial results if within 2 years).
- If the lab thinks the sensitivity of the method has changed significantly, then the most recent data may be used (min. of 7 reps, 3 batches, over 3 days).
- The lab has the option to use only the last 6 months or the 50 most recent method blanks, whichever yields the greater number of blanks
- The existing MDL can be left unchanged if the calculated MDL is within 0.5 - 2 times the existing MDL AND less than 3% of the method blanks are greater than the existing MDL.
- If sample analysis is not performed often for a given test, only quarters with actual sample analysis (do not include PT samples) need to have the spiked blanks analyzed. Take the last 24 months of data to generate the MDL.
- If the method is altered in a way that could be expected to change its sensitivity, then re-determine the initial MDL and restart the ongoing data collection.
- Only use data associated with passing calibrations and passing batch QC (reported data).



# MDL Study Example (Page 2)

Laboratory: Montgomery Co. Environmental Lab		Certification Year:	
Analyte: As		Method: EPA 200.5	
Instrument: Optima 4300		Matrix: Water	

Method Blanks																				
(this spreadsheet can calculate up to 200 method blanks)																				
Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Concentration	0.28	-0.53	0.33	-0.40	0.19	-0.26	0.46													
Date	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Concentration																				
Date	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Concentration																				
Date	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Concentration																				
Date	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Concentration																				
Date	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Concentration																				
Date	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Concentration																				
Date	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Concentration																				
Date	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Concentration																				
Date	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Concentration																				

Select Option to Use:	Stand. Dev	Existing MDL:	0.1
Average:	0.0098	Calculated MDLb:	1.2571
Standard Deviation:	0.3969	Calculated MDL:	1.5014
Student's t-value :	3.143	Can the existing MDL be left unchanged?	<b>YES</b>

Number of method blanks entered:	7
MDLb if standard deviation is used:	1.2571
MDLb if 99th percentile is used*:	



# MDL Studies

Info on the new Student's t-value spread function (TINV)

<http://www.opssys.com/InstantKB/article.aspx?id=14713>

Template of the MDL report for ongoing samples

<http://www.opssys.com/InstantKB/article.aspx?id=10713>



# Future Projects ?

- Completing the Prep Batch portion of the project (Tests that have a preliminary digestion, distillation, or extraction procedure)
- Using the QC variables to calculate statistical warning and control limits
- Taking advantage of the WIMS graphing abilities to do trend analysis on QC results and generating Reports
- Using LabCal to generate QC Reports
  - QC History for a Test(s)
  - QC Summary for Sample(s) with multiple tests (i.e. Ammonia, Phos, TSS)



# THANKS!

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## ANY QUESTIONS OR COMMENTS?

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