





It can be done

2019 SEDIMENTS CONFERENCE



Utilizing

ADAPTIVE MANAGEMENT TECHNIQUES

During An Environmental Dredging

Remediation Project

Presenter: Rick Elia





Agenda

- Introduction
- Project Background
- Challenges
- Adaptive Management Approach
- Benefits of Adaptive Management
- Project Recap





Introduction

- Rick Elia Bio/Credentials
 - ~20 years remediation experience
 - Over 20 projects completed
 - Various: sediments, soils, residential, federal, commercial
 - Corporate Manager of Subject Project
 - Oversaw from bid through completion



Project Background

- Lake project amidst residential community
- Little bit of everything:
 - Soils,
 - Sediments,
 - Hydraulic & Mechanical,
 - Stabilization,
 - Dewatering,
 - Water treatment,
 - Restoration
 - Backfill
 - Hydraulic capping
 - Wetlands mitigation





Work Completed

- 8,000 cys excavated soil
- 16,000 cys mechanically dredged sediment
- 128,000 cys hydraulically dredged sediment
- 71,000 tons dewatered and disposed
- 4,000 trucks disposal/deliveries
- 117 million gallons treated
- 20,000 cys hydraulic capping
- 10,000 cys mechanical capping
- 34,000 plantings
- 2.5 acres of wetlands mitigated



"Everybody has a plan until they get **punched in the mouth.**"

- Mike Tyson





Challenges





CHALLENGES:

- 1. Delays
- 2. Scope Increases
- 3. Water Treatment
- 4. PH Levels
- 5. TOC Levels
- 6. Changed Conditions
- 7. Coarse Materials
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Challenges - DELAYS

- Project Delayed
 - Community Discord
 - Activist Groups
 - Town resistance
 - Agencies reassessing
 - Several year delay





Challenges – <u>Scope Creep</u>

- Scope of Work Increase
 - Dredging and Capping:
 - 50% more hydraulic
 - 40% more acreage
 - Added all mechanical dredging and capping in 2 isolated areas





Challenges – <u>Water Treatment</u>

- Originally no WT
 - Discharge direct from presses
- Change to full
 2,500 gpm system
 - Discharge meeting
 NJDEP drinking
 water standards
 - Squeezed into small area
 - = 1.1 acres
 - = 0.12 acres





Challenges – <u>Water Treatment</u>

- High Levels of TOC
 - Undiscovered in treatability study
 - Exposed upon implementation
- pH Fluctuations
 - Informed lake pH varies due to algae
 - Installed automated system





Challenges – Water Level

- Marine Clearing
 - High water
 caused equipment
 access issues.
 - Required clearing prior to dredging isolated areas





Greatest Challenge! – Changed Condition







Adaptive Management Approach

• What is Adaptive Management?

"A rigorous approach for designing and implementing management actions to maximize learning about critical uncertainties that affect recurrent decisions while simultaneously striving to meeting multiple management objectives.."



- Marc Nelitz and David Marmorek

Adaptive Management Cycle





Planning Phase



- Assess
 - Frame the problem
 - Define goals
 - Discuss risks / uncertainties
 - Collect data
- Design
 - Brainstorm options
 - Constructability
 - Discuss alternatives



Planning - Assess

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Planning - Design

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Base	2017 Mechanical Dredging to Design Grade; 100% T&D	12,590	CYS	Lump Sum	\$3,757,743	\$312,557	\$4,070,301	\$64,657	Mech dredge; stabilize 100% on water in rolloffs; T&D 100%
Option 1	2017 Mechanical Dredge with Trommel to Design Grade; Sediment Stab. & T&D Recycle Rock	12,590	CYS	Lump Sum	\$3,073,592	\$312,557	\$3,386,150	\$53,790	Mech dredge with trommel; recycle rock; stabilize sediment on water in rolloffs; T&D sediment only
Option 2	2018 Mechanical Dredge with Trommel to Design Grade using Land Based Stabilization Pad; Sediment T&D Recycle Rock	12,590	CYS	Lump Sum	\$2,382,917	\$537,546	\$2,920,463	\$79,099	Mech Dredge with trommel; stabilize sediment on land; recycle rock; smaller WTP; T&D sediment only
Option 3	2017 Mechanical Screen Sediment & Rock; Hydraulically Dredge Sediment; Recycle Rock	12,590	CYS	Lump Sum	\$678,676	\$0	\$678,676	\$18,381	screen rock > 1-1/2", replace sediment then hydraulically dredge
Option 3 - Hyd	Added Cost for Hydraulical Dredging Coarse Material Area at lesser CY rate (added days to dredge entire area)	4	days	Days	\$104,186	şo	\$ 41 6,743	\$104,186	Contingency for inefficient hydraulic dredging in the screened coarse material area; needs to be considered by SF as opposed to CY.
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COR (Wkst)	Description	Quantity	Units	Measurement	Cost	Additional Costs	Total Cost	Daily Cost	Notes
COR (Wkst)	Description Investigation for changed condition	Quantity 1	Units	Measurement	<u>Cost</u> \$57,895	Additional Costs \$0	<u>Total Cost</u> \$57,895	Daily Cost	<u>Notes</u> Used debris barge to investigate changed condition
COR (Wkst) INV Option 3 - Setu	Description Investigation for changed condition Setup and Removal of Option 3 Equipment and Resources	Quantity 1	Units LS LS	Measurement Lump Sum Lump Sum	<u>Cost</u> \$57,895 \$80,420	Additional Costs \$0 \$0	<u>Total Cost</u> \$57,895 \$80,420	Daily Cost n/a n/a	Notes Used debris barge to investigate changed condition Use crane to lift and position equipment into ABD from Lakeside
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COR (Wkst) INV Option 3 - Setu Est Savings Est Save Est Save Est Save Est Save Est Save Est Save	Description Investigation for changed condition Setup and Removal of Option 3 Equipment and Resources Dredging - Potential Savings for Coarse Material Dredging - Rock % T&D - Potential Savings for Coarse Material Dredging - Rock % Dredging Shoreline - Potential Savings for Shoreline Dredging - E13-K19 (cost avoidance) Dredging Shoreline - Potential Savings for Shoreline Dredging - Rock % from E14 to M1 (cost avoidance) Dredging Shoreline - Potential Savings for Shoreline Dredging - Peat % from E14 toM1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Dredging - Peat % from E14 toM1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Dredging - Peat % from E14 toM1 (cost avoidance)	Quantity 1 1 Quantity 8,864 4,512 1,996 234 1,758 1,018	Units LS LS Units CYS CYS CYS CYS CYS tons CYS tons	Measurement Lump Sum Lump Sum Measurement per CY per CY per CY per CY per CY	Cost \$57,895 \$80,420 Unit Rate \$69.62 \$73.46 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62	Additional S0 S0 Additional Costs n/a n/a n/a n/a n/a n/a	Total Cost \$57,895 \$80,420 Total Savings -\$617,125 -\$331,464 -\$16,318 -\$16,318 -\$122,386 -\$74,779	Daily Cost n/a n/a Daily Cost n/a n/a n/a n/a n/a n/a n/a	Notes Used debris barge to investigate changed condition Use crane to lift and position equipment into ABD from Lakeside Notes Estimated savings after cost for not hydraulically dredging rock fraction Estimated savings after cost for not disposing screened rock fraction Estimated savings after cost for not hydraulically dredging shoreline between E13 and K19 Estimated savings after cost for not hydraulically dredging shoreline rock fraction between E14 and M1 Estimated savings after cost for not hydraulically dredging shoreline peat fraction between E14 & M1 Estimated savings after cost for not hydraulically dredging shoreline peat fraction between E14 & M1 Estimated savings after cost for not hydraulically dredging shoreline peat fraction between E14 & M1 Estimated savings after cost for not hydraulically dredging shoreline peat fraction between E13 and K19
COR (Wkst) INV Option 3 - Setu Est Savings Est Save Est Save Est Save Est Save Est Save Est Save Est Save	Description Investigation for changed condition Setup and Removal of Option 3 Equipment and Resources Description Dredging - Potential Savings for Coarse Material Dredging - Rock % T&D - Potential Savings for Coarse Material Dredging - Rock % Dredging Shoreline - Potential Savings for Shoreline Dredging - E13-K19 (cost avoidance) Dredging Shoreline - Potential Savings for Shoreline Dredging - Rock % from E14 to M1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Dredging - Peat % from E14 to M1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Dredging - Rock % from E14 to M1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Material Dredging - Rock % from E14-to M1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Material Dredging - Rock % from E14-to M1 (cost avoidance)	Quantity 1 1 0 8,864 4,512 1,996 234 1,758 1,018 119	Units LS LS CYS CYS CYS CYS CYS tons tons	Measurement Lump Sum Lump Sum Measurement per CY per CY per CY per CY per CY per CY	Cost \$57,895 \$80,420 Unit Rate \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$73.46	Additional S0 S0 Additional Costs n/a n/a n/a n/a n/a n/a n/a	Total Cost \$\$7,895 \$80,420 \$80,420 Cost -\$617,125 -\$631,464 -\$331,464 -\$138,962 -\$16,318 -\$122,386 -\$74,779 -\$8,765	Daily Cost n/a n/a Daily Cost n/a n/a n/a n/a n/a n/a n/a n/a n/a n/a	Notes Used debris barge to investigate changed condition Use crane to lift and position equipment into ABD from Lakeside Notes Estimated savings after cost for not hydraulically dredging rock fraction Estimated savings after cost for not disposing screened rock fraction Estimated savings after cost for not hydraulically dredging shoreline between E13 and K19 Estimated savings after cost for not hydraulically dredging shoreline peat fraction between E14 and M1 Estimated savings after cost for not hydraulically dredging shoreline peat fraction between E14 & M1 Estimated savings after cost for not disposing screened shoreline rock fraction between E13 and K19 Estimated savings after cost for not disposing screened shoreline rock fraction between E13 and K19 Estimated savings after cost for not disposing screened shoreline rock fraction between E14 & M1
COR (Wkst) INV Option 3 - Setu Est Savings Est Save Est Save Est Save Est Save Est Save Est Save Est Save Est Save	Description Investigation for changed condition Setup and Removal of Option 3 Equipment and Resources Dredging - Potential Savings for Coarse Material Dredging - Rock % T&D - Potential Savings for Coarse Material Dredging - Rock % Dredging Shoreline - Potential Savings for Shoreline Dredging - E13-K19 (cost avoidance) Dredging Shoreline - Potential Savings for Shoreline Dredging - Rock % from E14 to M1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Dredging - Peat % from E14 to M1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Material Dredging - Rock % from E14 to M1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Material Dredging - Rock % from E14 to M1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Material Dredging - Rock % from E14 to M1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Material Dredging - Rock % from E14 to M1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Material Dredging - Rock % from E14 to M1 (cost avoidance) T&D Shoreline - Potential Savings for Shoreline Material Dredging - Rock % from E14 to M1 (cost avoidance)	Quantity 1 1 2 8,864 4,512 1,996 234 1,758 1,018 119 897	Units LS LS CYS CYS CYS CYS CYS CYS tons tons	Measurement Lump Sum Lump Sum per CY per CY per CY per CY per CY per CY per CY per Ton per Ton per Ton	Cost \$57,895 \$80,420 Unit Rate \$69.62 \$73.46 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$69.62 \$73.46 \$73.46	Additional S0 S0 Additional Costs n/a n/a n/a n/a n/a n/a n/a n/a	Total Cost \$57,895 \$80,420 Total \$81,450 -\$617,125 -\$331,464 -\$16,318,962 -\$16,318 -\$12,2,386 -\$74,779 -\$8,765 -\$65,860	Daily Cost n/a	Notes Used debris barge to investigate changed condition Use crane to lift and position equipment into ABD from Lakeside Notes Estimated savings after cost for not hydraulically dredging rock fraction Estimated savings after cost for not disposing screened rock fraction Estimated savings after cost for not hydraulically dredging shoreline between E13 and K19 Estimated savings after cost for not hydraulically dredging shoreline pet fraction between E14 and M1 Estimated savings after cost for not hydraulically dredging shoreline peat fraction between E14 & M1 Estimated savings after cost for not disposing screened shoreline rock fraction between E13 and K19 Estimated savings after cost for not disposing screened shoreline rock fraction between E14 & M1 Estimated savings after cost for not disposing screened shoreline rock fraction between E14 & M1 Estimated savings after cost for not disposing screened shoreline rock fraction between E14 & M1



100 YEARS OF FAMILY Est. 1917

Planning - Design



& COLLECTION AREA AS PER ORIGINAL DESIGNED



Planning - Design

100 YEARS OF FAMILY Est. 1917



Execution Phase



Sevenson Environmental Services, Inc.

- Implement
 - Put your plan into action
- Monitor
 - Make observations
 - Gather data

Execute - Implement



Execute - Implement



Execute - Implement





Execute - Monitor







Execute - Monitor

Estimated Value			Dredging					Filter Presses										Water Treatment					Trucking and Disposal			
Dredge Day	Date	Day	Quantity Dredged (CY)	Hours Dredged	CY/Hr	Dredged to Date (CY)	DMU	Filter Presses Online	Run Hours	Drops Today	Drops to Date	Avg Cake Solids	CY Cake Today	CY Cake to Date	Est. Tons Oversize & Sand today	Est. Tons Oversize & Sand to Date	Runtime (mins)	Flowmeter Start	Flowmeter End	Discharge Today	Discharged to Date	Loads Today	Loads to Date	Tons Today	Tons to Date	
61	08/15/17	Tue	1.428	11.50	124	48,764	L8-10, E13	6	11.75	28	1,020	52.18%	622	22664	180	6196	695	58,300,000	59,547,000	1,247,000	59,634,936	28	1,407	669.59	32,196.49	
52	08/16/17	Wed	1,287	11.50	110	50,031	L8-9, E8	6	11.83	18	1,038	55.45%	400	23064	288	6484	680	59,547,000	60,946,000	1,399,000	61,033,936	36	1.443	858.96	33,055,45	
53	05/17/17	Thu	1,475	12.00	123	51,506	L8, K8-10	6	11.75	28	1,065	52.53%	622	23687	291	6775	710	50,946.000	62,200,000	1,254,000	62,287,936	43	1.486	1,003.81	34,059.26	
54	08/18/17	Fri	1.058	10.50	101	52,564	C8, K8-10	6	9.50	24	1,090	48.94%	533	24220	75	6850	645	62,200.000	63,119,400	919,400	63,207,336	24	1,510	674.38	34,633.64	
55	DS/21/17	Mon	1,010	11.75	86	53,574	C8-B8, K8,J8	6	11.50	16	1,106	52.75%	356	24575	213	7063	690	63,119.400	64,519,000	1,399,600	64,6D6,936	40	1,550	934.40	35,568.04	
56	08/22/17	Tue	1.235	11.50	107	54,809	17, E8-12	6	11.50	19	1,125	47.10%	422	24998	39	7102	705	64,519,000	65,834,000	1,315,000	65,921,936	40	1,590	919.58	36,487.62	
57	08/23/17	Wed	1.096	11.17	98	55,905	17, E12	6	11.13	19	1,144	45.13%	422	25420	(8	(177	695	65,834,000	67,067,000	1,233,000	67,154,936	10	1,600	234.85	36,722.47	
58	08/24/17	Thu	875	11.58	76	55,780	D9-12,17	6	11.82	16	1,160	47.37%	356	25775	105	7282	720	67,067,000	68,441,000	1,374,000	88,528,936	16	1,616	375.06	37,097.53	
59	08/25/17	Fn	949	12.00	79	60,913	D12-13, D5-10	6	11.50	15	1,175	43.37%	333	26109	120	7402	710	68,441,000	69,688,000	1.247,000	69,775,936	10	1,626	236.28	37.333.81	
60	08/28/17	Mon	1,054	11.00	96	61,967	D6-9, D11-13	6	11.75	18	1,193	45.09%	400	26508	105	7507	710	69,688,000	70,909,000	1,221,000	70,996,936	24	1,650	562.79	37,896.60	
61	05/29/17	Tue	1,119	12.00	93	63,000	C9+10, 17-5	0	11.50	21	1,214	47.23%	407	20570	100	7010	200	70,909,000	71,997,000	1,068,000	72,064,936	10	1,000	410.75	38.307.35	
62	05/30/17	wea	1,012	12.00	64	04,098	15,17-L7	0	11,15	16	1,232	52.40%	400	2/3/5	210	7831	700	71,997,000	73,208,000	1,211,000	73,295,936	30	1,090	037.04	38,998,15	
63	08/31/17	Inu	967	12.00	81	00,000	C10-12, L7	0	9.80	10	1,247	0U.47%	333	27708	312	8143	105	73,208.000	74,196,000	955,000	74,283,936	42	1.740	475.70	39,970.19	
64	09/01/17	Fn	023	1.07	08	00,088	U12-13, 17	0	6.15	11	1,205	43.40%	244	27903	10	8218	430	74,196.000	74,809,000	613,000	74,895,935	20	1.760	470.79	40,400.98	
60	09/00/17	Mod	963	10.00	79	87,999	17,37,N7,E7	0	10.00	10	1,274	55.0492	400	26306	210	0404	744	74,808.000	75,707,000	1,146,000	70,784,930	20	1.772	472.46	40,733.07	
60	09/00/17	Tiou	4 024	11.00	00	07,002	L7,10.30,N0.10,C0	é	10.21	10	1,282	50.01% E2 26%	400	20700	444	0000	710	76,767.000	78,832,000	1,140,000	79 005 000	20	1.182	473.40 604.00	41,207.02	
60	00/02/47	En	1,051	E 06	72	00,000	16,36,K6,L0,C6	0	6.02	42	1,010	49.679/	407	29175	100	0041	100	78,002,000	78,147,700	1,295,100 600,300	70,200,000	40	1,022	005.94	41,699.01	
60	09/09/17	Mon	700	11.33	70	60,600	C11.13 B11.1216	6	11.60	10	1,020	40.0776	203	23404	102	0745 8025	705	78,747,700	80.078.000	1 331 000	20 165 036	93	1,002	624 20	42.024.02	
70	098987	Tue	067	12.00	80	70.566	15 15 25 1 5 MS	e e	11.75	19	1,040	42.3376 51.4092	400	20041	132	0000	740	80.078.000	81 340 000	1.001,000	91 426 026	46	1,005	370.20	49 796 24	
70	09/12/17	Wed	681	11 16	61	71.247	15 K5 15 F14	6	11.30	10	1,301	53 01%	267	30508	200	9436	670	81 349 000	82 591 000	1.242.000	82,678,036	10	1,301	408.85	44.143.96	
77	09/14/17	Thu	587	11.50	61	71.879	15 13.4 E14.15	6	1138	R	1 381	51.01%	178	30686	180	9625	710	82 591 000	83 843 000	1.252.000	83,930,936	18	1934	383.76	44 527 71	
72	09/15/17	Eri	612	7.00	72	72 341	12-3 E15-18	6	6.83	12	1 393	46 19%	267	30652	28	9681	425	82,031,000	84 489 000	626.000	84 568 936	24	1.959	662.71	45,089,97	
74	09/18/17	Mon	517	11.75	44	72,858	E16 14-14	6	10.22	10	1,000	47.90%	201	31175	213	9874	665	84 469 000	85 524 000	1.055.000	85 611 936	20	1.978	469.82	45,559,74	
75	09/19/17	Tue	1.083	11.83	92	73.941	H5-7, 14, L4	6	9.33	16	1,419	52.78%	356	31530	219	10093	700	85.524.000	86.501.000	977.000	86.588.936	19	1.997	463.00	46.022.74	
76	09/20/17	Wed	1.028	11.75	87	74.969	H5-7 14	6	11.72	15	1.434	54.98%	333	31863	249	10342	710	86.501.000	87 495 000	994.000	87 582 936	1.8	2.015	433.50	46 456 24	
77	09/21/17	Thu	802	7.67	105	75.771	G5-7	6	7.62	10	1.444	53.92%	222	32086	165										AIT	
78	09/22/17	Fri	1.365	11.67	117	76.024	G5-7, L3-4	6	11.46	16	1.460	53.45%	356	32441	165				20-						100	
79	09/25/17	Mon	1.285	11.25	114	77,309	G5. L2-4	6	11.46	24	1,484	51.68%	533	32974	228			ale	-	5	-					
80	09/26/17	Tue	1.251	11.67	107	78,550	F5-7, L2, K4	6	12.00	18	1.502	51.03%	400	33374	312			10 8 10	the same	Capation Million	T I				A.P.	
81	09/27/17	Wed	1,117	11.58	96	79.677	F7, K2-4	б	12.00	21	1.523	48.25%	467	33841	231			1000		Com Th	and the second					
82	09/28/17	Thu	901	12.00	75	80.578	E7.F7.C7.K3-4	6	11.67	14	1.537	51.24%	311	34152	108		57				1. Sel	and a second	1000		CAL P	
83	09/29/17	Ffl	1,128	12.00	94	81,706	E7,F7,K2,K3	6	11.53	14	1,551	48.57%	311	34463	150		14				12		CONTRACTOR OF	all all a	2.1.1.1	
84	10/02/17	Mon	679	9.75	70	82,385	J2-4, E7	6	11.28	14	1,565	49.23%	311	34774	120		S.P.	ALC: NO.			LE L			Con A	And the second	
85	10/03/17	Tue	863	11.50	75	83,248	D7.C7,F6,E6	6	11.47	16	1.581	51.11%	356	35130	81	-		-	and the same	mal un					Sec. St.	
86	10/04/17	Wed	745	10.67	70	83,993	C6.D6,E6,F6	6	10.30	11	1,592	49.88%	244	35374	72	ANA .	-	And the		12121	Sector Barrier				CO. Second	
87	10/05/17	Thu	763	10.00	76	84,756	E6, J2-4	6	11.70	11	1.603	48.91%	244	35619	144	- 1	-	di la companya da companya d		a to the	1 Bar	La contra		20.23 M		
88	10/06/17	Fri	976	11.58	84	83,725	J2-3, 14	6	11.28	17	1,620	48.23%	378	35996	150	6 .	100 24	The Part of the Pa	340 ALANA		196.5	Sec.	Standard Street	0 F 115	and here a	
89	10/09/17	Mon	675	6.59	102	84,400	11-3	6	8.03	11	1,631	43.74%	244	36241	42	12		and the state			6 Start	1 -	ALC: NO			
90	10/10/17	Tue	679	10.84	63	85,079	F4,G4,H4,C10	6	10.83	10	1,641	42.22%	222	36463	282			C. Start Conta	5.000			the and	Sec. Sec.	1 an 1		
91	10/11/17	Wed	1,074	11.75	91	86,153	B10,C10,E4,F4	6	10.82	-17	1,858	44.94%	378	36841	66	- Caller					1 all	Cold States		a section	1	
92	10/12/17	Thu	1,179	12.00	98	87,332	C9,C10,B10,E4	6	10.82	17	1,675	43.20%	378	37219	63	E STREET	See. S	C. L. Harris	thing -	EST.EN	A State	A Real	Sec.	and the second		
93	10/13/17	Fri	1.190	11.75	101	88,522	A9,B9,C9,H4	6	10.85	13	1.688	40.12%	289	37507	78	34-8-	TE SAN	1 - ANA	RY	11 A	The state of the	Care to	Pre-	A COL	-	
94	10/16/17	Mon	1.036	11.75	88	89,558	B9. F4.G4.H4	6	10.42	15	1,703	42.12%	333	37841	150	a prome	-96-		at M		ALE SUNTA	ALC: Y	No. AN	(3)	date -	
95	10/17/17	Tue	1.121	11.08	101	90,679	C8, B8, F4, E4	6	11.25	19	1,722	40.41%	422	38263	72	19 20 Line	a train				A Start	19.44	Ann State	25.40	1	
96	10/18/17	Wed	863	9.92	87	91,542	H3,G3,A9,B8	6	11.67	15	1,737	41.07%	333	38596	48		34 M M		S		and the Ca	1	white	1		
97	10/19/17	Thu	1.169	11.42	102	92,711	G3.F3,H3	6	11.12	23	1,760	39.75%	511	39107	75		1-1-1-		1052 13		A CONTRACT	A STA	1.50	and a	2	
98	10/20/17	Fri	1.214	10.67	114	93,925	H3.G3,F3,E3	6	11.46	22	1,782	37.32%	489	39596	69	Barris and	Ceresta .	CONTRACTOR	127	1 Land and			1. 2. 2			
99	10/23/17	Mon	1.174	10.58	111	95,099	H2,G2,F2	6	10.95	19	1,801	38.97%	422	40018	75	- Spinter	1 The	The fair of	12/25	1 - Barris	Carl Carl	ALL N	C. AC	1.1		
100	10/24/17	Tue	507	7.83	65	95,606	F2,F5,E5,C7	6	9.28	11	1,812	42.40%	244	40263	93		MA BES		27 2	3.32	The start	1	5 (V) 3			
						CO. 0	2			A		197				And and a second se	and the second second	Statement of the local division of the local	A DECK DECK DECK DECK DECK DECK DECK DECK	and the second second second	CAPITAL COLORING	States of the local division of the local di	and the second second			





Learning Phase





- Evaluate
 - Analyze Data
 - Compare with predictions
 - Draw conclusions
- Adjust
 - Employ lessons learned
 - Modify implementation

Learning – Evaluate/Adjust





Benefits of Adaptive Management

- Clarifying Problem
- Empowering Team
- Improving Design
- Communication
- Adjusting
- Learning





















References

- Marc Nelitz and David Marmorek. "Adaptive Management for Large-Scale Water Infrastructure: An Overview of AM". 7/27/18. <u>http://mississippiriverdelta.org/files/2018/08/Nelitz-ESSA-AM-Overview.pdf</u>
- Isabel Ashton, Ben Baldwin, Ben Bobowoski, Scott Esser, and Paul McLaughlin. "Honoring the past and celebrating the present: 100 years of research as Rocky Mountain National Park." May 2016. <u>https://www.nps.gov/articles/parkscience32_2_68-9_ashton_et_al_3840.htm</u>









YEARS OF FAMIL Est. 1917