The Electronic Laboratory Notebook: Design and application of an ELN in the microbiology area of a wastewater laboratory

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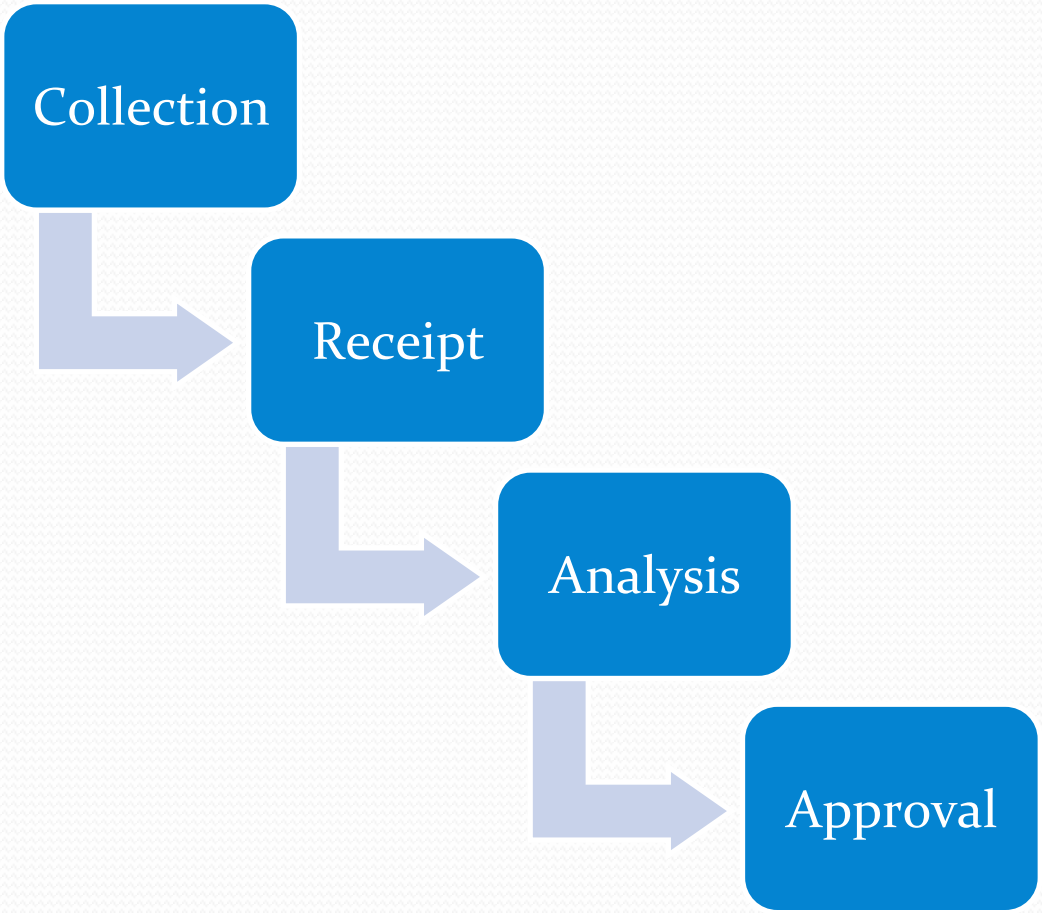
Laboratory Information Workflow



Electronic Laboratory Notebook: ELN

- Tool for managing and storing laboratory analysis and quality assurance logs
- Part of a Laboratory Execution System (LES)
- Use alongside the LIMS system
- Control workflow at the bench level

Advantages in the Laboratory

- Streamline process from collection to approval
- Decrease in transcription and manual calculation errors
- Information is centrally located
- Data is readily available
- Reduced paper use and eliminate multiple log books
- Traceable and auditable information

Design Goals

- Creation of an electronic data worksheet
- Data worksheet that will interface with LIMS system
- Creation of an electronic quality assurance log sheet
- Log sheet will link to the data worksheet
- Worksheets that would adhere to the quality assurance requirements

Part One: Creation of Data and quality log worksheets

Data sheet design

- Use an existing excel template
- Analyst creates a batch of available samples for an analysis in LIMS
- Upload that batch into ELN data sheet
- Analysis and data entry
- Release data into the LIMS system

Data worksheet

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Submit To Labworks

A1 MEDIA

BATCH NAME: FECAL-34138

GET BATCH NAME

FECAL COLIFORM BY MPN METHOD 5 TUBES

RUN Date: 5/1/2016 ***Initial By Tester:*** BB

Sample Type: **PLANT** ***Initial By Reader:*** RR

LIMS ID #	CODE	BB36018	CODE	BB36019	CODE	BB36041	CODE	BB36042	CODE	BB36043
SAMPLE DATE		4/30/2016		5/1/2016		5/1/2016		5/1/2016		5/1/2016
CONTROL #'S		FP Final Effluent		FP Final Effluent		BP Final Effluent		BP Final Effluent		BP Final Effluent
Setup Time		0750		750		750		750		750
Incubation @ 35^{0}C		0820		820		820		820		820
Transfer time (44.5^0)		1120		1120		1120		1120		1120
Readout Time		0800		800		800		800		800
10	0	00000	0	00000	1	+0000	0	00000	2	++000
0	0	00000	0	00000	0	00000	0	00000	0	00000
-1	0	00000	0	00000	0	00000	0	00000	0	00000
-2	0	00000	0	00000	0	00000	0	00000	0	00000
-3	0	00000	0	00000	0	00000	0	00000	0	00000
-4		00000		00000		00000		00000		00000
-5		00000		00000		00000		00000		00000
Preliminary Dilution:		1		1		1		1		1
DILUTION FACTOR		1		1		1		1		1
MPN INDEX FACTOR		000		000		100		000		200
RESULT IN MPN/ 100ML w/o DILUTION		<2		<2		2		<2		4
RESULT IN MPN/100ML w/ DILUTION		<2		<2		2		<2		4

Log worksheet

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Bacteria Cultures Quality Control Log

Run Date: 4/18/2016 **Analyst:** NVL

Culture:	NBC Serial Lot #	NBC Inventory ID	Standard Type:	Media Type	Media Serial #	Expiration
E.coli	16002584-01	15008760-01 ...	STOCK	TSA	16001111-03 ...	6/1/2016
E.faecalis	16002584-02	15008760-02 ...	STOCK	TSA	16001111-03 ...	6/1/2016
E.coli	16002584-03	15008760-01 ...	WORKING	LTB	16001111-04 ...	6/1/2016
E.faecalis	16002584-04	15008760-02 ...	WORKING	AZB	16001111-05 ...	6/1/2016

CONTROLS

Culture	Culture	Culture	Culture
E.coli	E. faecalis	E. coli	E. faecalis
Media Check	Media Check	Media Check	Media Check
A-1	A-1	Enterolert	Enterolert
Media Serial #	Media Serial #	Media Serial #	Media Serial #
16002227-07 ...	16002227-07 ...	8033-05 ...	8033-05 ...
Result	Result	Result	Result
pos	neg	neg	pos

Dilution Water Lot # 25307B

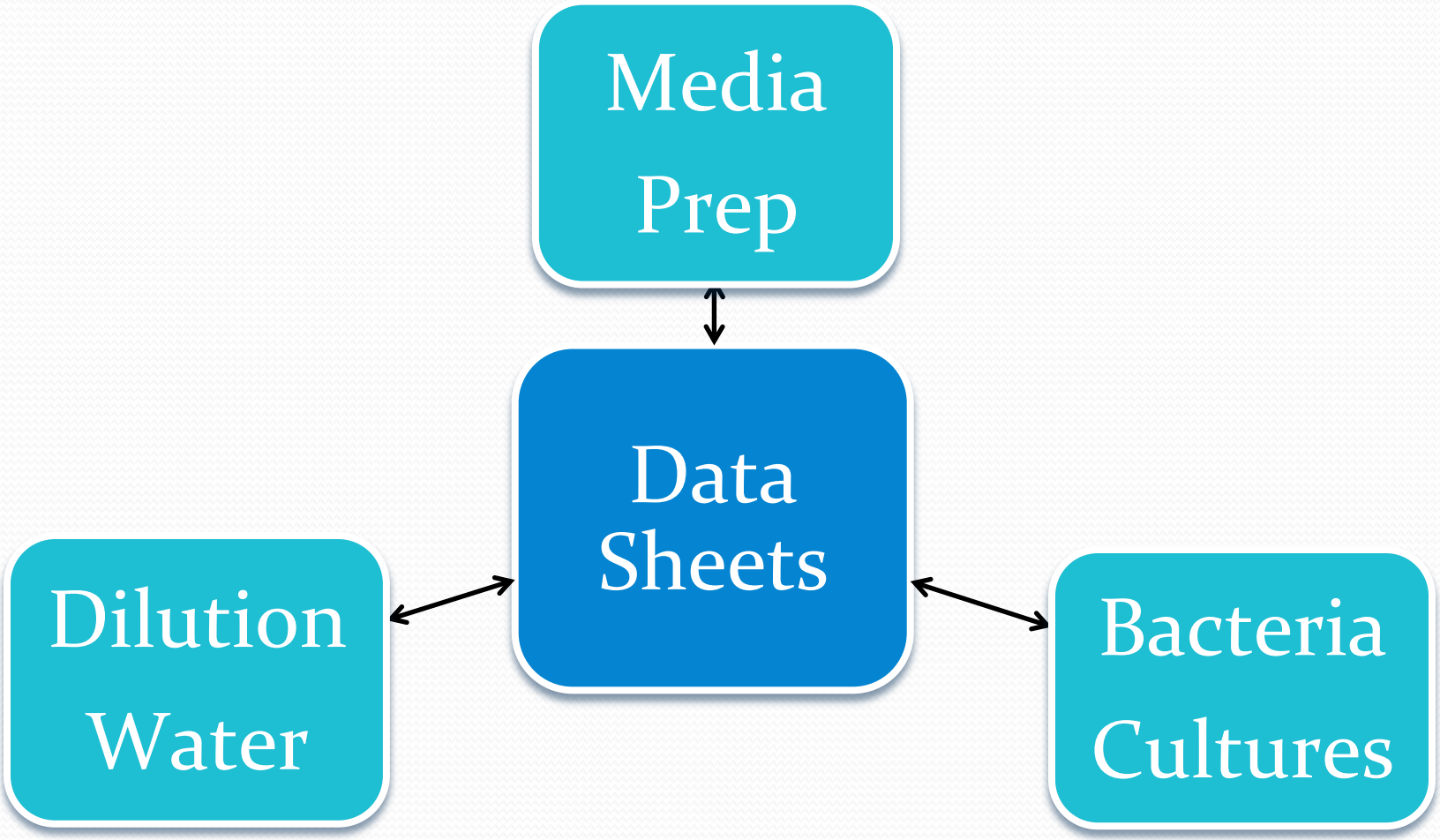
Dilution Water Expiry 11/30/2017

Part Two: Creation of multi-directional links between the worksheets

Multi-directional links

- Link the two types of worksheets together
  - Data worksheet with sample results
  - Log worksheet for quality assurance
- Multi-directional links so forwards and backwards information flow
- Links would streamline audit process by eliminating the complexity of multiple worksheets
- Efficient search-ability of data

Data Sheet with Links



Worksheet Reference: REF-16002227

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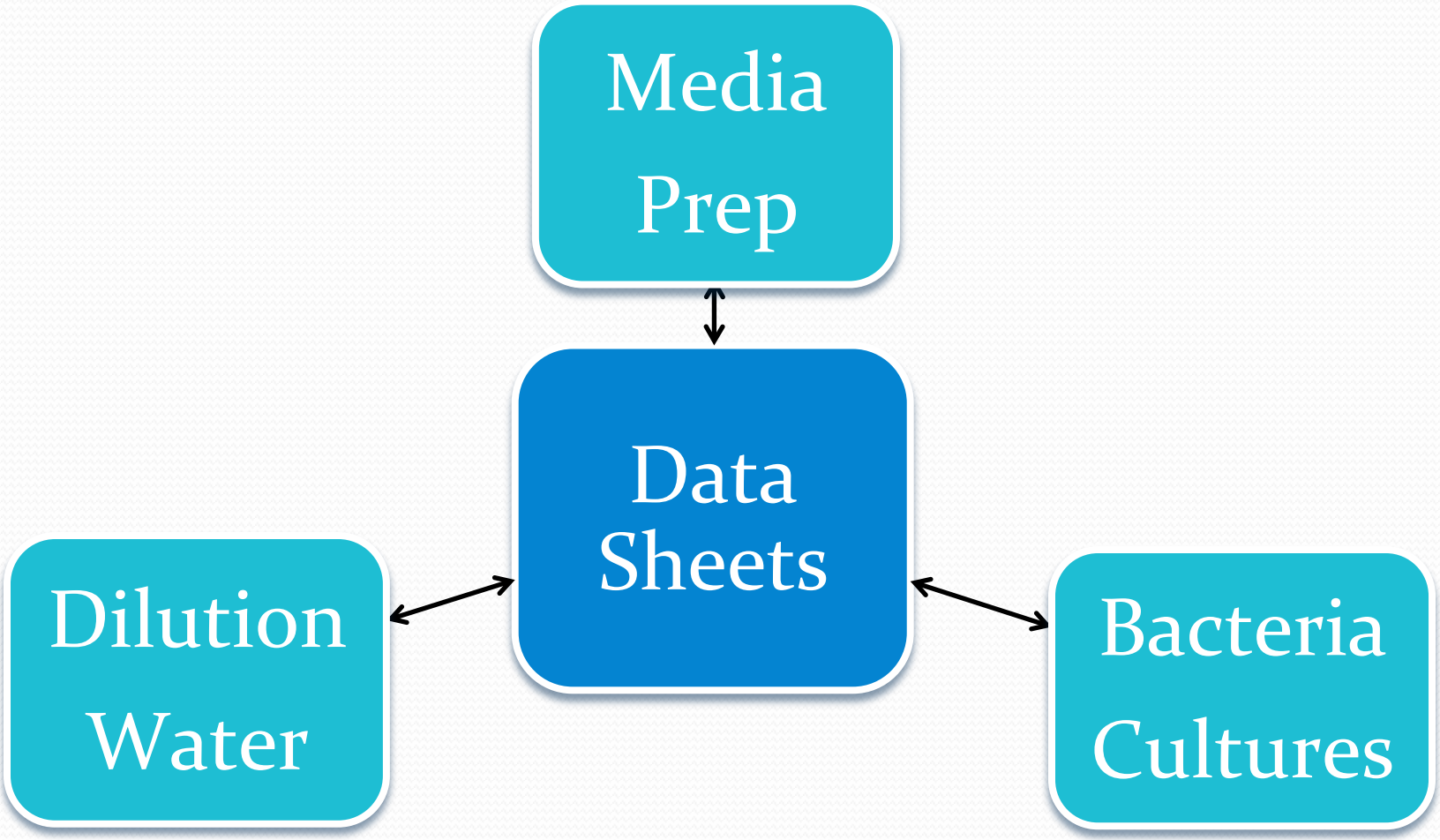
Media Prep Log

Analyst: NVL **Date:** 4/4/2016

NBC media serial #	Strength	Media Type	Lot #	NBC Inventory ID #	Weight (g)	Volume (L)	pH / adjustments	Insp By
16002227-01	1X	A-1 MEDIA	L15-63	16000963-09 REF-16000963	94.5	3	6.80	NVL
16002227-02	1X	A-1 MEDIA	L15-63	16000963-10 REF-16000963	94.5	3	6.81	NVL
16002227-03	2X	A-1 MEDIA	L15-63	16000963-10 REF-16000963	189.0	3	6.70	NVL
16002227-04	1X	A-1 MEDIA	L15-63	16000963-10 REF-16000963	94.5	3	7.01	NVL
16002227-05	1X	A-1 MEDIA	L15-63	16000963-10 REF-16000963	94.5	3	6.98	NVL
16002227-06	2X	A-1 MEDIA	L15-63	16002290-01 REF-16002290	189.0	3	6.81	NVL
16002227-07	1X	A-1 MEDIA	L15-63	16002290-02 REF-16002290	94.5	3	6.78	NVL
16002227-08	1X	A-1 MEDIA	L15-63	16002290-02 REF-16002290	94.5	3	6.78	NVL
16002227-09	2X	A-1 MEDIA	L15-63	16002290-01 REF-16002290	189.0	3	6.71	NVL
16002227-10	2x	A-1 MEDIA	L15-63	16002290-02 REF-16002290	189.0	3	6.72	NVL

Data Sheet with Links



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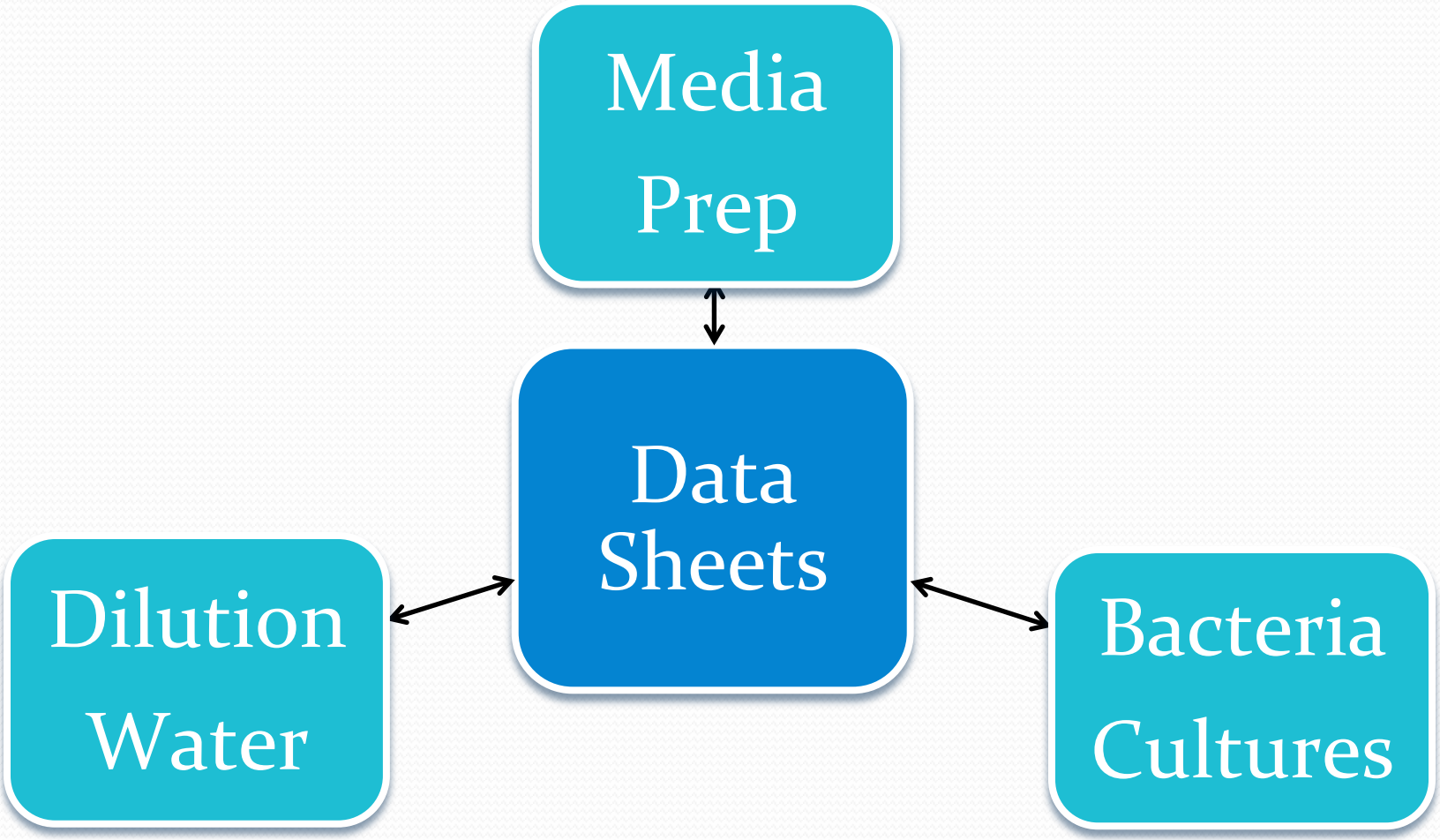
Bacteria Dilution Water Quality Control Log

Run Date: 4/27/2016 **Analyst:** RR

NBC Dilution Water Serial #	Manufacturer	Lot #	Expiry	pH	Vol (ml)	Precipitate	Sterility
16002887-01	IN-HOUSE	160427	10/27/2016	7.2	1000	NEG	NEG
16002887-02							
16002887-03							

Data Sheet with Links



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Bacteria Cultures Quality Control Log

Run Date: 4/18/2016 **Analyst:** NVL

Culture:	NBC Serial Lot #	NBC Inventory ID	Standard Type:	Media Type	Media Serial #	Expiration
E.coli	16002584-01	15008760-01 ...	STOCK	TSA	16001111-03 ...	6/1/2016
E.faecalis	16002584-02	15008760-02 ...	STOCK	TSA	16001111-03 ...	6/1/2016
E.coli	16002584-03	15008760-01 ...	WORKING	LTB	16001111-04 ...	6/1/2016
E.faecalis	16002584-04	15008760-02 ...	WORKING	AZB	16001111-05 ...	6/1/2016

CONTROLS

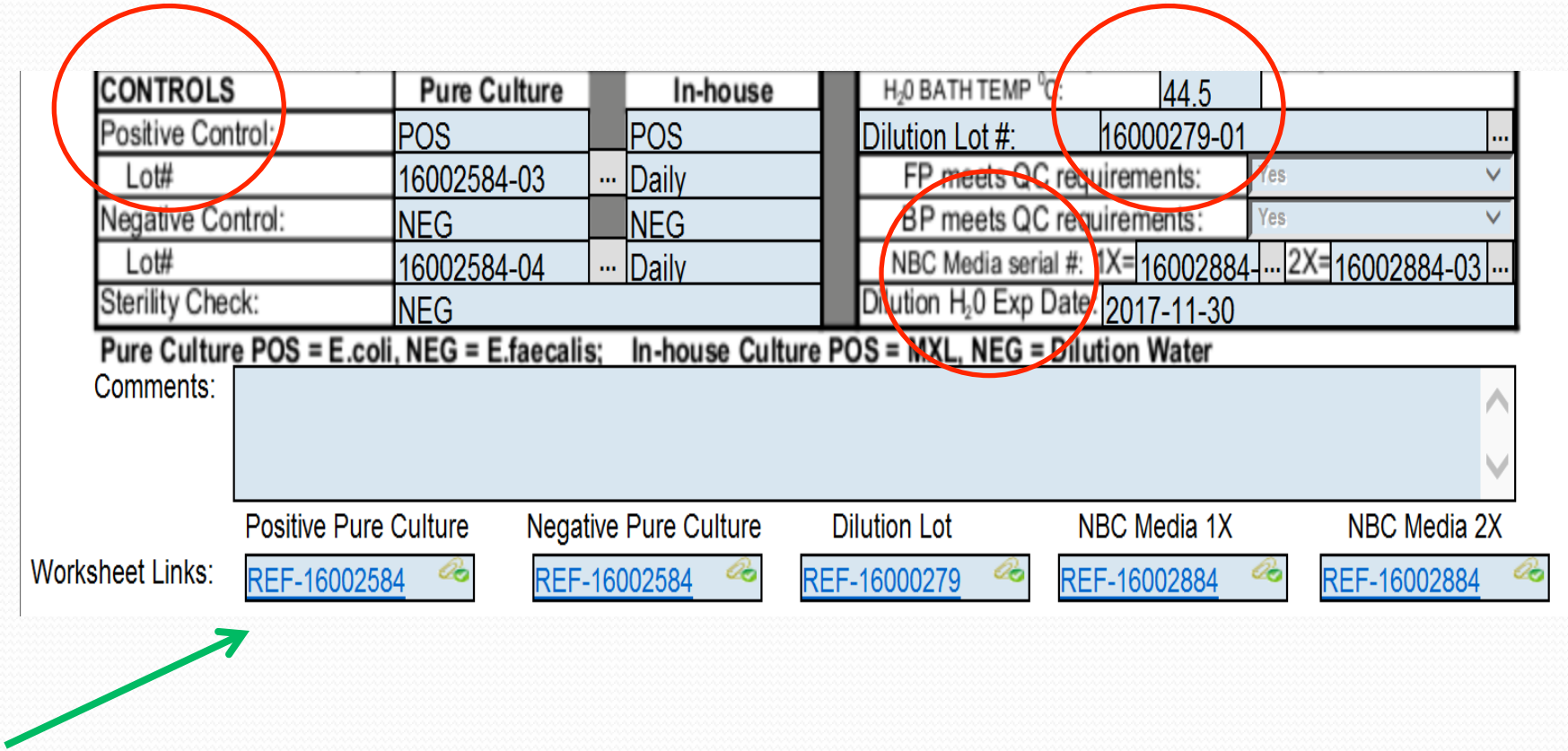
Culture: E.coli
Media Check: A-1
Media Serial #: 16002227-07 ...
Result: pos
Dilution Water Lot #: 25307B

Culture: E. faecalis
Media Check: A-1
Media Serial #: 16002227-07 ...
Result: neg
Dilution Water Expiry: 11/30/2017

Culture: E. coli
Media Check: Enterolert
Media Serial #: 8033-05 ...
Result: neg

Culture: E. faecalis
Media Check: Enterolert
Media Serial #: 8033-05 ...
Result: pos

Data Sheet with multi-directional links



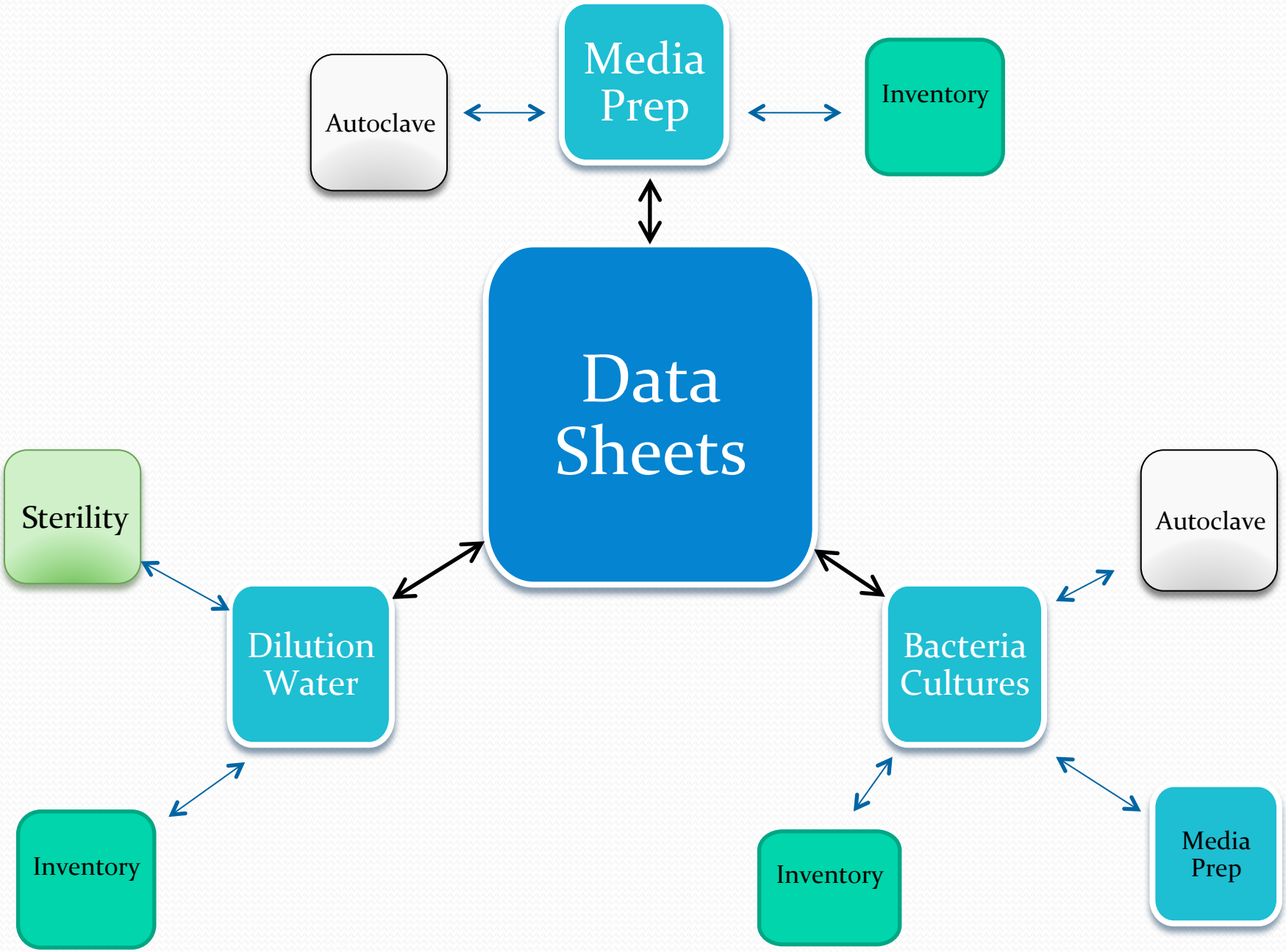
CONTROLS	Pure Culture		In-house
Positive Control:	POS		POS
Lot#	16002584-03	...	Daily
Negative Control:	NEG		NEG
Lot#	16002584-04	...	Daily
Sterility Check:	NEG		

H_20 BATH TEMP °C:	44.5
Dilution Lot #:	16000279-01 ...
FP meets QC requirements:	Yes
BP meets QC requirements:	Yes
NBC Media serial #:	1X= 16002884- ... 2X= 16002884-03 ...
Dilution H_20 Exp Date:	2017-11-30

Pure Culture POS = E.coli, NEG = E.faecalis; In-house Culture POS = MXL, NEG = Dilution Water

Comments:

	Positive Pure Culture	Negative Pure Culture	Dilution Lot	NBC Media 1X	NBC Media 2X
Worksheet Links:	REF-16002584	REF-16002584	REF-16000279	REF-16002884	REF-16002884


Autoclave
Media Prep
Inventory
Data Sheets
Sterility
Dilution Water
Inventory
Bacteria Cultures
Autoclave
Inventory
Media Prep

QUALITY ASSURANCE

- Completed ELN worksheets transfer to “Finished” folder
- To modify data it is necessary to “Un-finish” to re-run
- Sample history and audit trail
  - ELN system
  - Copy within SharePoint system

Finished Worksheet History

Finished Worksheet Details

Worksheet Information:

Form name:	FECAL_COLIFORM_PLANT	Form description:	Fecal Coliform Plant form
Form version:	27		
Worksheet ID:	5-1-16 PLANT FECAL	Batch number:	
Worksheet reference:	REF-16002937	Initiated date:	Sunday, May 01, 2016 6:42:26 AM
Priority:		Created by:	Beaudry, William
Assigned Users:	iLAB Admin, iLAB User, ELN_Admin,	Due date:	Monday, May 02, 2016 12:00:00 AM
Worksheet status:	Finished		
Completed by:	Lough, Nora-Jean	Completed date:	Monday, May 02, 2016 8:49:14 AM
Finished by:	Lough, Nora-Jean	Finished date:	Monday, May 02, 2016 8:49:14 AM
Finished Report Doc ID:	QXAXS7VD5RUN-7-165515	Finished Report Version:	1.0
Reviewer Report Doc ID:	QXAXS7VD5RUN-7-165511	Reviewer Report Version:	1.0

List of Available Reports:

Finished Report
Reviewer Report

View ViewAll

Sample History and Audit Trail

Result History for REF-16002932 :

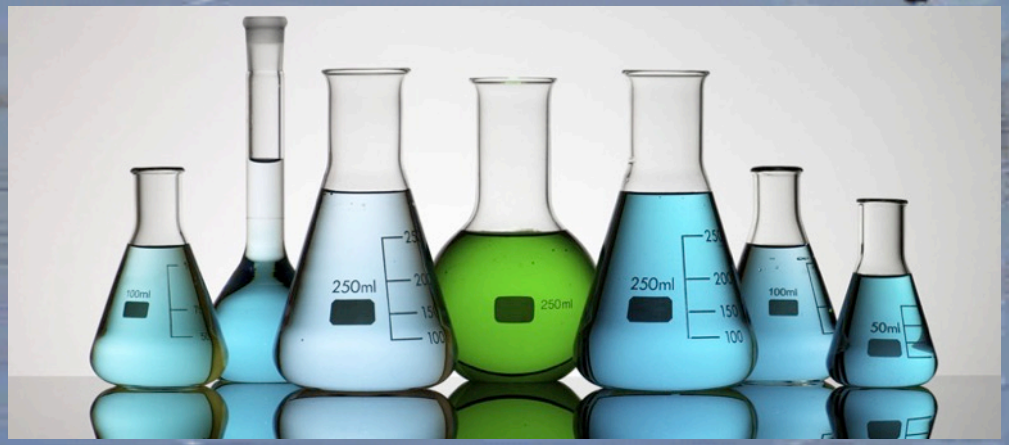
Result Date	User Name	Result Name	Result Value	Previous	Change Reason
5/1/2016 6:41:20 AM	Beaudry, William	Negative_Control_IH	neg		
5/1/2016 6:41:20 AM	Beaudry, William	10_Result_Sample_4	+0000	00000	
5/1/2016 6:41:20 AM	Beaudry, William	3_Sample_6	0		
5/1/2016 6:41:20 AM	Beaudry, William	1_Sample_4	0		
5/1/2016 6:41:20 AM	Beaudry, William	3_Sample_3	0		
5/1/2016 6:41:20 AM	Beaudry, William	2_Sample_6	0		

Challenges

- Design and set-up took foresight of complete system
- Plan on a new electronic data system that is sophisticated while being user-friendly
- Updating and amending worksheets

Future Goals

- Fine tune advanced information pathways
  - Temperature Monitoring
  - Interface with new technology- autoclave
- Utilize ELN for microscopic examinations reports and pictures
- Implement a peer review system that can link directly to worksheets



The Narragansett Bay Commission