WATER QUALITY MONITORING PROJECT FOR DEMONSTRATION OF CANAL REMEDIATION METHODS FLORIDA KEYS

Report #2: Canal Water Characterization Before Remediation and Monitoring After Remediation

Henry O. Briceño & Alexandra Serna

Southeast Environmental Research Center

Florida International University

Miami, FL 33199

http://serc.fiu.edu/wqmnetwork/

This page is intentionally left blank

WATER QUALITY MONITORING PROJECT FOR DEMONSTRATION OF CANAL REMEDIATION METHODS, FLORIDA KEYS

Report #2: Canal Water Characterization Before Remediation and Monitoring After Remediation

US EPA Agreement #X7 00D02412

This is contribution number 756T from the Southeast Environmental Research Center, Florida International University.

WATER QUALITY MONITORING PROJECT FOR DEMONSTRATION OF CANAL REMEDIATION METHODS, FLORIDA KEYS

Report #2: Canal Water Characterization Before Remediation and Monitoring After Remediation

EXECUTIVE SUMMARY

This report serves as a summary of our efforts to date in the execution of the Water Quality Monitoring Project for Demonstration of Canal Remediation Methods, and a channel to deliver the datasets generated during field and laboratory measurements. The period of record for this report is Jan. 2015 – Sep. 2015 and includes data from two sampling events. Data from Mar. 2014 – Dec. 2014 are included for comparison and they were presented in a previous report.

The objective of the project is to provide data needed to make unbiased, statistically rigorous statements about the status and temporal trends of water quality parameters in the remediated canals. The execution of the project includes two phases: 1) Characterization of canal waters before remediation; and 2) monitoring water quality changes after remediation. We have completed the phase of data collection for the Characterization stage with two measuring/sampling campaigns. Monitoring stage after remediation in this report consist of two measuring/sampling campaigns. Data was gathered using three techniques, measuring vertical profiles (casts), continuous 24-hour recording (diel) of physical-chemical properties, and water sampling and analysis for nutrients. We deployed multi-sensor, water quality monitoring instruments (SeaBird CTD and YSI) to measure physicochemical parameter of at least two profiles throughout the water column at each canal, to generate depth profiles of each parameter. We also deployed pairs of YSI sondes to continuously measure physical-chemical variables of water quality during 24-hours.

Data are presented in files as follows:

Vertical Profiles	CTD 001_002_003_004
Diel Tests	DIEL FKC03 and DIEL FKC04
Water Quality	FKC01 WQ DATA, FKC02 WQ DATA
	FKC03 WQ DATA, FKC04 WQ DATA

Submission of this Report and dataset satisfies all deliverables for the Canal Sub-project required under contract as of September 2015, and therefore this task is complete.

Proposed Remediation Technologies

The restoration technologies proposed for canal restoration demonstration are as follows:

- Reductions in weed wrack loading (using bubble curtains, weed gates or other methods)
- Enhanced circulation (using culverts, pumps, or other means) to reduce hydraulic residence times and eliminate areas of water column stagnation
- Removal of accumulated organic sediments, in areas where the sediments are contributing to the development of phytoplankton blooms, bottom-water hypoxia and excessive hydrogen sulfide production; and
    - Backfilling to reduce canal depth, in areas where excessive depth is contributing to poor circulation, bottom-water hypoxia, and other canal management issues.

TABLE 1. Selected Canal Demonstration Projects Monroe Count (Modified after AMEC 2013)

Weed Barrier			**Organic Removal**	**Weed Barrier & Organic Removal**	**Pumping**	**Culvert Installation**		**Backfilling**
#137 Plantation Key Treasure Harbor	#148 Lower Matecumbe Key Mate-Lido Beach	#287 Big Pine Hollerich Subdivision	#290 Big Pine Between Ave I & J	#266 Big Pine. Dr Arm Subdivision	#278 Big Pine. Eden Pines Colony Subdivision	#277 Big Pine. Tropical Bay Subdivision	#459 Geiger. Boca Chica Ocean Shores Subdivision	#29 Key Largo Sexton Cove Estates Subdivision
							#472 Geiger. Geiger Mobile Homes Subdivision	
#132 Plantation Key	**#147 Matecumbe K**	**#293 Big Pine**			**#282 Big Pine**		**#458 Geiger**	**# 28 Key Largo**

Control canals highlighted in yellow

Two additional canal, Canal #460 and Canal #470 , connected via new culverts to canals #459 and #472 respectively were incorporated for monitoring,

Results of Characterization of Canal Waters Before Remediation and Monitoring After Remediation

Characterization and monitoring was accomplished using three data-gathering techniques from the toolkit, vertical profiles, continuous 24-hour recording (diel) of physical-chemical properties, and water sampling and analysis for nutrients. We deployed multi-sensor, water quality monitoring instruments (SeaBird CTD and YSI) to measure physicochemical parameter of at least two profiles throughout the water column, to generate depth profiles of each parameter. YSIs were used for diel tests.

Sites were selected at each canal after considerations of preliminary water quality (AMEC) and canal cross-sections. The measured physicochemical parameters included depth (m), salinity (PSU), specific conductivity, temperature (°C), dissolved oxygen (DO in mg l^{-1}), %DO Saturation, PAR (µE m^{-2} s^{-1}), pH, turbidity and in situ chromophoric dissolved organic matter (CDOM) fluorescence. The light extinction coefficient (k_d in m^{-1}) was calculated as a log function from PAR measurements through the water column.

1. Diel experiments

Diel experiments included the deployment of a couple of YSI sondes at each canal as shown in Figure 1. Sondes were placed inside a perforated PVC pipe; one was positioned close to surface (about 1 ft deep) and the second one at about 1 ft above the canal bottom.

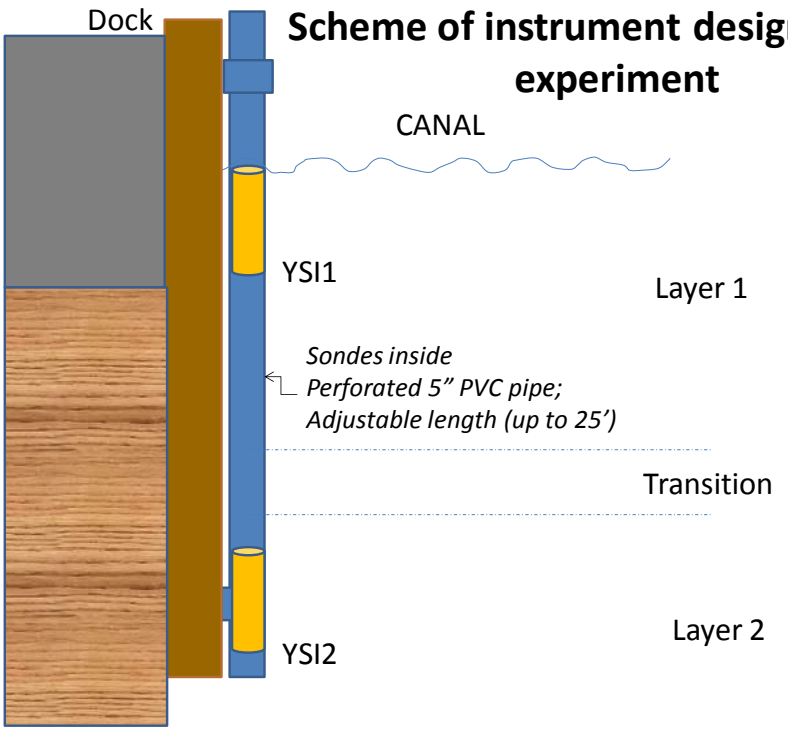

Figure 1: Placement of YSI sondes for capturing physical-chemical properties of water column in Florida Keys canals. YSI are inside PVC pipe clamped to wooden piling

Survey No. 3

Results of diels experiments for Survey No.3 are shown in figures 1.1 to 1.6. They were conducted only in canal #472 (remediated) and canal #458 (control).

CULVERT INSTALLATION

Geiger Key

5/5/2015

Control Canal #458. Surface

	C458A - Surface Temp C	C458A - Surface Sal ppt	C458A - Surface Depth meters	C458A - Surface pH	C458A - Surface Turbid+ NTU	C458A - Surface ODOsat %	C458A - Surface ODO mg/L	C458A - Surface Turbid+
Average	24.40	36.93	0.38	7.88	1.54	92.13	6.23	1.54
Median	24.03	36.92	0.38	7.87	1.50	91.50	6.25	1.50
Stand. Dev	0.89	0.08	0.01	0.04	0.52	14.02	0.88	0.52
%DO Sat Exceedances	0%							

Control Canal #458. Bottom

	C458A - Bottom Temp C	C458A - Bottom Sal ppt	C458A - Bottom Depth meters	C458A - Bottom pH	C458A - Bottom Turbid+ NTU	C458A - Bottom ODOsat %	C458A - Bottom ODO mg/L
Average	23.90	38.51	2.01	7.86	0.87	73.28	4.95
Median	23.74	38.51	2.00	7.85	0.80	73.50	5.00
Stand. Dev	0.33	0.01	0.10	0.03	0.58	7.20	0.47
%DO Sat Exceedances	0%						

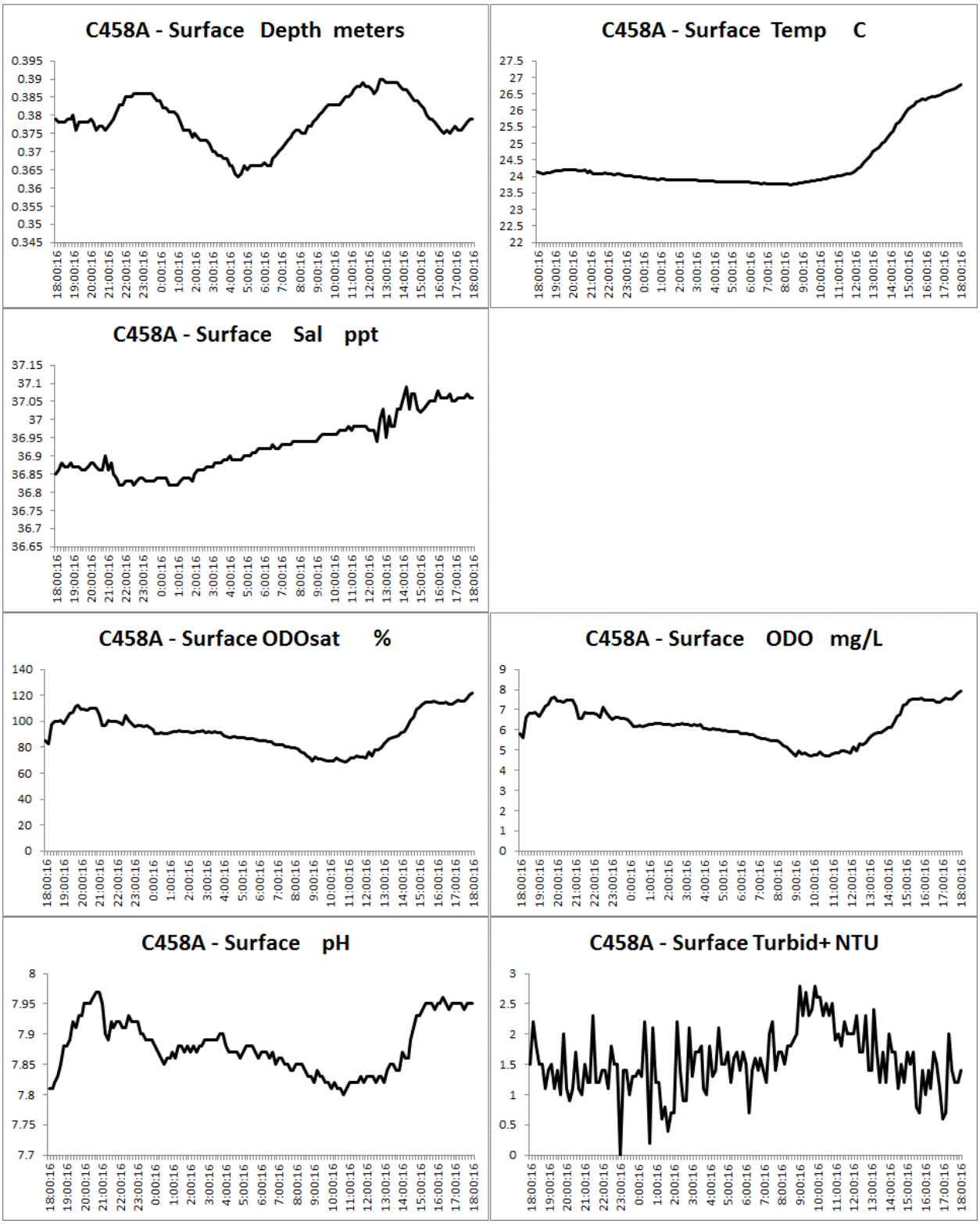

Figure 1.1: Time-series of physical-chemical data for surface water at site A in canal #458 during a 24-hour cycle (Diel cycle 5/5/2015).

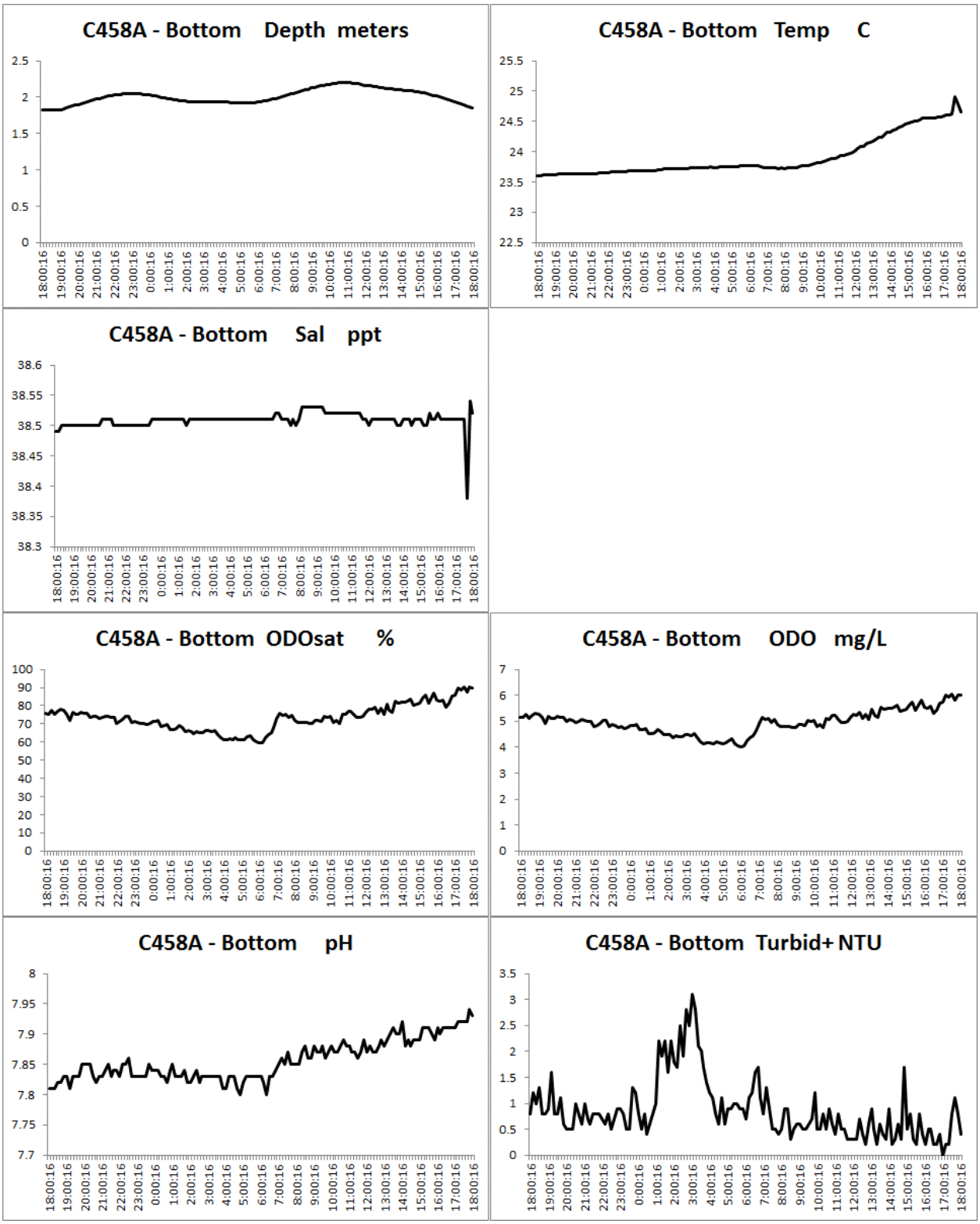

Figure 1.2: Time-series of physical-chemical data for bottom water at site A in canal #458 during a 24-hour cycle (Diel cycle 5/5/2015).

5/4/2015

Remediation Canal #472. Surface

	C472A - Surface Temp C	C472A - Surface Sal ppt	C472A - Surface Depth meters	C472A - Surface pH	C472A - Surface Turbid+ NTU	C472A - Surface ODOsat %	C472A - Surface ODO mg/L
Average	25.05	37.60	0.40	7.84	2.06	78.79	5.25
Median	25.12	37.57	0.40	7.85	2.00	79.70	5.27
Stand. Dev	0.72	0.28	0.00	0.04	0.57	8.60	0.56
%DO Sat Exceedances	0%						

Remediation Canal #472. Bottom

	C472A - Bottom Temp C	C472A - Bottom Sal ppt	C472A - Bottom Depth meters	C472A - Bottom pH	C472A - Bottom Turbid+ NTU	C472A - Bottom ODOsat %	C472A - Bottom ODO mg/L
Average	25.66	39.71	3.79	7.89	0.75	80.55	5.25
Median	25.80	39.77	3.79	7.89	0.50	82.30	5.35
Stand. Dev	0.48	0.30	0.20	0.02	0.74	5.14	0.33
%DO Sat Exceedances	0%						

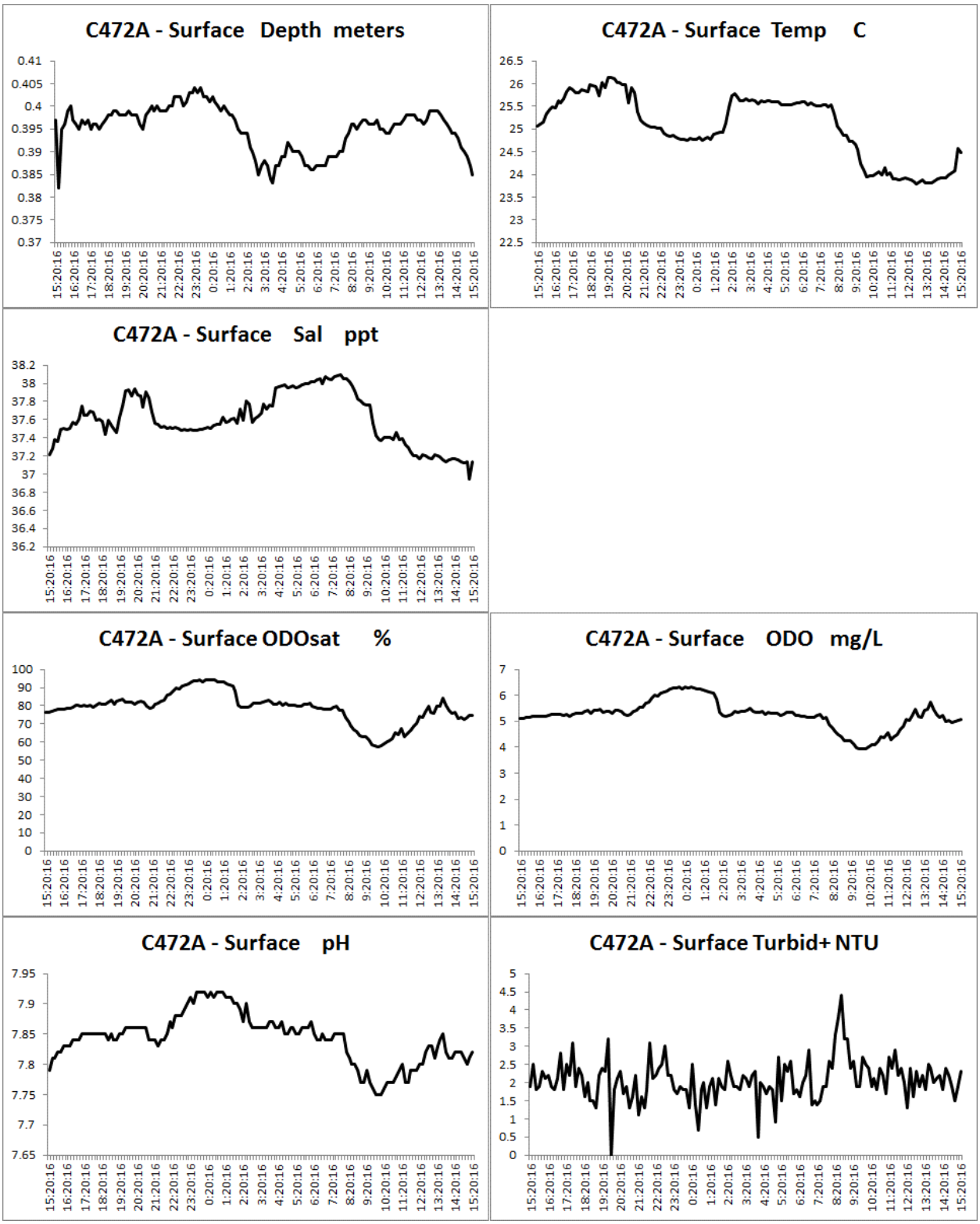

Figure 1.3: Time-series of physical-chemical data for surface water at site A in canal #472 during a 24-hour cycle (Diel cycle 5/4/2015)

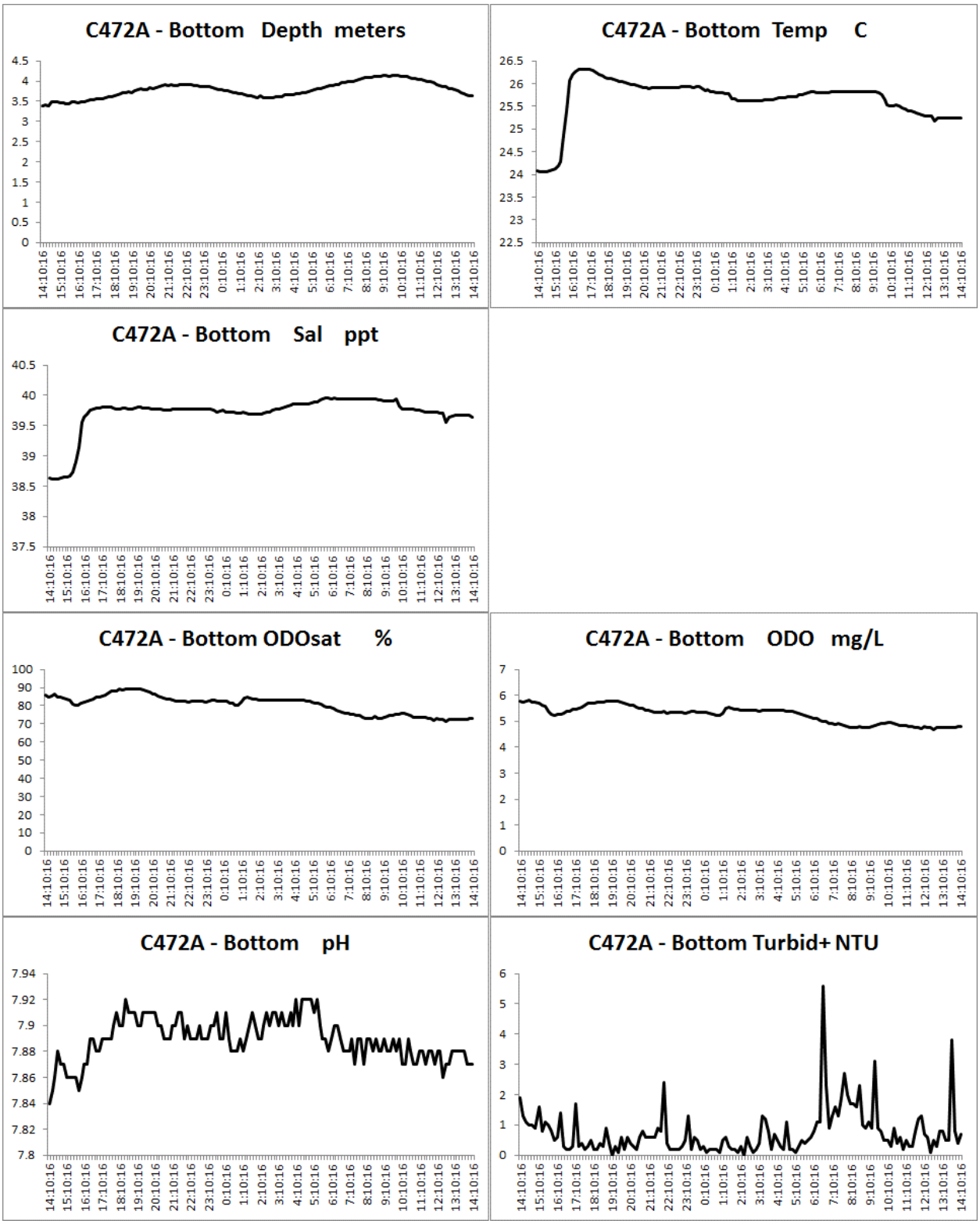

Figure 1.4: Time-series of physical-chemical data for bottom water at site A in canal #472 during a 24-hour cycle (Diel cycle 5/4/2015)

5/7/2015

Remediation Canal #472. Surface

	C472A-2 - Surface Temp C	C472A-2 - Surface Sal ppt	C472A-2 - Surface Depth meters	C472A-2 - Surface pH	C472A-2 - Surface Turbid+ NTU	C472A-2 - Surface ODOsat %	C472A-2 - Surface ODO mg/L
Average	28.60	37.75	0.39	7.86	1.38	95.59	6.00
Median	28.53	37.87	0.39	7.87	1.40	96.40	6.08
Stand. Dev	0.40	0.29	0.01	0.03	0.42	10.26	0.62
%DO Sat Exceedances	0%						

Remediation Canal #472. Bottom

	C472A-2 - Bottom Temp C	C472A-2 - Bottom Sal ppt	C472A-2 - Bottom Depth meters	C472A-2 - Bottom pH	C472A-2 - Bottom Turbid+ NTU	C472A-2 - Bottom ODOsat %	C472A-2 - Bottom ODO mg/L
Average	28.42	39.51	3.64	7.90	0.69	87.30	5.45
Median	28.49	39.53	3.64	7.90	0.50	87.10	5.43
Stand. Dev	0.25	0.07	0.18	0.02	0.79	5.04	0.32
%DO Sat Exceedances	0%						

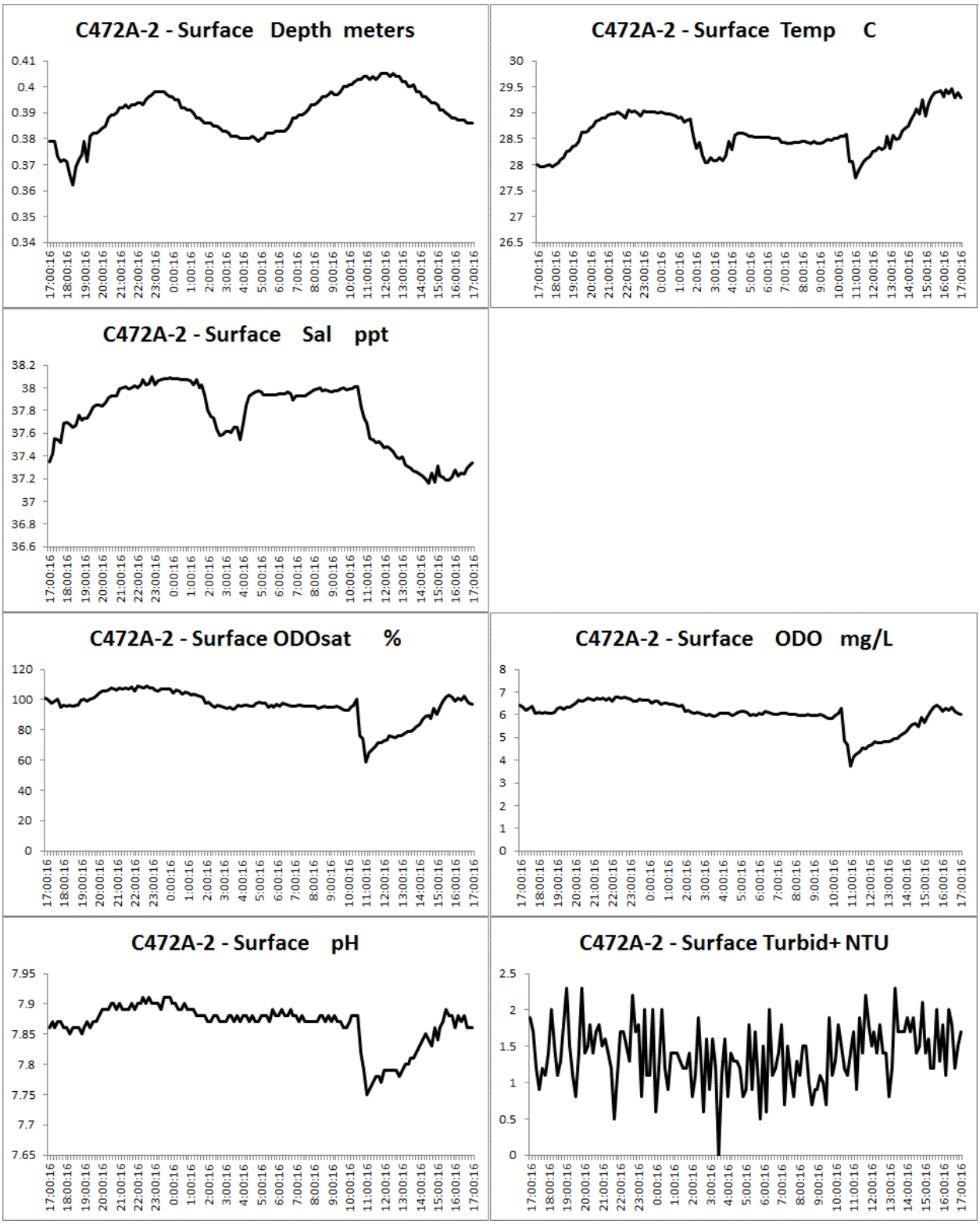

Figure 1.5: Time-series of physical-chemical data for surface water at site A in canal #472 during a 24-hour cycle (Diel cycle 5/7/2015)

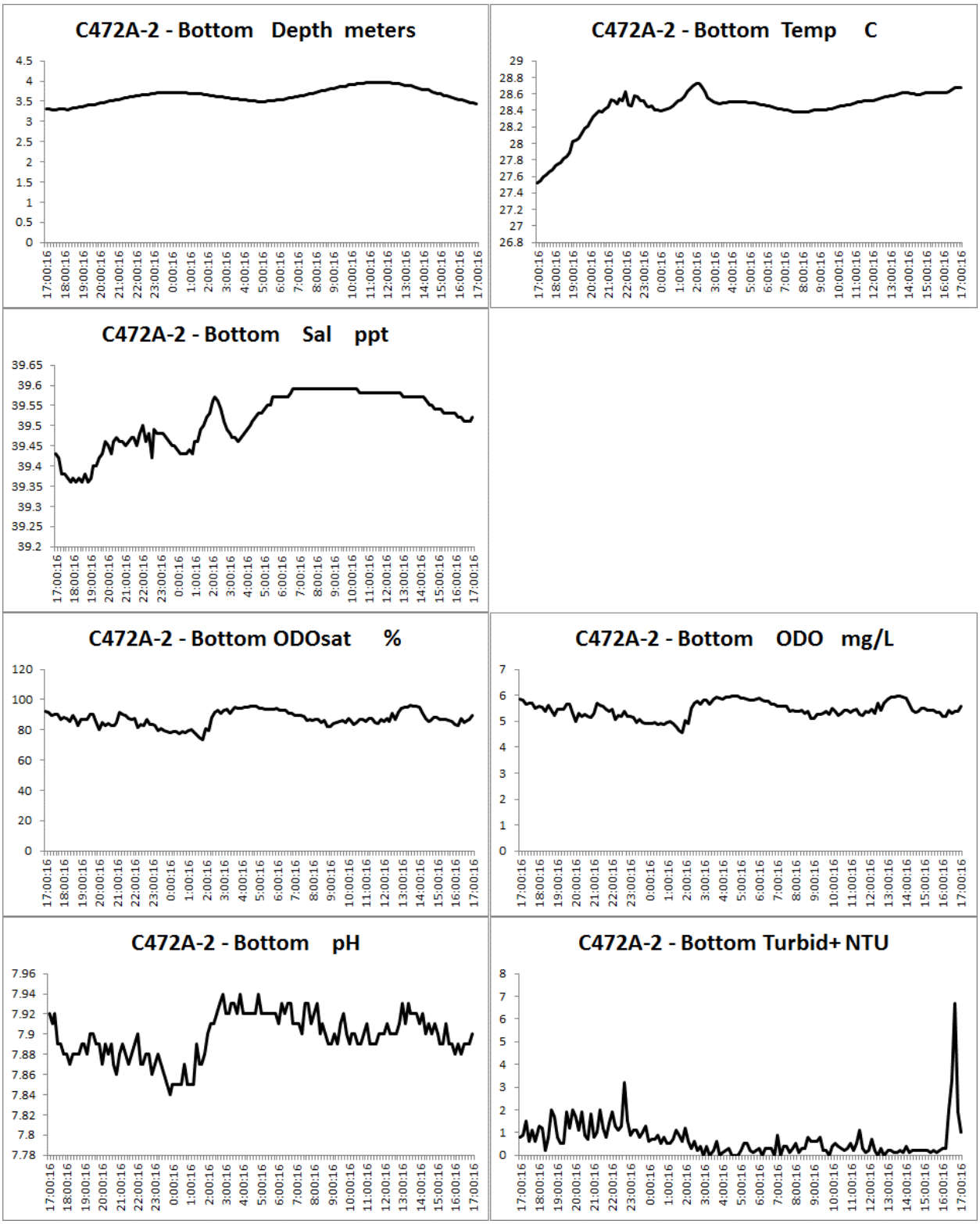

Figure 1.6: Time-series of physical-chemical data for bottom water at site A in canal #472 during a 24-hour cycle (Diel cycle 5/7/2015)

Summary of Diel Experiments in Canal 472

Surface

		Before	Before	After	After	After halted
		FKC01 5/22/14	FKC02 9/25/14	FKC03 5/4/15	FKC03 5/7/15	FKC04 8/1/15
Surface Temp	°C	26.61	30.02	25.12	28.53	32.11
Surface SpCond	mS/cm	58.17	50.64			58.46
Surface Sal	ppt	38.76	33.07	37.57	37.87	38.8
Surface pH		7.93	7.79	7.85	7.87	7.18
Surface Turbid	NTU	0.9	0.4	2	1.4	1.2
Surface ODOsat	%	79.8	87.5	79.7	96.4	90.6
Surface ODO	mg/L	5.11	5.53	5.27	6.08	5.37
%DO Sat Exceedances	%	0%	0%	0%	0%	0%

Bottom

		Before	Before	After	After	After halted
		FKC01 5/22/14	FKC02 9/25/14	FKC03 5/4/15	FKC03 5/7/15	FKC04 8/1/15
Bottom Temp	°C	26.1	27.86	25.8	28.49	30.34
Bottom SpCond	mS/cm	58.4	57.29	39.77		63.78
Bottom Sal	ppt	38.97	38.08		39.53	42.91
Bottom pH		7.82	6.64	7.89	7.9	6.82
Bottom Turbid	NTU	3.9	26.4	0	0.5	20.5
Bottom ODOsat	%	30.5	3.4	82.2	87.1	2.8
Bottom ODO	mg/L	1.98	0.21	5.34	5.43	0.17
%DO Sat Exceedances	%	91%	100%	0%	0%	99%

Survey No 4

Diel experiments included the deployment of a couple of YSI sondes at all canals except for #266, #28 and #29. Additionally, two new stations were incorporated to the monitoring program, one in canal #470 and one in canal #460. Results of diel experiments for Survey No.4 are shown in figures 1.7 to 1.38.

WEED BARRIER

Plantation Key

Control Canal #132. Surface

Water Depth displays rather a flat depth curve.

Water Temperature rises from morning to afternoon, followed by a decline until next morning.

Salinity and Specific Conductance values peak in the early morning and in the afternoon.

Dissolved Oxygen and Oxygen saturation increases with low tides. %DO Sat exceedances reach 9%.

pH follows closely the DO and %DO Saturation patterns.

Turbidity follows tides coarsely.

	C132A- Surface Temp C	C132A- Surface SpCond mS/cm	C132A- Surface Sal ppt	C132A- Surface Depth meters	C132A- Surface pH	C132A- Surface Turbid NTU	C132A- Surface ODOsat %	C132A- Surface ODO mg/L
Average	31.27	56.97	37.71	0.40	6.85	1.35	52.83	3.18
Median	31.27	56.98	37.72	0.40	6.84	1.10	53.90	3.24
Stand. Dev	0.44	0.07	0.05	0.01	0.04	0.90	7.07	0.41
%DO Sat Exceedances	9%							

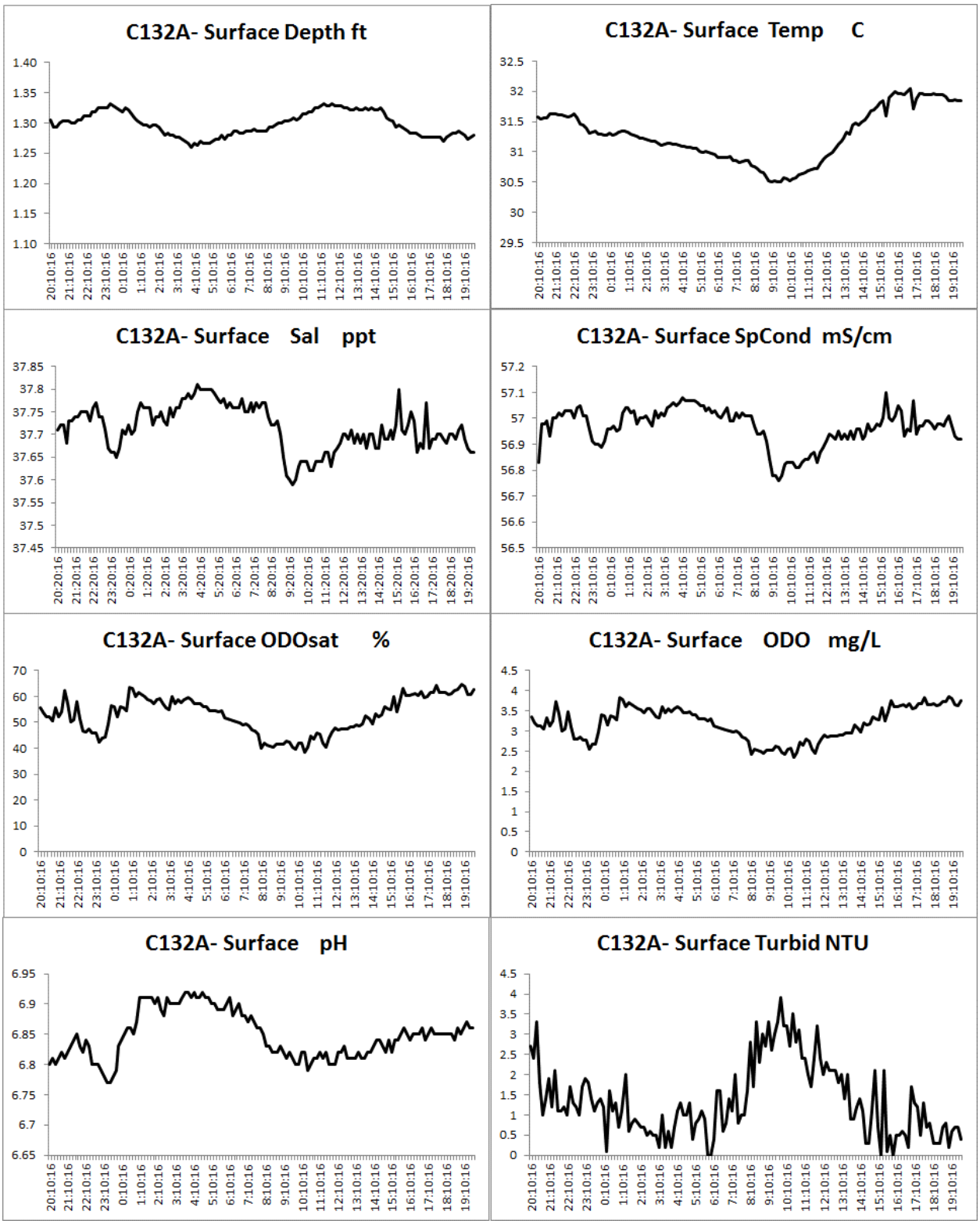

Figure 1.7: Time-series of physical-chemical data for surface water at site A in canal #137 during a 40-hour cycle (Diel cycle). Survey FKC04 (Jul 18, 2015)

Control Canal #132. Bottom

Water Depth displays an asymmetrical tidal cycle with just about 2 ft tidal range.

Water Temperature follows tides coarsely. Temperature decline in the early morning and evening is of about 2 °C.

Salinity and Specific Conductance rise from the early morning to noon, when a decreasing trend starts and continue to evening hours.

Dissolved Oxygen and Oxygen saturation are low with periods of increasing values in the early morning and around noon. %DO Sat exceedances reach 100%.

pH follows closely the DO and %DO Saturation patterns with significant linear correlation coefficients of r^2=0.78.

Turbidity seems to increase during low tides.

	C132A- Bottom Temp C	C132A- Bottom SpCond mS/cm	C132A- Bottom Sal ppt	C132A- Bottom Depth meters	C132A- Bottom pH	C132A- Bottom Turbid NTU	C132A- Bottom ODOsat %	C132A- Bottom ODO mg/L
Average	29.59	58.04	38.58	2.37	7.16	16.36	9.88	0.60
Median	29.89	58.05	38.58	2.38	7.12	15.10	5.95	0.37
Stand. Dev	0.76	0.36	0.25	0.22	0.17	10.91	8.51	0.52
%DO Sat Exceedances	100%							

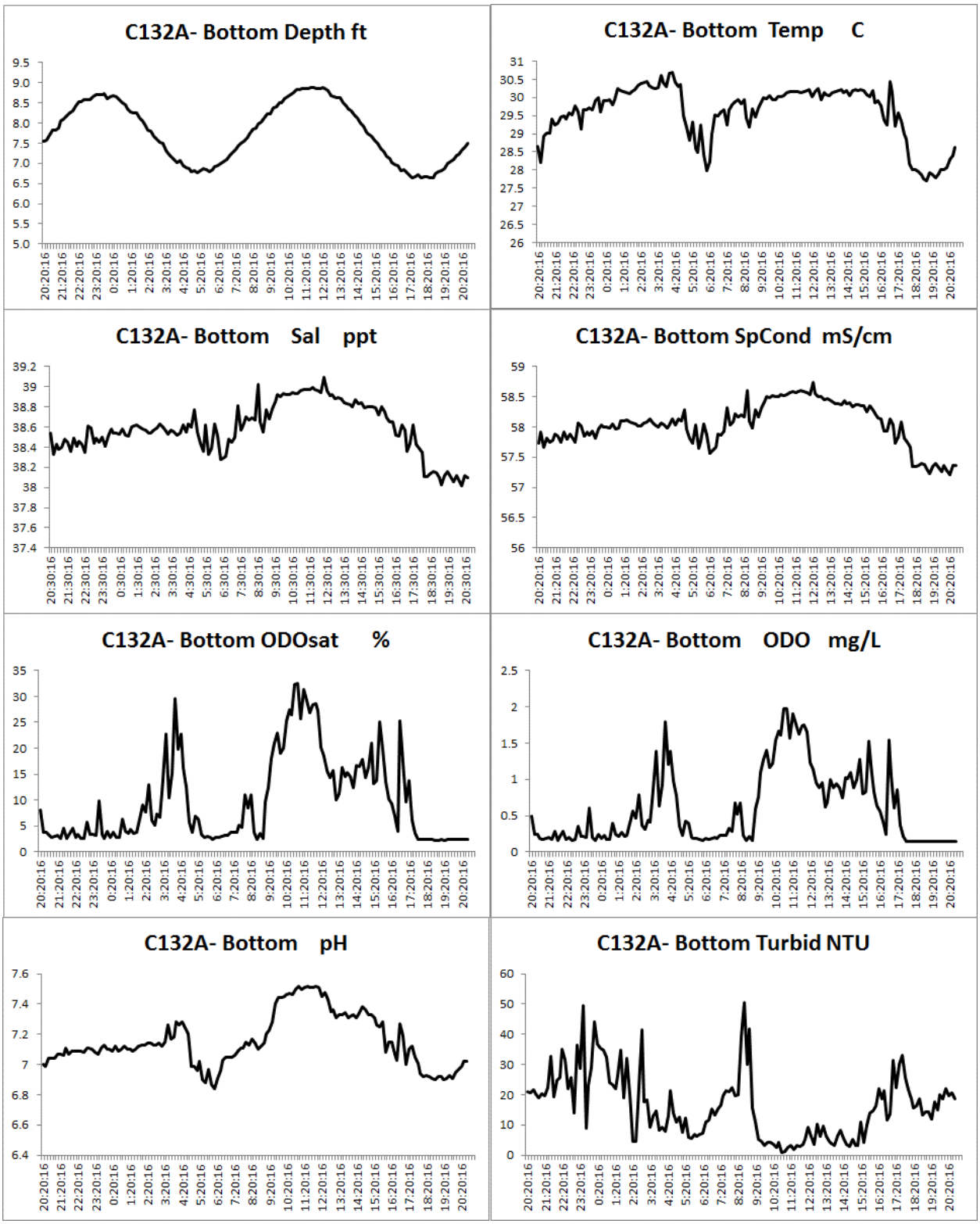

Figure 1.8: Time-series of physical-chemical data for bottom water at site A in canal #132 during a 24-hour cycle (Diel cycle). Survey FKC04 (Jul 18, 2015)

Demonstration Canal #137. Surface

Water Depth displays an asymmetrical tidal cycle with just about 0.12 ft tidal range.

Water Temperature shows a decline during night hours extending to the following morning, when an increasing trend starts and continues to evening hours. Evenings are characterized by relatively higher variability. Temperature range is a little over 2 °C range.

Salinity and Specific Conductance display a continuous decline.

Dissolved Oxygen and Oxygen saturation display a decline during night hours extending to the following morning, when an increasing trend starts and continues to evening hours. %DO Sat exceedances reach 34%.

pH follows very closely the DO and %DO Saturation patterns with significant linear correlation coefficients of r^2=0.73.

Turbidity seems to increase during low tides.

July 30, 2015

	C137A- Surface Temp C	C137A- Surface SpCond mS/cm	C137A- Surface Sal ppt	C137A- Surface Depth meters	C137A- Surface pH	C137A- Surface Turbid NTU	C137A- Surface ODOsat %	C137A- Surface ODO mg/L
Average	31.33	57.53	38.14	0.37	7.53	3.39	55.90	3.35
Median	31.26	57.54	38.13	0.37	7.50	3.20	49.50	2.97
Stand. Dev	0.54	0.21	0.15	0.01	0.14	1.39	22.60	1.32
%DO Sat Exceedances	34%							

July 17-18, 2015

	C137A- Surface Temp C	C137A- Surface SpCond mS/cm	C137A- Surface Sal ppt	C137A- Surface Depth meters	C137A- Surface pH	C137A- Surface Turbid NTU	C137A- Surface ODOsat %	C137A- Surface ODO mg/L
Average	30.93	57.88	38.41	0.39	6.82	1.60	48.51	2.92
Median	30.97	57.86	38.42	0.39	6.80	1.50	47.20	2.85
Stand. Dev	0.34	0.08	0.06	0.01	0.08	0.74	10.99	0.65
%DO Sat Exceedances	29%							

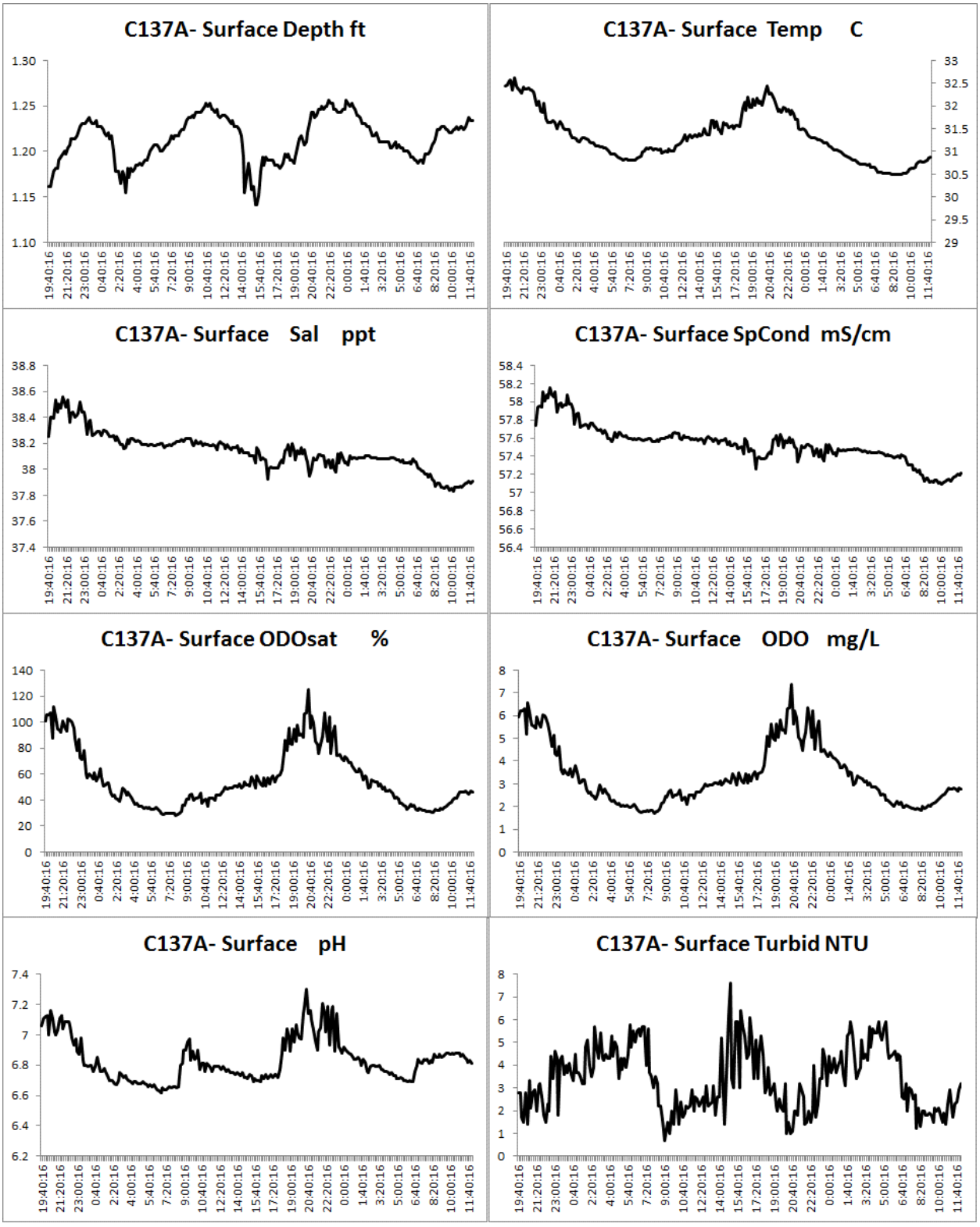

Figure 1.9: Time-series of physical-chemical data for surface water at site A in canal #137 during a 40-hour cycle (Diel cycle). Survey FKC04 (Aug 2015)

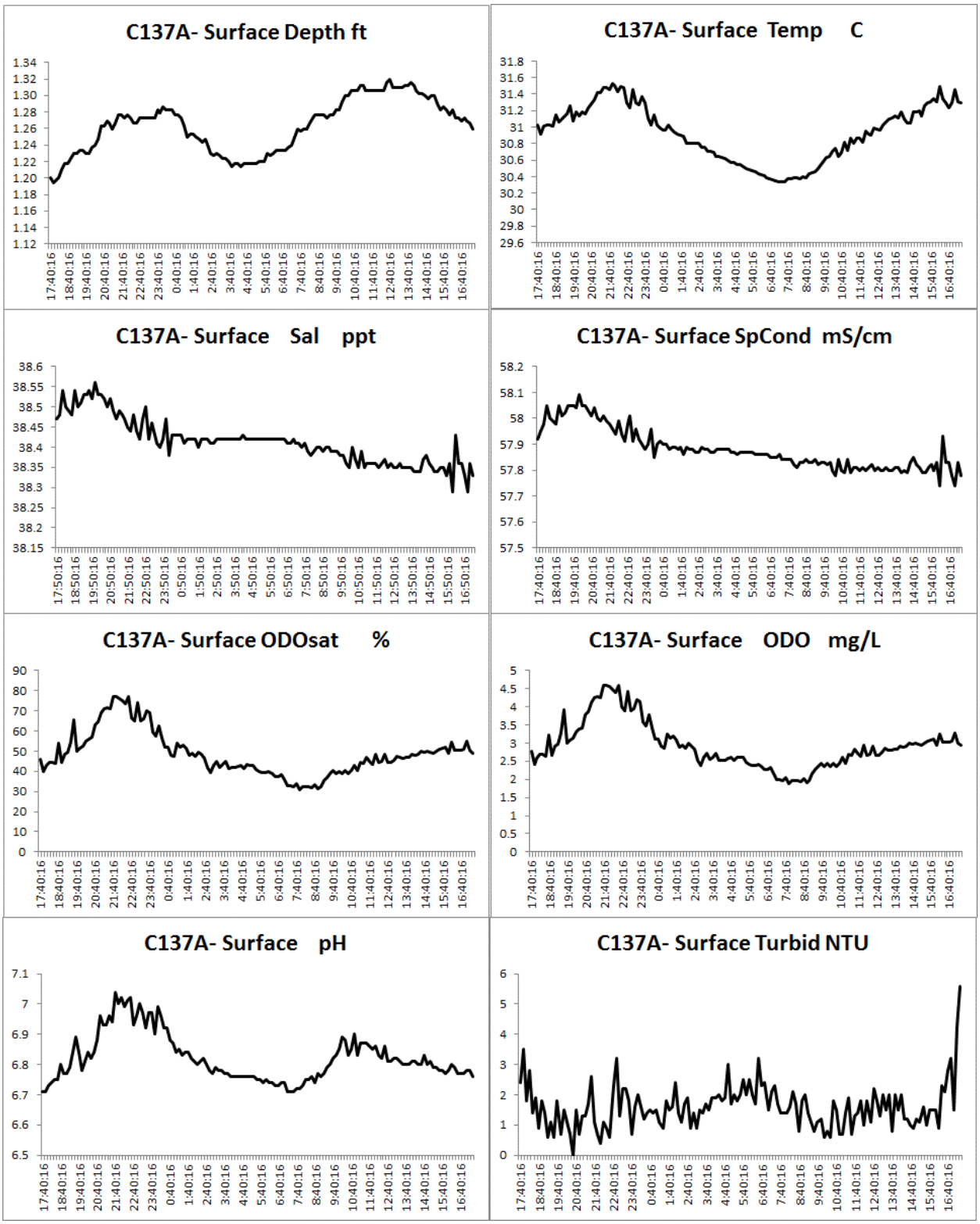

Figure 1.10: Time-series of physical-chemical data for surface water at site A in canal #137 during a 24-hour cycle (Diel cycle). Survey FKC04 (Jul 2015)

Demonstration Canal #137. Bottom

Water Depth displays a very regular tidal cycle with a 3.2 ft tidal range.

Water Temperature shows a decline during night hours extending to the following morning, when an increasing trend starts and continues to evening hours. The temperature range of variation is about 1.5 °C.

Salinity and Specific Conductance remained practically constant until early morning (8 AM) when a sudden increase is observed.

Dissolved Oxygen and Oxygen saturation decline during night hours extending to the following morning, when an increasing trend starts and continues to evening hours. %DO Sat exceedances reach 51%

pH follows very closely the DO and %DO Saturation patterns.

Turbidity seems to increase during low tides.

July 30, 2015

	C137A- Bottom Temp C	C137A- Bottom SpCond mS/cm	C137A- Bottom Sal ppt	C137A- Bottom Depth meters	C137A- Bottom pH	C137A- Bottom Turbid NTU	C137A- Bottom ODOsat %	C137A- Bottom ODO mg/L
Average	31.09	58.37	38.78	1.67	7.17	2.84	40.57	2.43
Median	31.16	58.38	38.78	1.72	7.17	2.60	41.20	2.46
Stand. Dev	0.38	0.08	0.06	0.29	0.05	1.55	11.31	0.67
%DO Sat Exceedances	51%							

July 17-18, 2015

	C137A- Bottom Temp C	C137A- Bottom SpCond mS/cm	C137A- Bottom Sal ppt	C137A- Bottom Depth meters	C137A- Bottom pH	C137A- Bottom Turbid NTU	C137A- Bottom ODOsat %	C137A- Bottom ODO mg/L
Average	30.60	59.23	39.45	2.22	7.26	1.41	37.87	2.28
Median	30.62	59.24	39.47	2.22	7.27	1.20	37.20	2.24
Stand. Dev	0.24	0.07	0.06	0.23	0.04	1.04	4.91	0.29
%DO Sat Exceedances	79%							

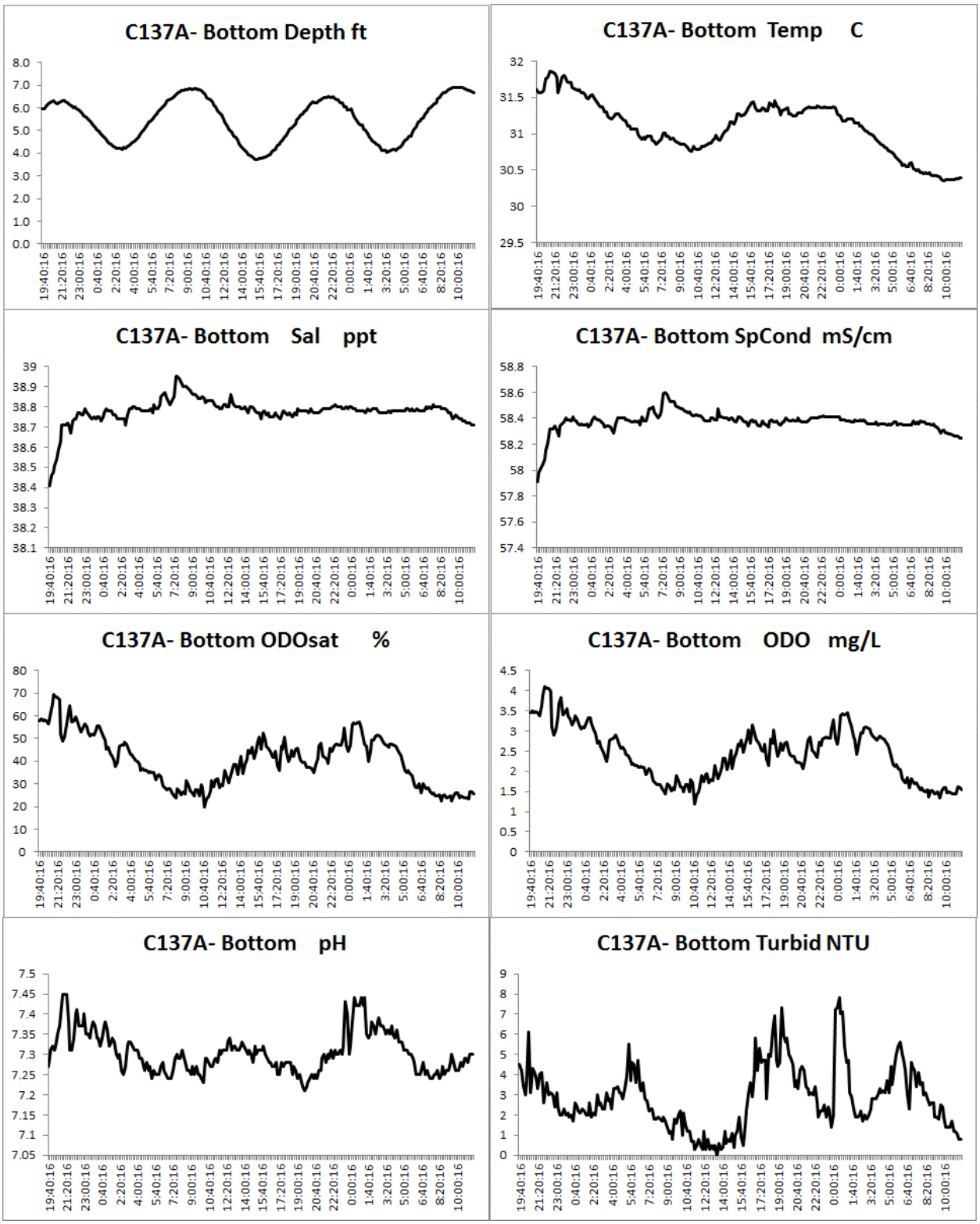

Figure 1.11: Time-series of physical-chemical data for bottom water at site A in canal #137 during a 41-hour cycle (Diel cycle). Survey FKC04 (Aug 2015)

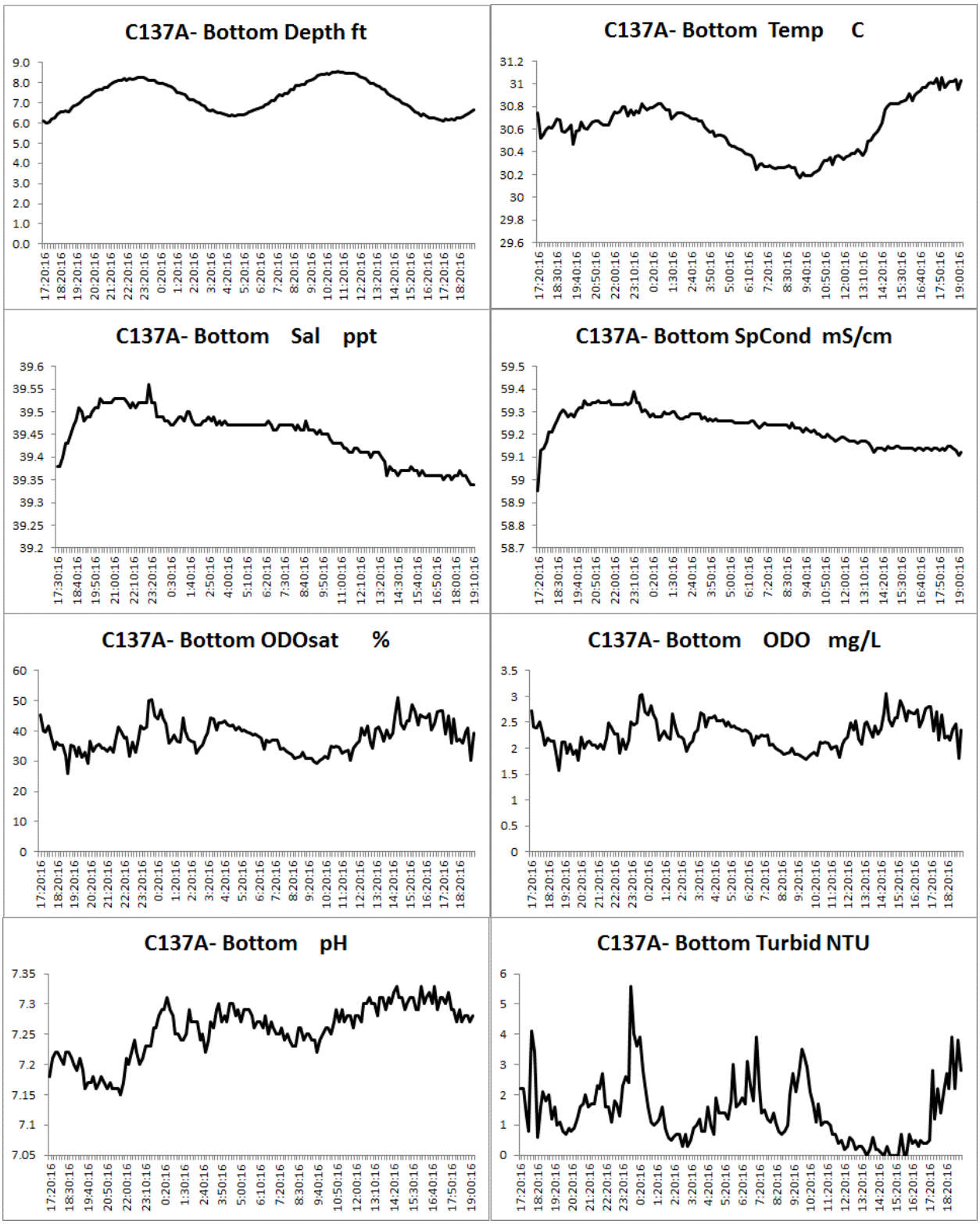

Figure 1.12: Time-series of physical-chemical data for bottom water at site A in canal #137 during a 24-hour cycle (Diel cycle). Survey FKC04 (July 2015)

Lower Matecumbe Key

Control Canal #147. Surface

Water Depth displays a regular tidal cycle with aboyt 1 ft tidal range.

Water Temperature shows an increase from noon to afternoon, followed by an increase.

Salinity and Specific Conductance display a decrease in the morning (10 AM). Values remain about constant the rest of the time.

Dissolved Oxygen and Oxygen saturation slightly increase in the afternoon until values reach the maximum, then display and increasing tendency. %DO Saturation exceedances reach 73%

pH follows closely the DO and %DO Saturation patterns with significant linear correlation coefficients of r^2=0.90.

Turbidity follows tides coarsely.

	C147A- Surface Temp C	C147A- Surface SpCond mS/cm	C147A- Surface Sal ppt	C147A- Surface Depth meters	C147A- Surface pH	C147A- Surface Turbid NTU	C147A- Surface ODOsat %	C147A- Surface ODO mg/L
Average	33.67	53.17	34.79	0.36	7.67	1.46	34.07	2.00
Median	33.51	53.21	34.84	0.34	7.67	1.40	34.00	2.00
Stand. Dev	0.76	0.17	0.11	0.10	0.05	0.56	11.81	0.67
%DO Sat Exceedances	73%							

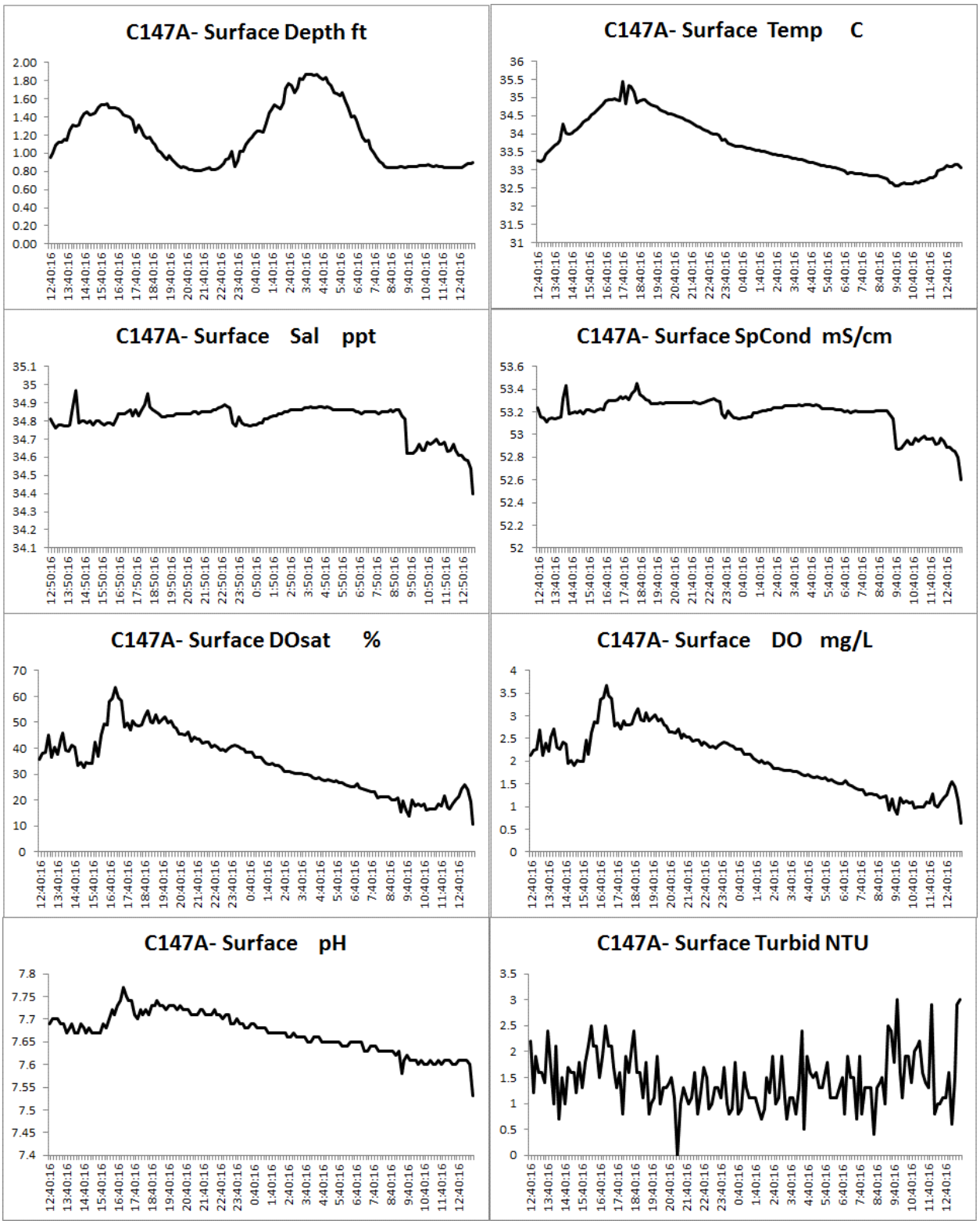

Figure 1.13: Time-series of physical-chemical data for surface water at site A in canal #147 during a 24-hour cycle (Diel cycle). Survey FKC04 (Aug 23, 2015)

Control Canal #147. Bottom

Water Depth displays a regular tidal cycle with a1 ft tidal range.

Water Temperature remains constant with a drop during the morning.

Salinity and Specific Conductance constantly increase.

Dissolved Oxygen and Oxygen saturation remain constant and close to zero. DO Sat exceedances reach 100%.

pH is highly variable and seems to increase with low tides.

Turbidity is high with only a period of lower values starting around noon.

	C147A- Bottom Temp C	C147A- Bottom SpCond mS/cm	C147A- Bottom Sal ppt	C147A- Bottom Depth meters	C147A- Bottom pH	C147A- Bottom Turbid NTU	C147A- Bottom DOsat %	C147A- Bottom DO mg/L
Average	26.79	62.30	41.91	1.63	7.18	59.00	2.62	0.17
Median	26.77	62.42	42.00	1.64	7.17	58.80	2.60	0.17
Stand. Dev	0.22	0.47	0.36	0.15	0.07	29.06	0.05	0.00
%DO Sat Exceedances	100%							

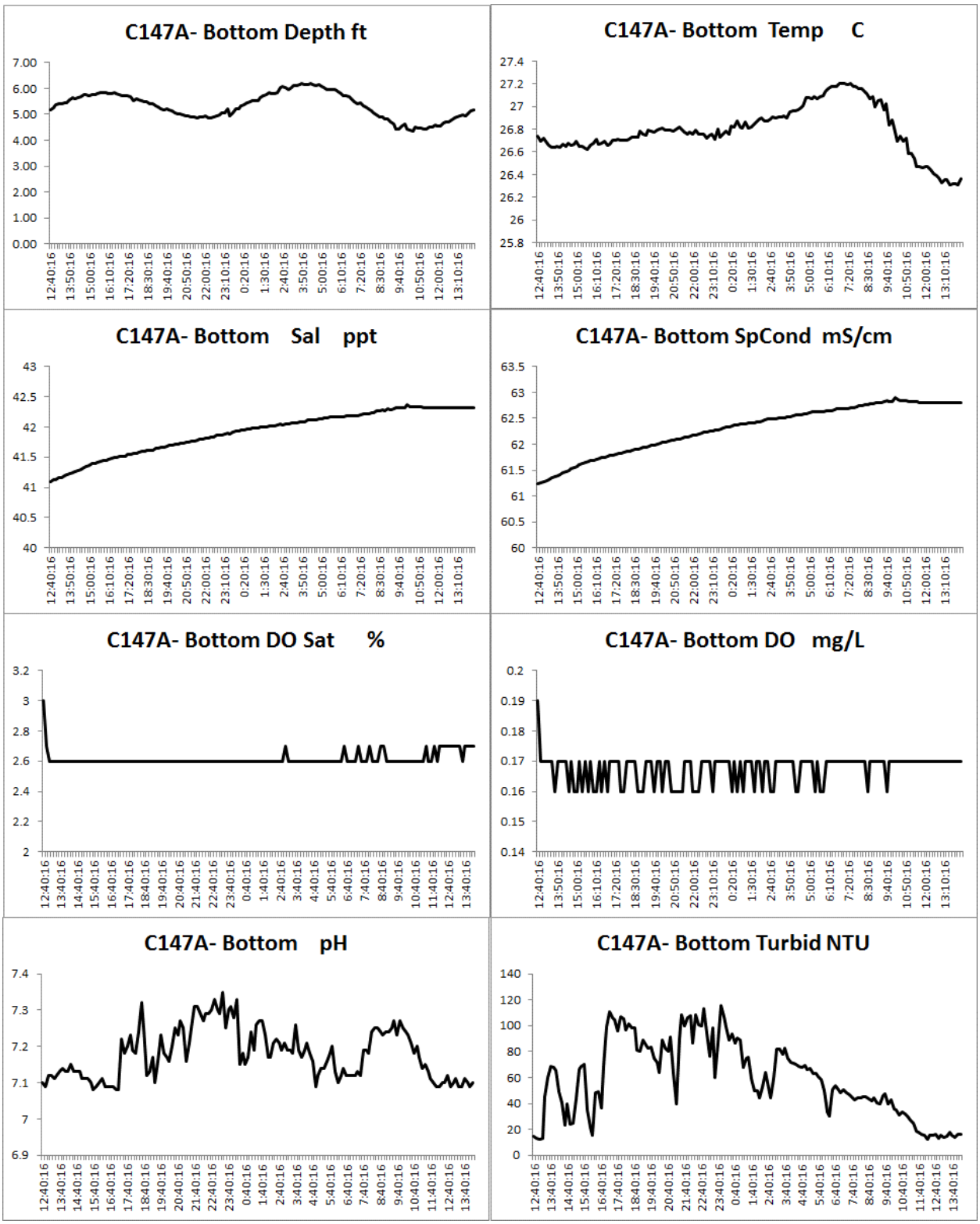

Figure 1.14: Time-series of physical-chemical data for bottom water at site A in canal #147 during a 24-hour cycle (Diel cycle). Survey FKC04 (Aug 23, 2015)

Remediation Canal #148. Surface

Water Depth displays an irregular tidal cycle with a period of high variability between midnight and the early morning (5:30 AM).

Water Temperature shows a hump peaking at 5:30 PM. Temperature range is a little over 2.6 °C range.

Salinity and Specific Conductance remain very constant until the evening when a sudden decrease initiates slightly higher variability and constant values until the next morning.

Dissolved Oxygen and Oxygen saturation decline from midnight to early morning, then an increasing trend is observed. %DO Sat exceedances reach 46%

pH follows closely the DO and %DO Saturation patterns with linear correlation coefficients of r^2=0.80.

Turbidity is low with only a period of higher values starting at midnight and dropping sharply.

	C148A- Surface Temp C	C148A- Surface SpCond mS/cm	C148A- Surface Sal ppt	C148A- Surface Depth meters	C148A- Surface pH	C148A- Surface Turbid NTU	C148A- Surface DO Sat %	C148A- Surface DO mg/L
Average	32.63	53.15	34.82	0.24	7.71	2.36	45.65	2.72
Median	32.41	54.04	35.49	0.23	7.72	1.80	45.45	2.73
Stand. Dev	0.73	1.21	0.88	0.02	0.07	2.21	17.62	1.02
%DO Sat Exceedances	46%							

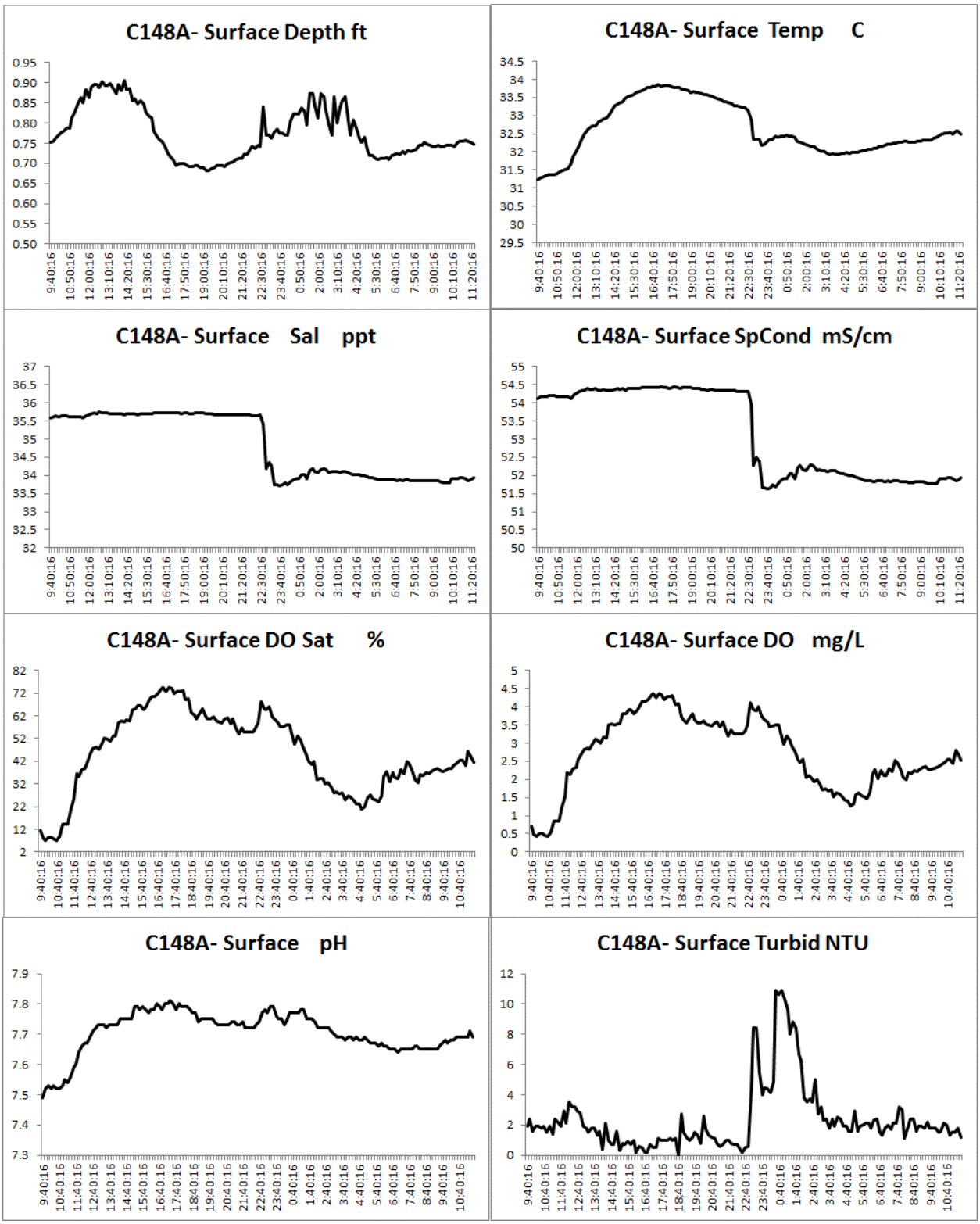

Figure 1.15: Time-series of physical-chemical data for surface water at site A in canal #148 during a 26-hour cycle (Diel cycle). Survey FKC04 (Aug 22, 2015)

Remediation Canal #148. Bottom

Water Depth displays a very regular tidal cycle with a1.6 ft tidal range.

Water Temperature remains relatively constant with a sudden increase around midnight.

Salinity and Specific Conductance constantly increase.

Dissolved Oxygen and Oxygen saturation remain constant and close to zero. DO Sat exceedances reach 100%.

pH continuously increases during the day and declines after midnight.

Turbidity is highly variable with only a period of decreasing values starting from midnight to the next morning.

	C148A- Bottom Temp C	C148A- Bottom SpCond mS/cm	C148A- Bottom Sal ppt	C148A- Bottom Depth meters	C148A- Bottom pH	C148A- Bottom Turbid NTU	C148A- Bottom DO Sat %	C148A- Bottom DO mg/L
Average	26.90	59.95	40.12	1.70	7.19	54.88	2.67	0.17
Median	26.72	59.88	40.08	1.70	7.19	50.10	2.70	0.17
Stand. Dev	0.41	0.31	0.23	0.14	0.09	22.64	0.07	0.00
%DO Sat Exceedances	100%							

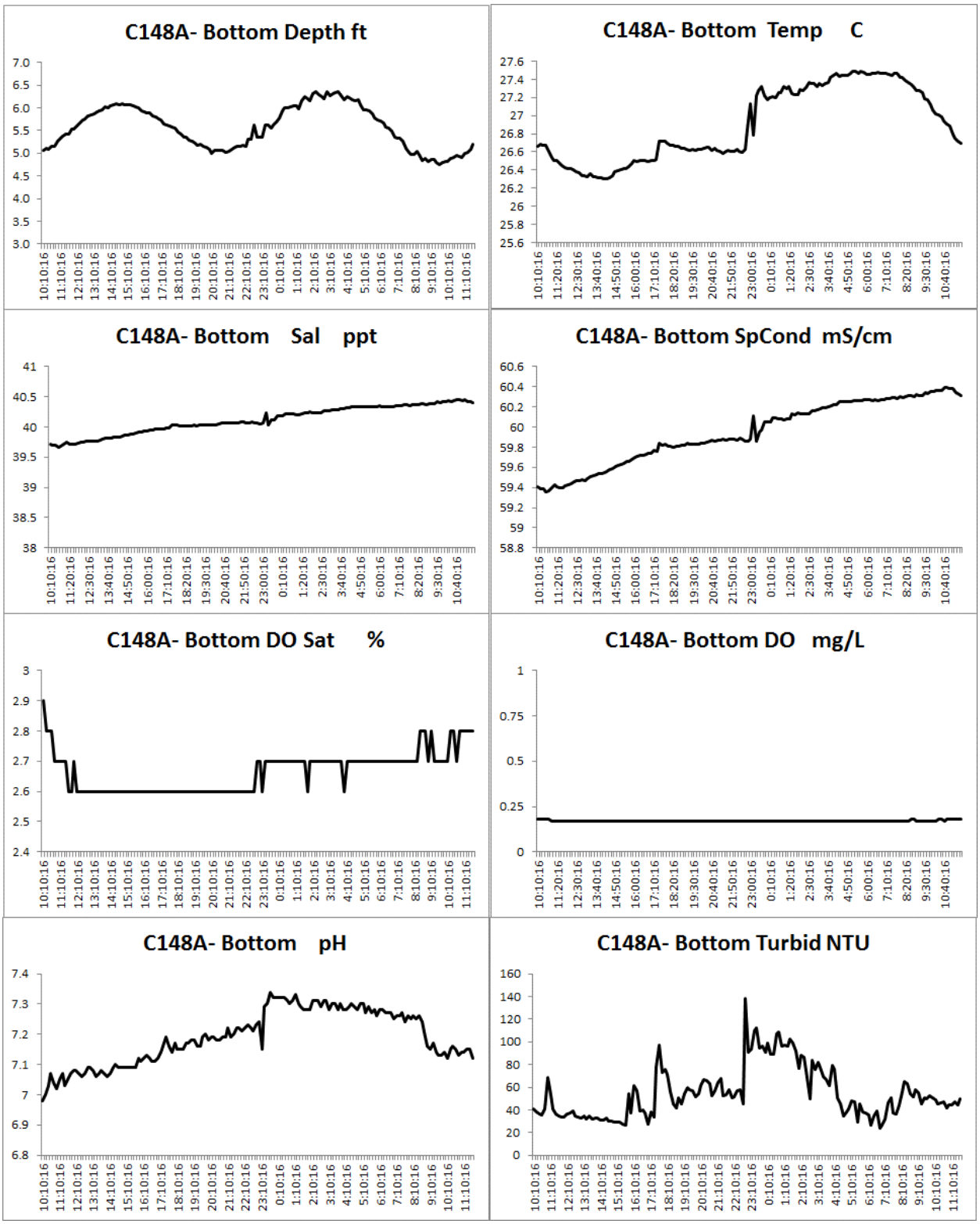

Figure 1.16: Time-series of physical-chemical data for bottom water at site A in canal #147 during a 25-hour cycle (Diel cycle). Survey FKC04 (Aug 22, 2015)

Big Pine Hollerich Subdivision

Remediation Canal #287. Surface

Water Depth displays a regular tidal cycle with a 0.4 ft tidal range.

Water Temperature decreased from afternoon to early morning hours, then increases until afternoon hours.

Salinity and Specific Conductance remain relatively constant with a slight drop in the morning and an increasing tendency right after that with values peaking at 2 PM.

Dissolved Oxygen and Oxygen saturation declines from afternoon, continuously until mid-morning and then increase. %DO Sat exceedances reach 10%

pH roughly follows DO and %DO Saturation patterns with a highly significant linear correlation coefficients of r^2=0.95.

Turbidity seems to increase with low tides. The highest values are reached in the morning around 9 AM.

	C287A- Surface Temp C	C287A- Surface SpCond mS/cm	C287A- Surface Sal ppt	C287A- Surface Depth meters	C287A- Surface pH	C287A- Surface Turbid NTU	C287A- Surface ODOsat %	C287A- Surface ODO mg/L
Average	32.25	58.77	39.03	0.28	7.57	1.12	63.36	3.72
Median	32.10	58.76	39.04	0.28	7.56	1.10	60.90	3.60
Stand. Dev	0.71	0.07	0.03	0.04	0.05	0.41	15.94	0.90
%DO Sat Exceedances	10%							

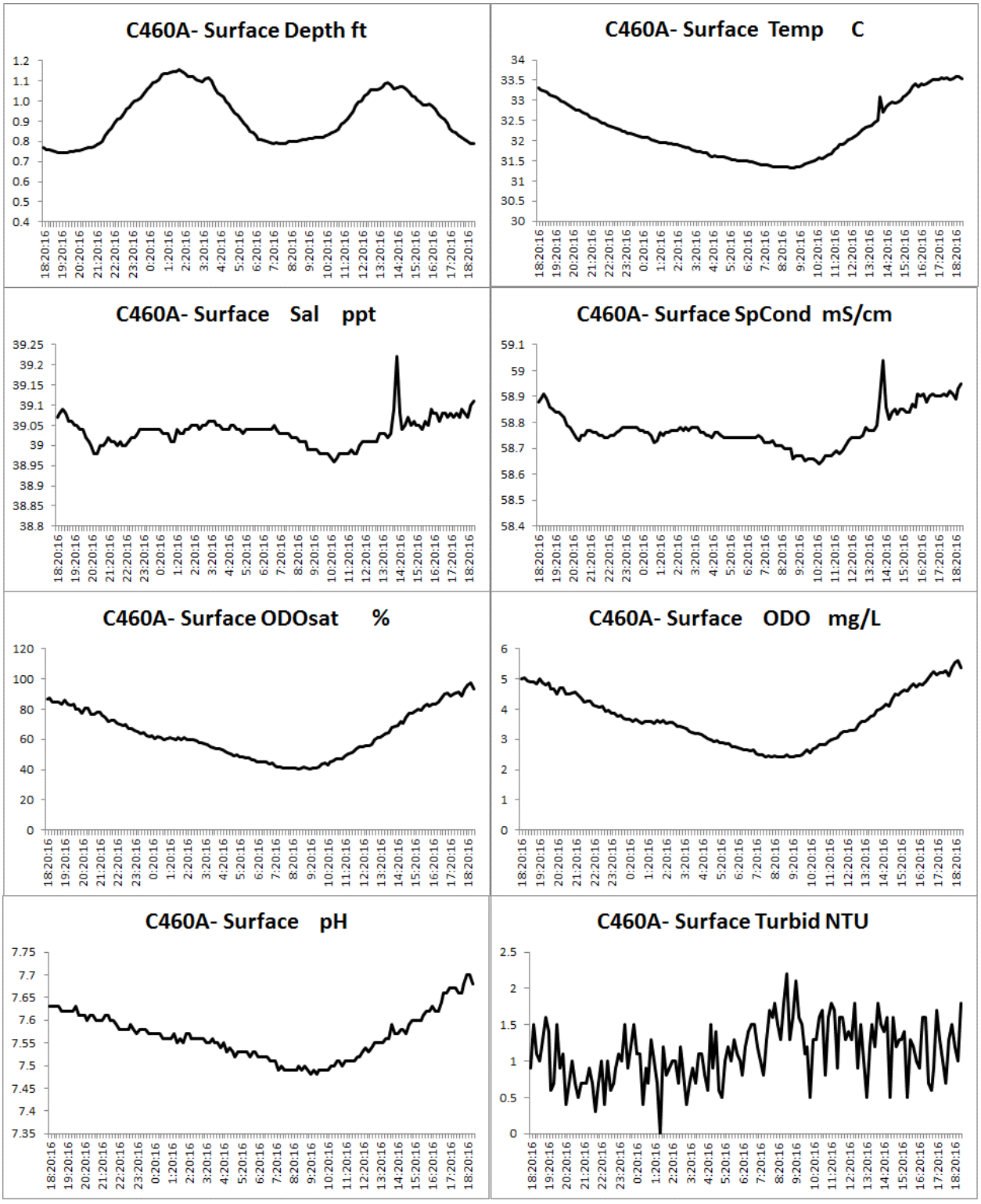

Figure 1.17: Time-series of physical-chemical data for surface water at site A in canal #287 during a 24-hour cycle (Diel cycle). Survey FKC04 (Aug 19, 2015)

Remediation Canal #287. Bottom

Water Depth displays a regular tidal cycle with a 1 ft tidal range.

Water Temperature increases from noon to very early morning hours, then decreases until noon.

Salinity and Specific Conductance show a decreasing tendency right after values peaking at 9 AM.

Dissolved Oxygen and Oxygen saturation coarsely follows tides. Values are low and reach the minimum in the mid morning. %DO Sat exceedances reach 10%.

pH roughly follows DO and %DO Saturation patterns.

Turbidity increases during low tides especially in the morning and until 1 PM.

	C287A- Bottom Temp C	C287A- Bottom SpCond mS/cm	C287A- Bottom Sal ppt	C287A- Bottom Depth meters	C287A- Bottom pH	C287A- Bottom Turbid NTU	C287A- Bottom ODOsat %	C287A- Bottom ODO mg/L
Average	31.03	63.88	42.97	2.17	7.50	3.20	16.77	0.98
Median	31.03	63.87	42.97	2.18	7.51	2.40	17.10	1.01
Stand. Dev	0.14	0.04	0.03	0.09	0.04	2.76	5.57	0.33
%DO Sat Exceedances	100%							

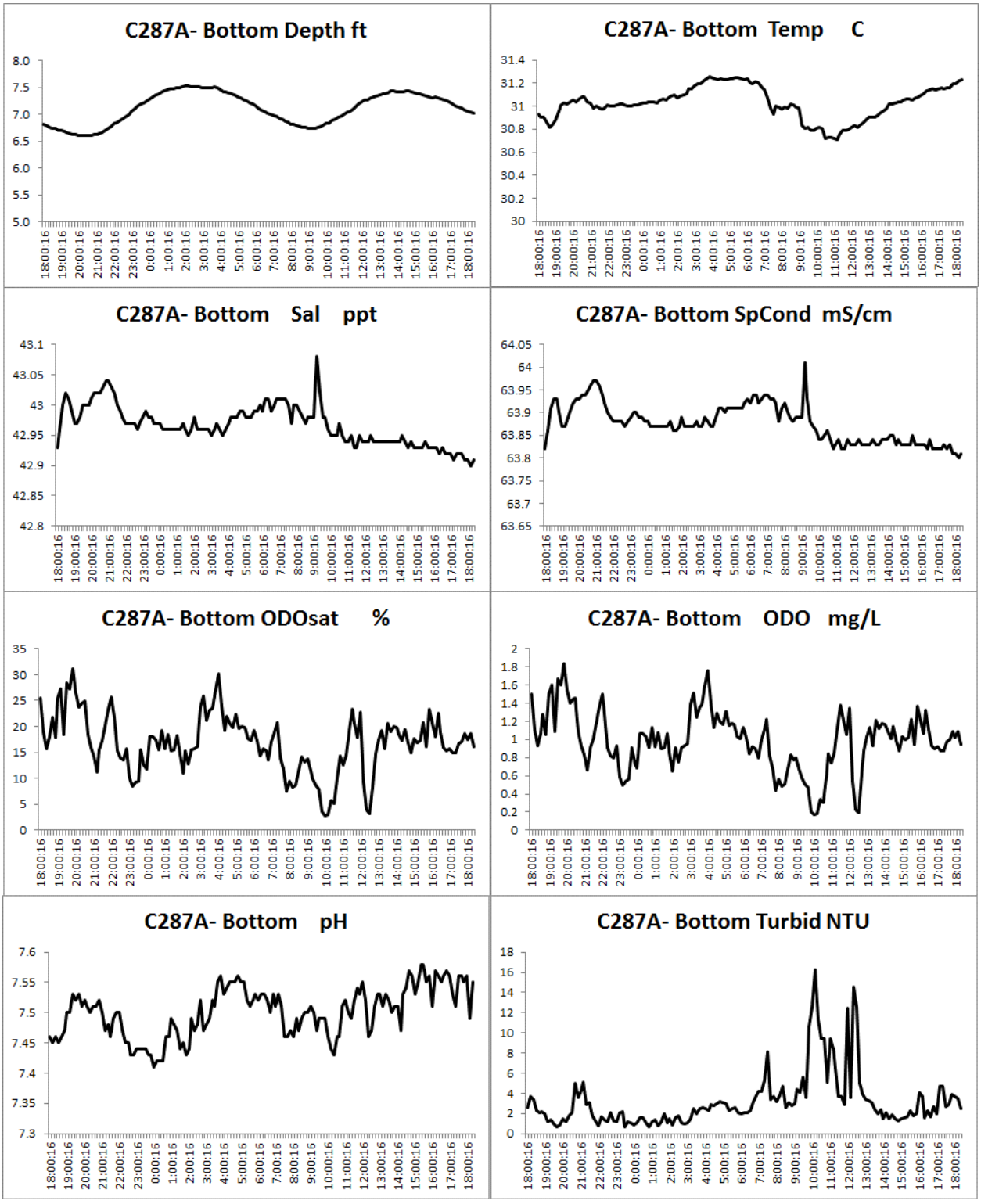

Figure 1.18: Time-series of physical-chemical data for bottom water at site A in canal #287 during a 24-hour cycle (Diel cycle). Survey FKC04 (Aug 19, 2015)

ORGANIC REMOVAL

Big Pine

Control Canal #293. Surface

Water Depth does not display a tidal cycles.

Water Temperature begins to drop after sunset and rises again in the morning. Range of variation is about 2 °C.

Salinity and Specific Conductance remain about constant.

Dissolved Oxygen and Oxygen saturation drop after sunset, then show a period of constant very low values until the values rise again around noon. %DO Sat exceedances reach 70%.

pH follows very closely the DO and %DO saturation patterns with an average value of 7.47. pH and the DO and %DO Saturation have significant linear correlation coefficients of r^2=0.94.

Turbidity begins to drop at noon and starts to rise in the night.

	C293A- Surface Temp C	C293A- Surface SpCond mS/cm	C293A- Surface Sal ppt	C293A- Surface Depth meters	C293A- Surface pH	C293A- Surface Turbid NTU	C293A- Surface DO Sat %	C293A- Surface DO mg/L
Average	31.25	58.16	38.61	0.26	7.47	13.04	25.90	1.54
Median	31.08	58.15	38.61	0.26	7.48	13.20	26.50	1.60
Stand. Dev	0.61	0.09	0.06	0.01	0.08	4.58	19.54	1.16
%DO Sat Exceedances	70%							

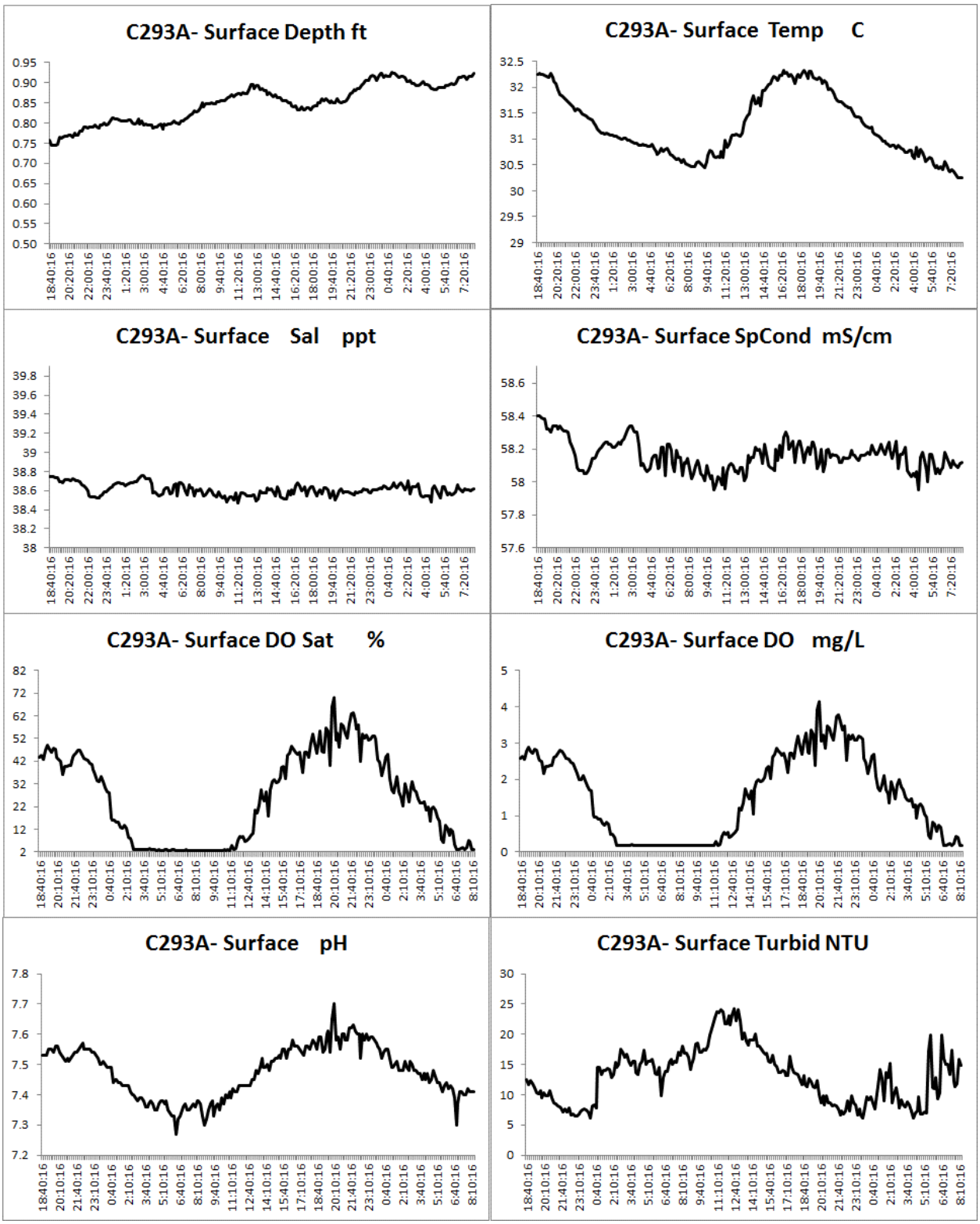

Figure 1.19: Time-series of physical-chemical data for surface water at site A in canal #293 during a 37-hour cycle (Diel cycle). Survey FKC04 (Aug 16, 2015)

Control Canal #293. Bottom

Water Depth displays a regular tidal cycles with a 1.3 ft tidal range.

Water Temperature remains constant until the early morning when a sudden drop occurs and become stable again.

Salinity and Specific Conductance continuously increase

Dissolved Oxygen and Oxygen saturation remain constant and low. %DO Sat exceedances reach 100%.

pH remains constant until the early morning when a sudden increase happens and become stable again.

Turbidity describes a similar pattern as that of pH.

	C293A- Bottom Temp C	C293A- Bottom SpCond mS/cm	C293A- Bottom Sal ppt	C293A- Bottom Depth meters	C293A- Bottom pH	C293A- Bottom Turbid NTU	C293A- Bottom DO Sat %	C293A- Bottom DO mg/L
Average	29.78	62.26	41.78	2.93	7.04	9.39	2.80	0.17
Median	29.71	62.54	42.00	2.93	7.07	10.60	2.80	0.17
Stand. Dev	0.14	0.87	0.67	0.11	0.10	3.05	0.05	0.00
%DO Sat Exceedances	100%							

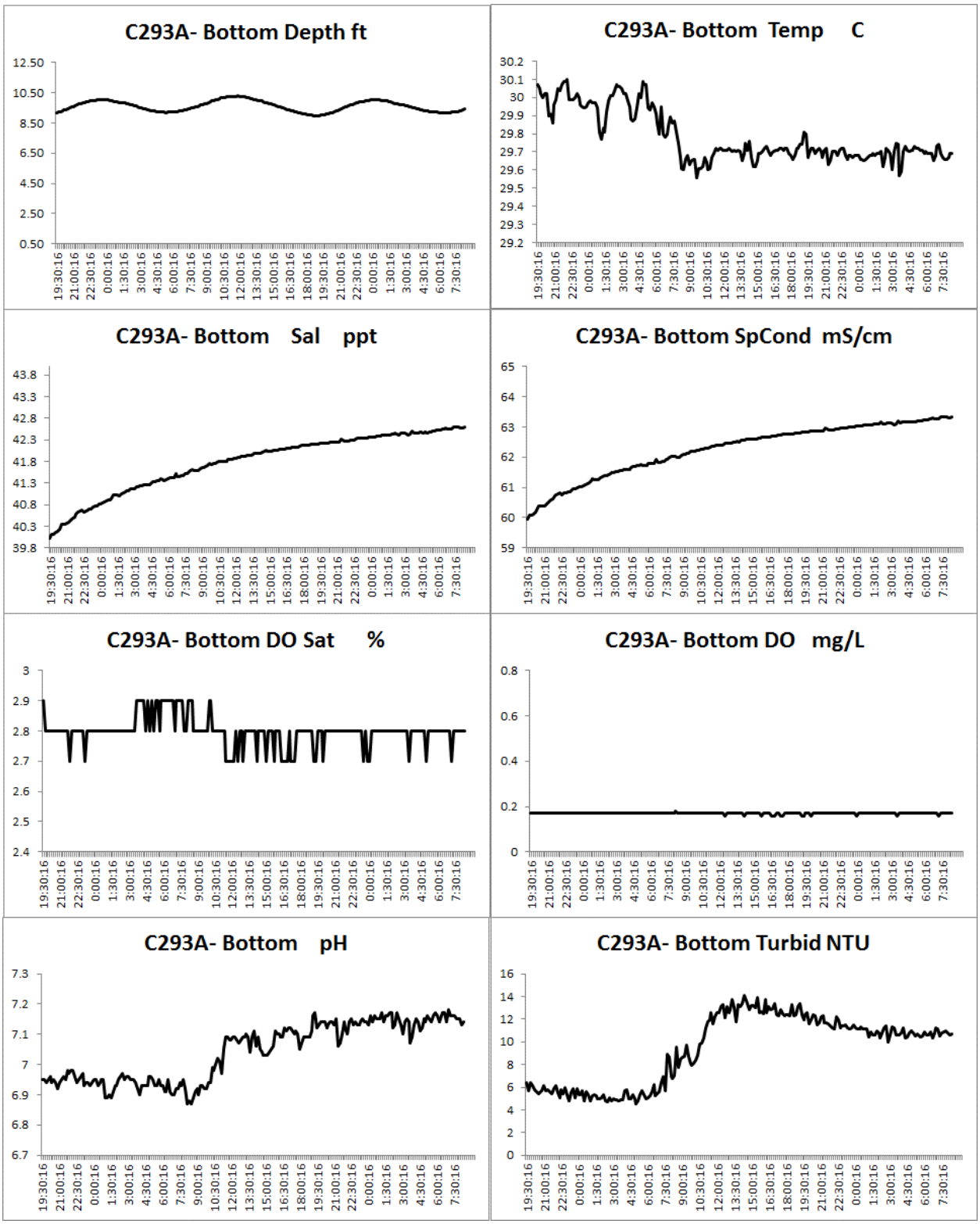

Figure 1.20: Time-series of physical-chemical data for bottom water at site A in canal #293 during a 41-hour cycle (Diel cycle). Survey FKC04 (Aug 17, 2015)

Remediation Canal #290. Surface

Water Depth displays a flat depth curve.

Water Temperature increases during the morning and declines in the afternoon.

Salinity and Specific Conductance remain practically constant.

Dissolved Oxygen and Oxygen saturation drop after sunset and rise again in the morning. %DO Sat exceedances reach 23%.

pH follows the DO and %DO saturation patterns. The DO and %DO Saturation have significant linear correlation coefficients of r^2=0.97.

Turbidity shows high values from afternoon to midnight, when it becomes low and constant around 2 NTU.

	C290A- Surface Temp C	C290A- Surface SpCond mS/cm	C290A- Surface Sal ppt	C290A- Surface Depth meters	C290A- Surface pH	C290A- Surface Turbid NTU	C290A- Surface DO Sat %	C290A- Surface DO mg/L
Average	31.56	58.36	38.75	0.27	7.66	5.68	75.45	4.47
Median	31.38	58.35	38.75	0.28	7.66	2.40	69.80	4.17
Stand. Dev	0.80	0.07	0.04	0.01	0.11	6.71	34.32	1.99
%DO Sat Exceedances	23%							

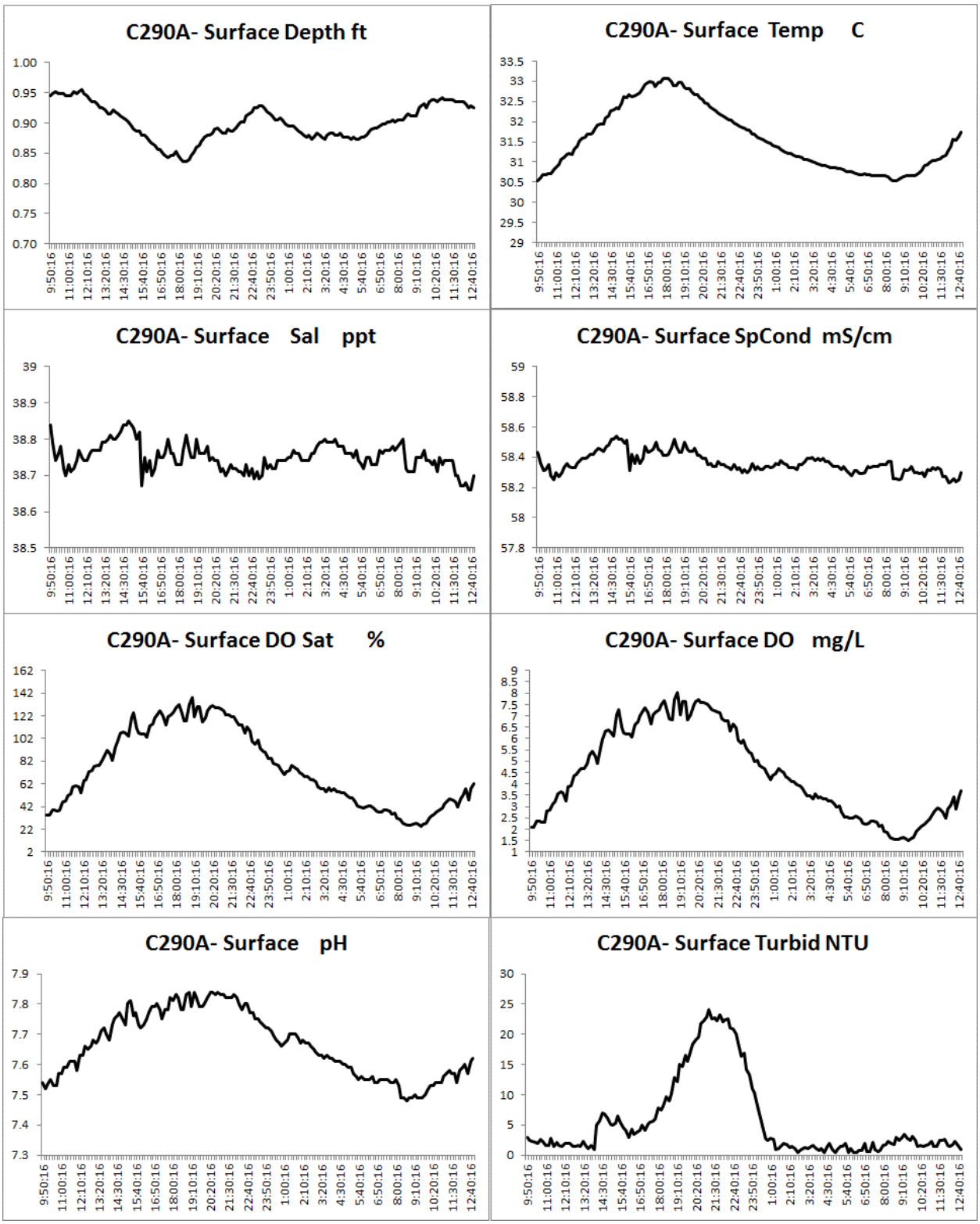

Figure 1.21: Time-series of physical-chemical data for surface water at site A in canal #290 during a 24-hour cycle (Diel cycle). Survey FKC04 (Aug 17, 2015)

Remediation Canal #290. Bottom

Water Depth displays a regular tidal cycles with about 1 ft tidal range.

Water Temperature slightly rises in the morning until the afternoon when it remains practically constant and rises again in the morning after a sudden drop. Range of variation is less than 1 °C.

Salinity and Specific Conductance display only a very slight decline early in the morning.

Dissolved Oxygen and Oxygen saturation show a period where values remain totally flat at practically zero from evening to noon next day, between this period, values are high and show high variability. %DO Sat exceedances reach 100%

pH displays a declining tendency from mid afternoon to mid morning, when a slight decreasing tendency set in.

Turbidity shows periods of increasing values peaking after low tides.

	C290A- Bottom Temp C	C290A- Bottom SpCond mS/cm	C290A- Bottom Sal ppt	C290A- Bottom Depth meters	C290A- Bottom pH	C290A- Bottom Turbid NTU	C290A- Bottom DO Sat %	C290A- Bottom DO mg/L
Average	30.47	63.71	42.86	1.81	7.30	18.99	4.53	0.27
Median	30.60	63.72	42.87	1.82	7.32	15.80	2.80	0.17
Stand. Dev	0.23	0.09	0.07	0.11	0.10	9.97	3.98	0.24
%DO Sat Exceedances	100%							

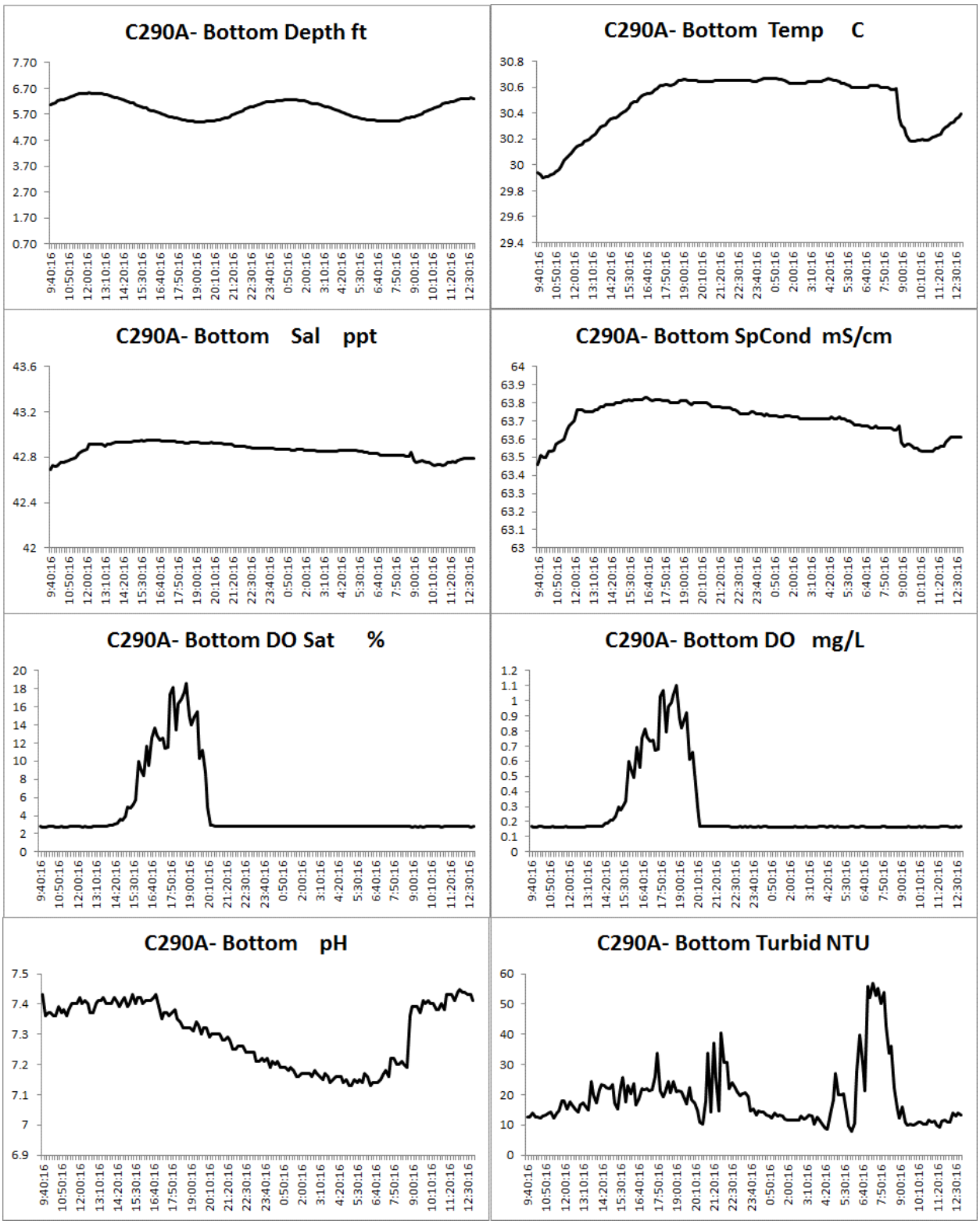

Figure 1.22: Time-series of physical-chemical data for bottom water at site A in canal #290 during a 24-hour cycle (Diel cycle). Survey FKC04 (Aug 6, 2015)

PUMPING

Control Canal #282. Surface

Water Depth displays an asymmetrical tidal cycle with just about 0.1 ft range.

Water Temperature shows a decline from mid afternoon until to the following morning, when an increasing trend starts.

Salinity and Specific Conductance remains constant until early morning when values peak and show higher variability.

Dissolved Oxygen and Oxygen saturation display a decline during from early to mid morning, when an increasing trend starts and continues to afternoon. %DO Sat exceedances reach 26%.

pH follows very closely the DO and %DO Saturation patterns with significant linear correlation coefficients of r^2=0.94 and 0.93, respectively.

Turbidity seems to increase during low tides. A sudden increase in turbidity occurs in the morning with a strong peak at 7:00 AM.

	C282A- Surface Temp C	C282A- Surface SpCond mS/cm	C282A- Surface Sal ppt	C282A- Surface Depth meters	C282A- Surface pH	C282A- Surface Turbid NTU	C282A- Surface ODOsat %	C282A- Surface ODO mg/L
Average	32.32	58.26	38.64	0.27	7.58	2.25	55.83	3.28
Median	32.12	58.20	38.58	0.27	7.62	1.60	64.10	3.82
Stand. Dev	0.69	0.19	0.15	0.01	0.07	1.58	21.77	1.26
%DO Sat Exceedances	26%							

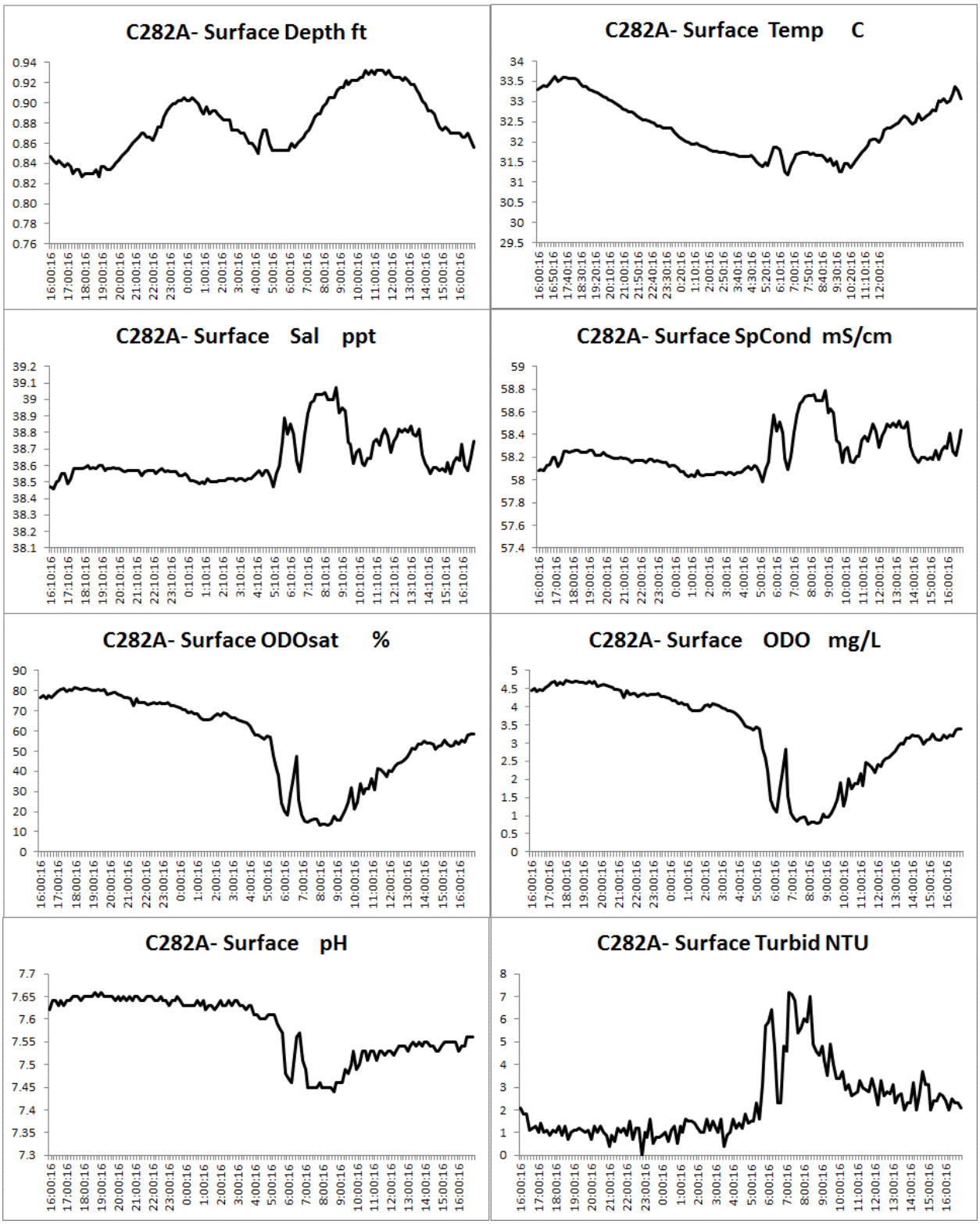

Figure 1.23: Time-series of physical-chemical data for surface water at site A in canal #282 during a 24-hour cycle (Diel cycle). Survey FKC04 (Aug 2015)

Control Canal #282. Bottom

Water Depth displays a very regular tidal cycle with a 1 ft tidal range.

Water Temperature decreased from afternoon to early morning hours, then increase until afternoon hours.

Salinity and Specific Conductance follows tides coarsely. Decrease slightly from afternoon to evening hours and then start to increase.

Dissolved Oxygen and Oxygen saturation decline during night hours extending to the following morning, when an increasing trend starts and continues to evening hours. %DO Sat exceedances reach 72%

pH follows very closely the DO and %DO Saturation patterns with significant linear correlation coefficients of r^2=0.89.

Turbidity seems to increase during low tides despite the high variability.

	C282A- Bottom Temp C	C282A- Bottom SpCond mS/cm	C282A- Bottom Sal ppt	C282A- Bottom Depth meters	C282A- Bottom pH	C282A- Bottom Turbid NTU	C282A- Bottom ODOsat %	C282A- Bottom ODO mg/L
Average	31.50	64.13	43.15	0.98	7.55	3.20	30.87	1.80
Median	31.49	64.18	43.19	0.98	7.55	3.10	29.70	1.73
Stand. Dev	0.21	0.20	0.16	0.09	0.07	0.84	17.89	1.04
%DO Sat Exceedances	72%							

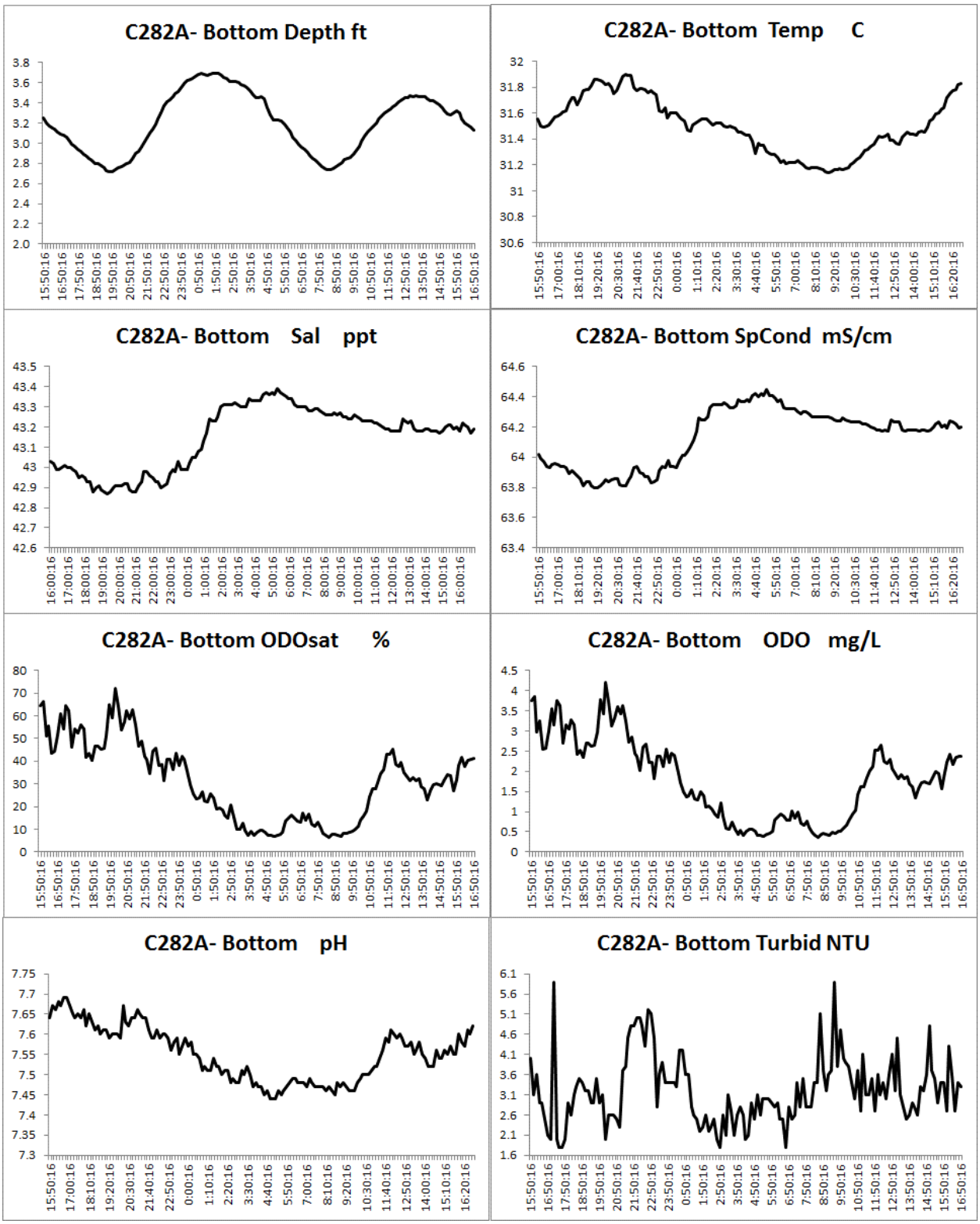

Figure 1.24: Time-series of physical-chemical data for bottom water at site A in canal #282 during a 25-hour cycle (Diel cycle). Survey FKC04 (Aug 2015)

Remediation Canal #278. Surface

Water Depth displays a flat depth curve with just 0.1 ft range.

Water Temperature shows a very slight decline during night hours extending to the following morning, when an increasing trend starts and continues to evening hours.

Salinity and Specific Conductance decrease during evening hours with relatively high variability. Salinity coarsely follows temperature.

Dissolved Oxygen and Oxygen saturation describe a similar pattern as that of temperature. There were no %DO Sat exceedances.

pH follows closely the DO and %DO Saturation patterns with significant linear correlation coefficients of r^2=0.72 and 0.73, respectively.

Turbidity shows low and noisy signal with values oscillating around 1 NTU.

	C278A- Surface Temp C	C278A- Surface SpCond mS/cm	C278A- Surface Sal ppt	C278A- Surface Depth meters	C278A- Surface pH	C278A- Surface Turbid NTU	C278A- Surface ODOsat %	C278A- Surface ODO mg/L
Average	33.14	54.33	35.68	0.26	7.77	0.97	85.42	5.05
Median	33.20	54.36	35.68	0.26	7.76	1.00	82.10	4.87
Stand. Dev	0.30	0.10	0.06	0.01	0.02	0.38	6.99	0.39
%DO Sat Exceedances	0%							

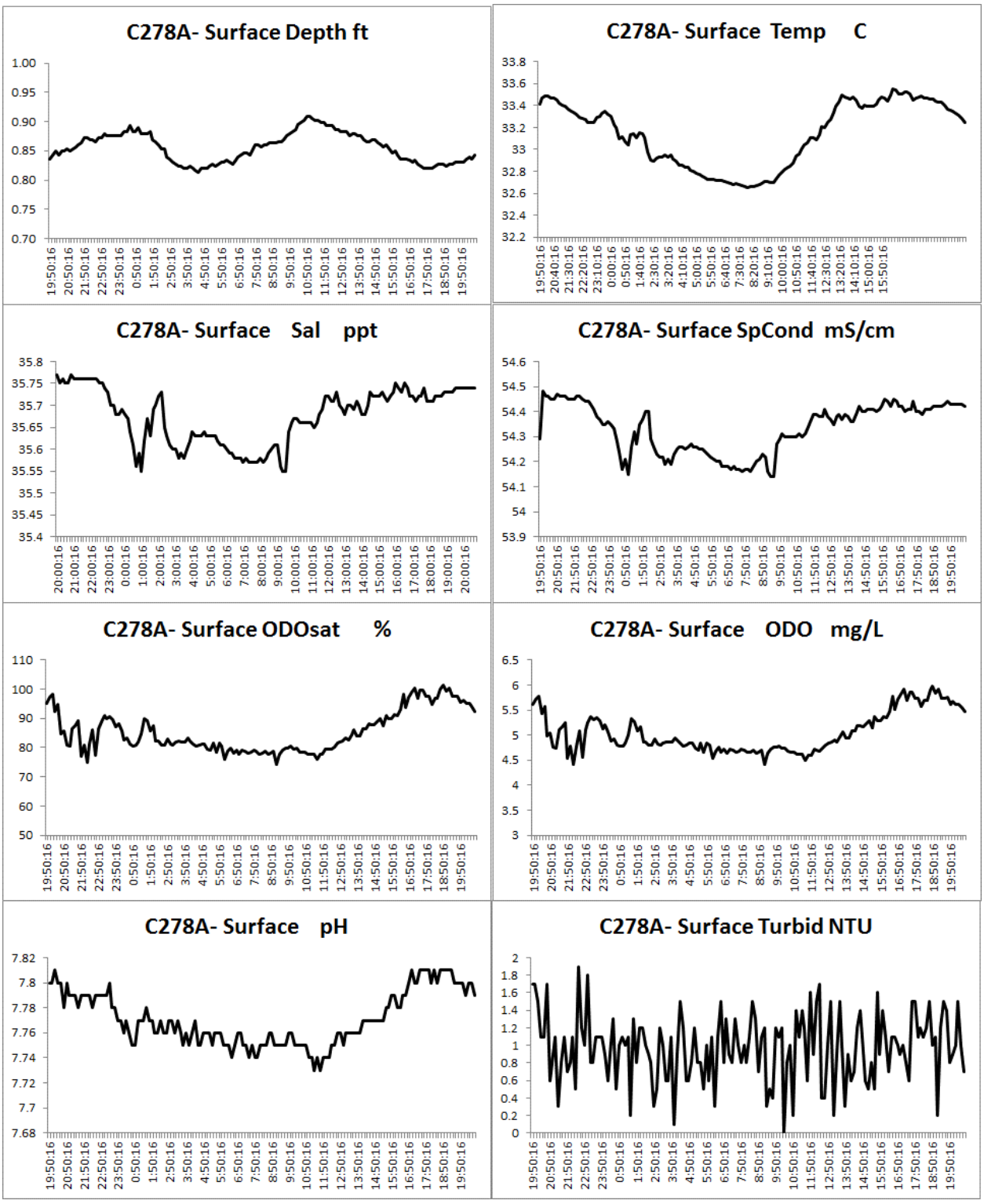

Figure 1.25: Time-series of physical-chemical data for surface water at site A in canal #278 during a 24-hour cycle (Diel cycle). Survey FKC04 (Aug 2015)

Remediation Canal #278. Bottom

Water Depth displays a tidal cycle with about 0.7 ft range.

Water Temperature increase constantly.

Salinity and Specific Conductance remained practically constant with a sudden increase observed between 1 AM and 5 AM.

Dissolved Oxygen and Oxygen saturation slightly decline during night hours. There are not %DO Sat exceedances.

pH roughly follows DO and %DO Saturation patterns.

Turbidity follows tides coarsely.

	C278A- Bottom Temp C	C278A- Bottom SpCond mS/cm	C278A- Bottom Sal ppt	C278A- Bottom Depth meters	C278A- Bottom pH	C278A- Bottom Turbid NTU	C278A- Bottom ODOsat %	C278A- Bottom ODO mg/L
Average	33.14	59.64	39.65	2.03	7.84	0.58	72.51	4.20
Median	33.11	59.64	39.65	2.03	7.84	0.40	72.60	4.20
Stand. Dev	0.08	0.11	0.09	0.07	0.03	0.65	13.37	0.77
%DO Sat Exceedances	0%							

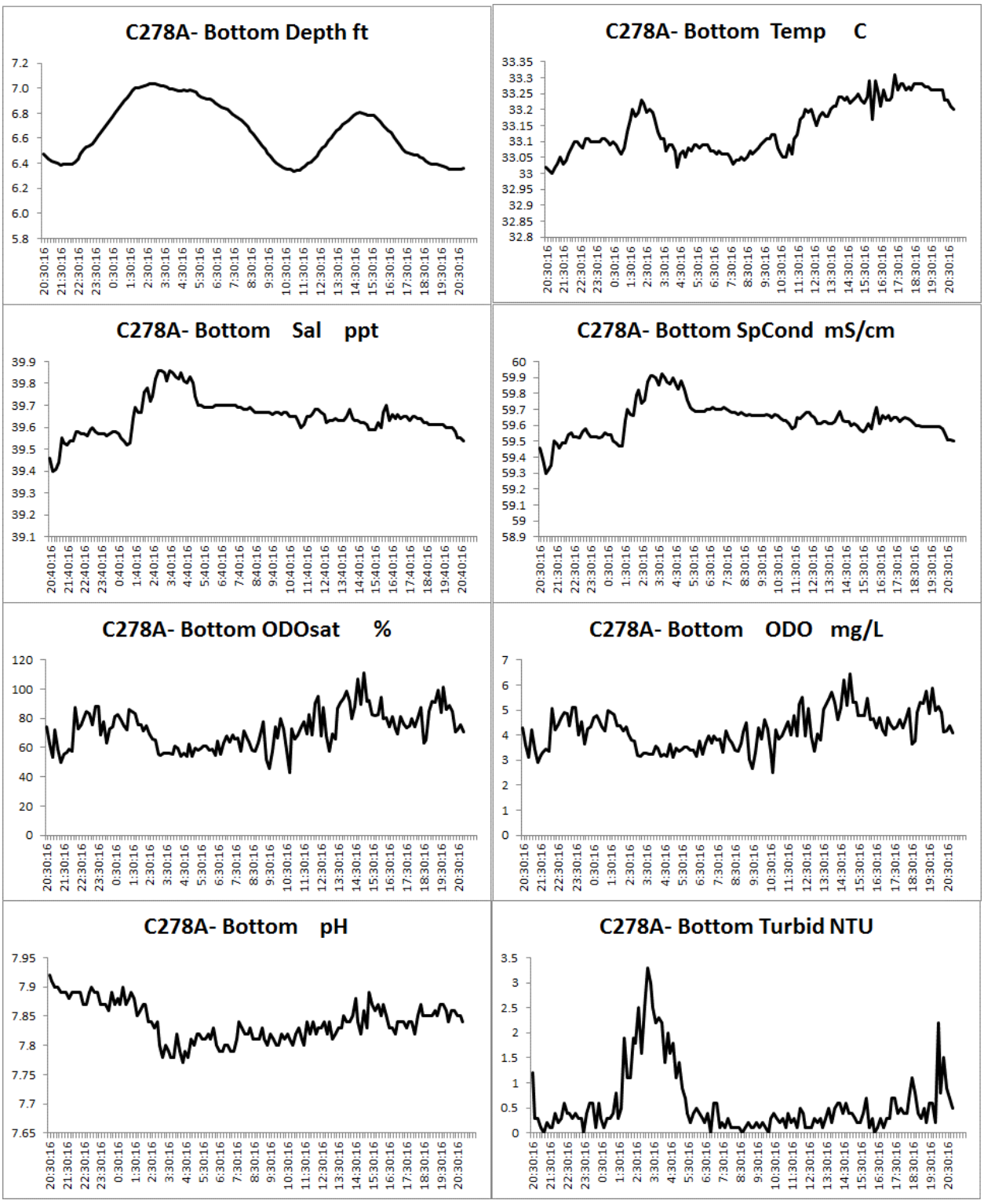

Figure 1.26: Time-series of physical-chemical data for bottom water at site A in canal #278 during a 24-hour cycle (Diel cycle). Survey FKC04 (Aug 2015)

CULVERT INSTALLATION

Geiger Key

Control Canal #458. Surface

Water Depth displays a regular tidal cycles with a 0.9 ft tidal range.

Water Temperature begins to drop after sunset and rises again in the morning. Range of variation is less than 2 °C.

Salinity and Specific Conductance follow tides coarsely, but display only a very slight decline early in the morning.

Dissolved Oxygen and Oxygen saturation drop after sunset and rise again in the morning. Water remains well oxygenated, without exceeding the regulation levels (all values above 42% DO Sat).

pH follows very closely the DO and %DO saturation patterns with an average value of 7.88. pH and the DO and %DO Saturation have a significant linear correlation coefficients of r^2=0.95.

Turbidity is low with an increasing trend from evening to early morning.

	C458A- Surface Temp C	C458A- Surface SpCond mS/cm	C458A- Surface Sal ppt	C458A- Surface Depth meters	C458A- Surface pH	C458A- Surface Turbid NTU	C458A- Surface ODOsat %	C458A- Surface ODO mg/L
Average	32.23	58.23	38.62	0.37	7.88	1.40	81.54	4.80
Median	32.23	58.29	38.69	0.37	7.88	1.30	78.20	4.62
Stand. Dev	0.57	0.15	0.13	0.01	0.07	0.71	24.60	1.41
%DO Sat Exceedances	0%							

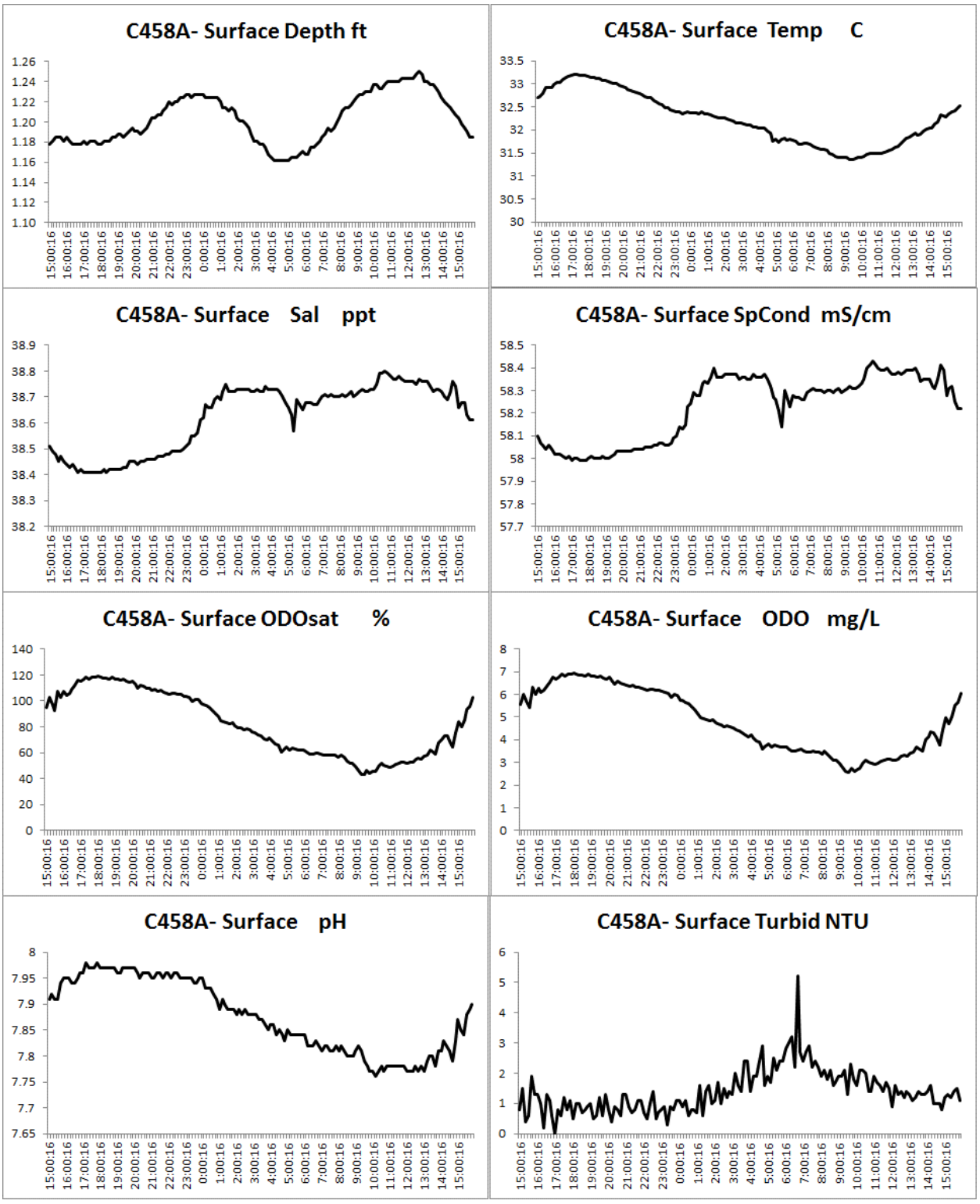

Figure 1.27: Time-series of physical-chemical data for surface water at site A in canal #458 during a 24-hour cycle (Diel cycle). Survey FKC04 (Aug 5, 2015)

Control Canal #458. Bottom

Water Depth displays a regular tidal cycles with a 0.9 ft tidal range.

Water Temperature remained practically constant in the late afternoon, followed by a decrease until the morning when values start to rise again the morning.

Salinity and Specific Conductance show a continuous increasing trend interrupted by a sudden drop early in the morning.

Dissolved Oxygen and Oxygen saturation follows tides coarsely, but display a peak increase around midnight. %DO Sat exceedances reach 45%.

pH follows very closely the DO and %DO saturation patterns and have a significant linear correlation coefficients of r^2=0.67 and 0.68, respectively.

Turbidity is low with values peaking around midnight.

	C458A- Bottom Temp C	C458A- Bottom SpCond mS/cm	C458A- Bottom Sal ppt	C458A- Bottom Depth meters	C458A- Bottom pH	C458A- Bottom Turbid NTU	C458A- Bottom ODOsat %	C458A- Bottom ODO mg/L
Average	31.78	58.10	38.54	2.16	7.73	1.36	42.94	2.55
Median	31.96	58.09	38.55	2.17	7.73	1.20	43.10	2.57
Stand. Dev	0.50	0.21	0.17	0.08	0.03	0.91	9.35	0.56
%DO Sat Exceedances	45%							

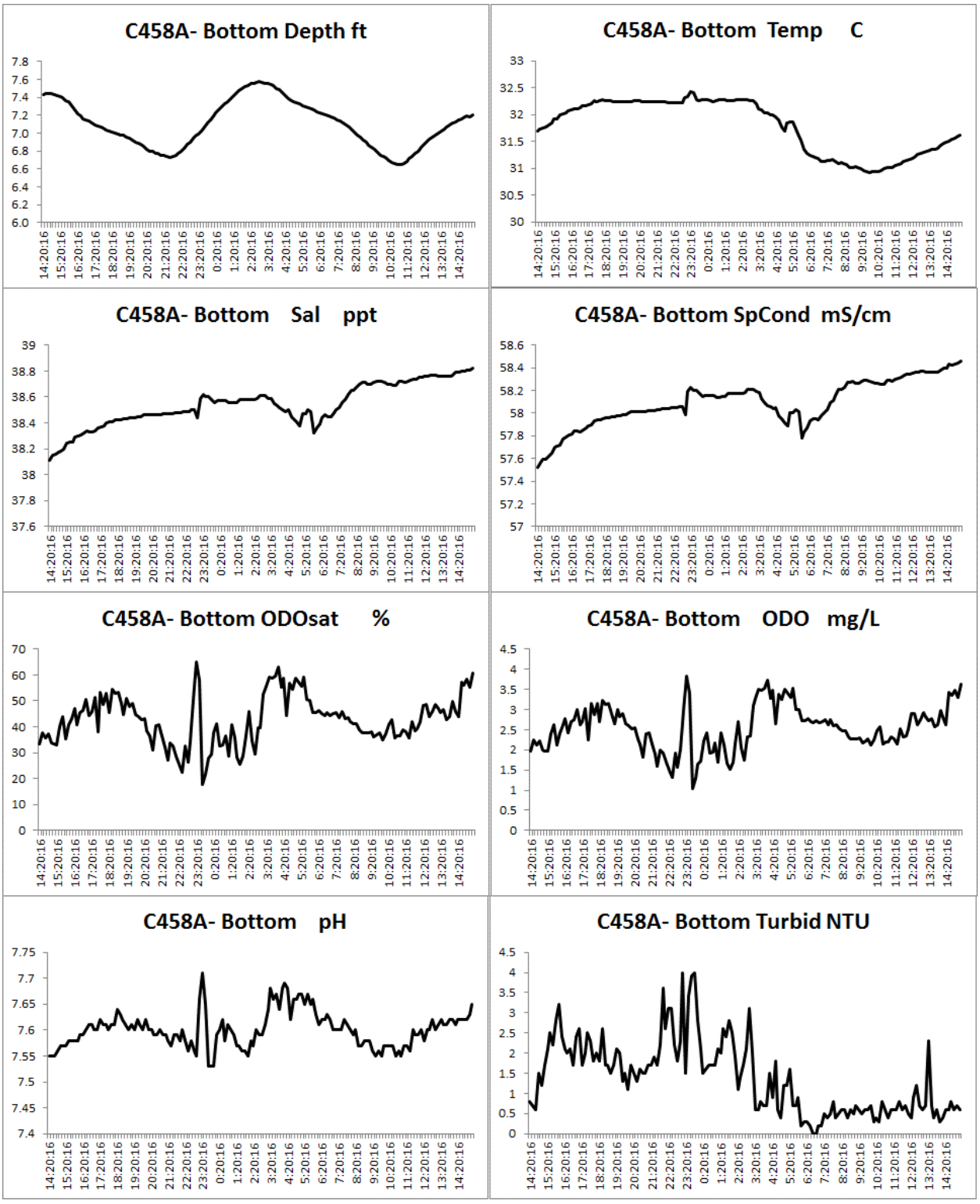

Figure 1.28: Time-series of physical-chemical data for bottom water at site A in canal #458 during a 41-hour cycle (Diel cycle). Survey FKC04 (Aug 5, 2015)

Canal #459. Surface

Water Depth displays a flat depth curve.

Water Temperature begins to drop after sunset and rises again in the morning. Range of variation is less than 2 °C.

Salinity and Specific Conductance display a slightly increasing trend from afternoon to early morning (5 AM).

Dissolved Oxygen and Oxygen saturation drop after sunset and rise again in the morning. %DO Sat exceedances reach 14%.

pH follows very closely the DO and %DO saturation patterns. pH and the DO and %DO Saturation have a significant linear correlation coefficients of r^2=0.94.

Turbidity values are low and noisy, with periods of increasing values peaking after midnight.

	C459A- Surface Temp C	C459A- Surface SpCond mS/cm	C459A- Surface Sal ppt	C459A- Surface Depth meters	C459A- Surface pH	C459A- Surface Turbid NTU	C459A- Surface ODOsat %	C459A- Surface ODO mg/L
Average	32.93	56.56	37.35	0.26	7.90	0.93	68.03	3.99
Median	33.02	56.47	37.28	0.27	7.90	0.90	66.60	3.90
Stand. Dev	0.57	0.30	0.22	0.01	0.07	0.41	24.60	1.41
%DO Sat Exceedances	14%							

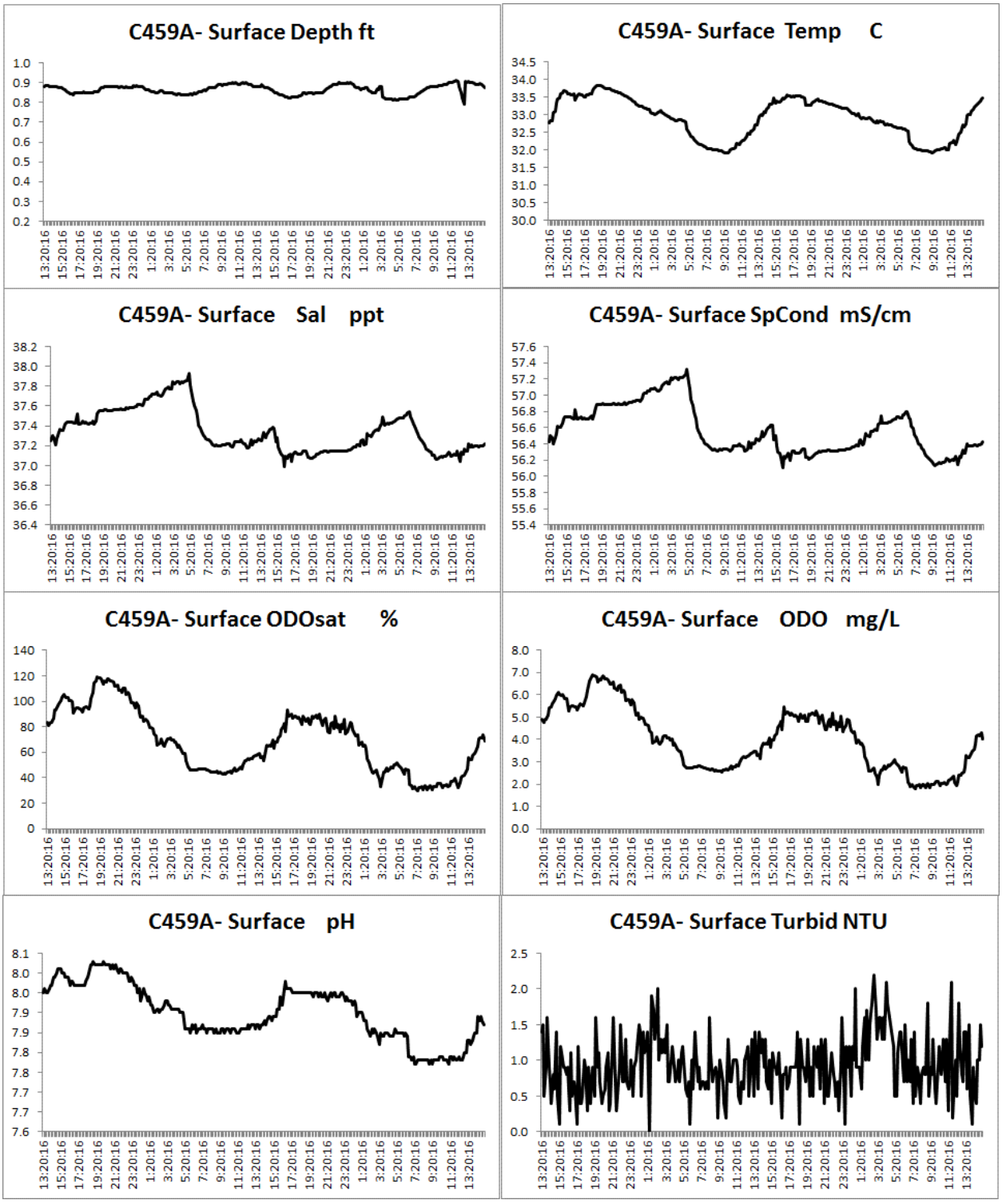

Figure 1.29: Time-series of physical-chemical data for surface water at site A in canal #459 during a 50-hour cycle (Diel cycle). Survey FKC04 (Aug 8, 2015)

Canal #459. Bottom

Water Depth displays an asymmetrical tidal cycles.

Water Temperature begins to drop after sunset and rises again in the morning. Range of variation is about 2 °C.

Salinity and Specific Conductance follows tides coarsely.

Dissolved Oxygen and Oxygen saturation drop after sunset and rise again in the morning. %DO Sat exceedances reach 35%.

pH follows closely the DO and %DO saturation patterns and the DO and %DO Saturation have a significant linear correlation coefficients of r^2=0.93.

Turbidity shows periods of increasing values peaking after midnight.

	C459A- Bottom Temp C	C459A- Bottom SpCond mS/cm	C459A- Bottom Sal ppt	C459A- Bottom Depth meters	C459A- Bottom pH	C459A- Bottom Turbid NTU	C459A- Bottom ODOsat %	C459A- Bottom ODO mg/L
Average	32.83	56.35	37.19	0.85	7.73	0.74	56.15	3.30
Median	32.91	56.26	37.13	0.81	7.72	0.40	53.10	3.13
Stand. Dev	0.52	0.30	0.22	0.11	0.08	0.74	22.93	1.33
%DO Sat Exceedances	35%							

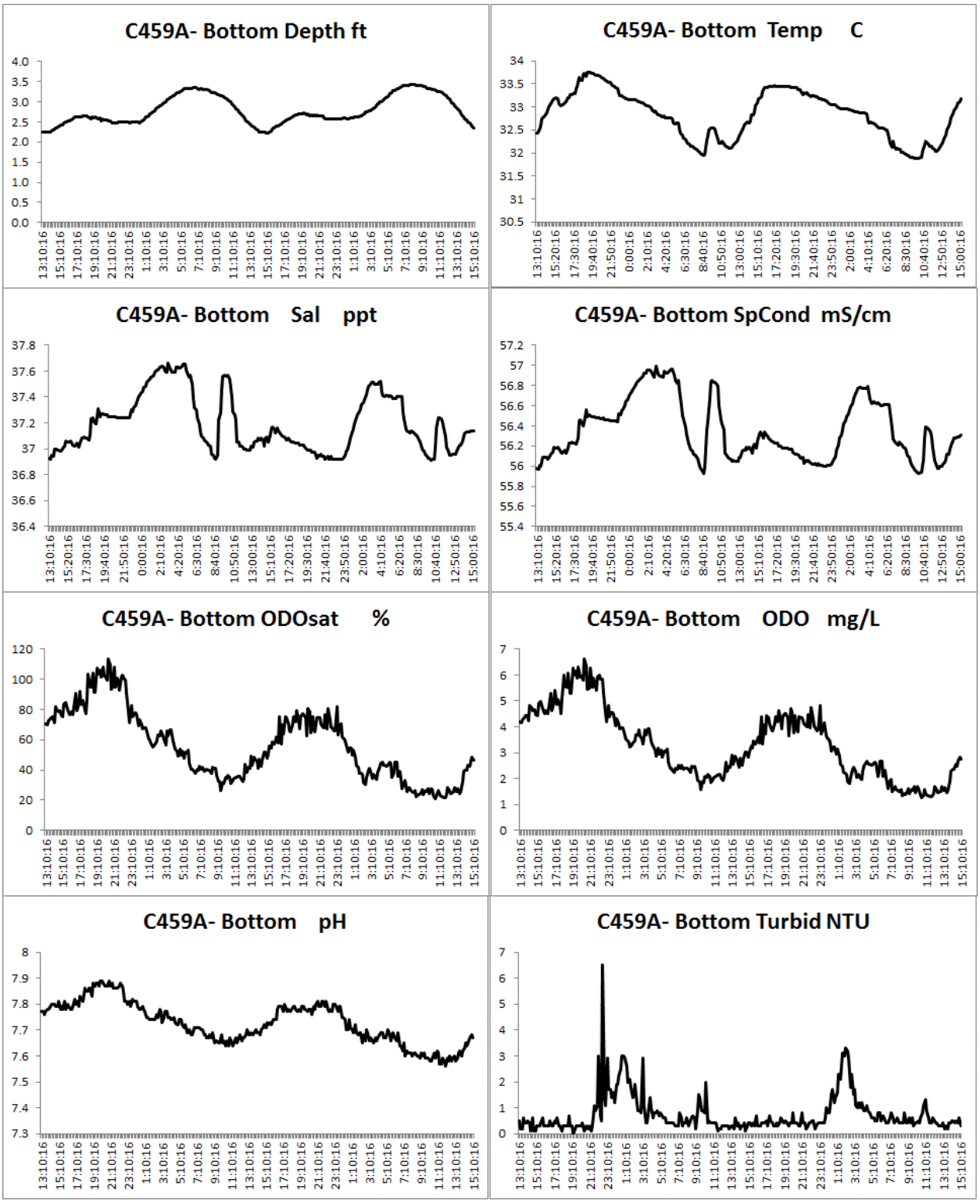

Figure 1.30: Time-series of physical-chemical data for bottom water at site A in canal #459 during a 41-hour cycle (Diel cycle). Survey FKC04 (Aug 6, 2015)

Canal #460. Surface

Water Depth displays a flat depth curve.

Water Temperature begins to drop after sunset and rises again in the morning. Range of variation is less than 3 °C.

Salinity and Specific Conductance continuously increase.

Dissolved Oxygen and Oxygen saturation drop after sunset and rise again in the morning with high variability. %DO Sat exceedances reach 2%.

pH follows very closely the DO and %DO saturation patterns and have a significant linear correlation coefficients of r^2=0.88 and 0.87, respectively.

Turbidity values are low and noisy, with periods of slight increasing values early morning.

	C460A- Surface Temp C	C460A- Surface SpCond mS/cm	C460A- Surface Sal ppt	C460A- Surface Depth meters	C460A- Surface pH	C460A- Surface Turbid NTU	C460A- Surface ODOsat %	C460A- Surface ODO mg/L
Average	32.82	66.02	44.54	0.31	7.99	0.74	90.10	5.10
Median	32.67	66.06	44.54	0.31	7.99	0.80	92.85	5.27
Stand. Dev	0.70	0.20	0.15	0.01	0.05	0.34	24.63	1.36
%DO Sat Exceedances	2%							

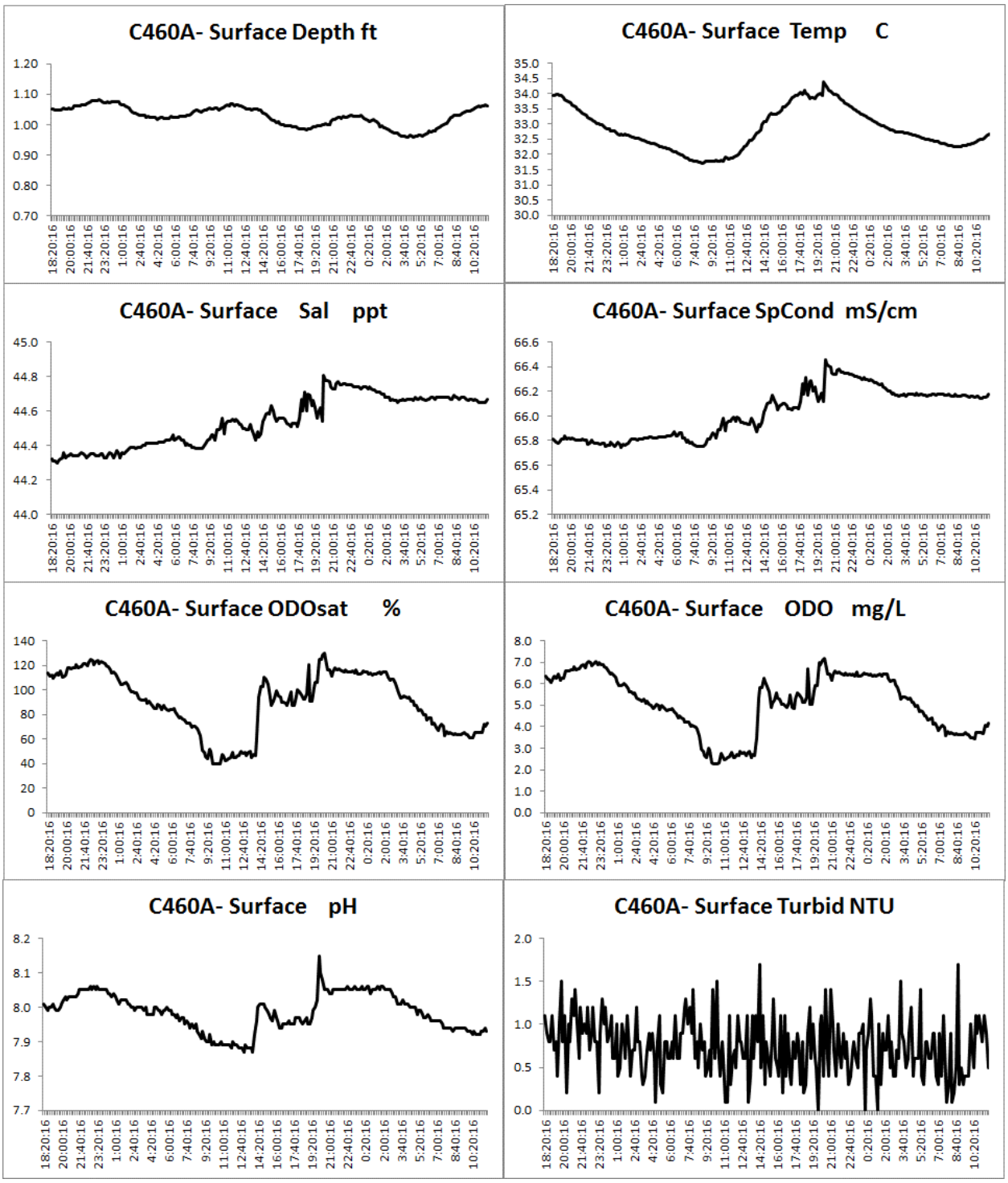

Figure 1.31: Time-series of physical-chemical data for surface water at site A in canal #460 during a 41-hour cycle (Diel cycle). Survey FKC04 (Aug 6, 2015)

Canal #460. Bottom

Water Depth displays a rather flat tidal curve with just 0.3 ft tidal range.

Water Temperature begins to drop after sunset and rises again in the morning. Range of variation is about 1.5 °C.

Salinity and Specific Conductance continuously increase with some slower values after midnight.

Dissolved Oxygen and Oxygen saturation drop after sunset and rise again in the morning. %DO Sat exceedances reach 13%.

pH follows closely the DO and %DO saturation patterns and the DO and %DO Saturation have a significant linear correlation coefficients of r^2=0.91.

Turbidity is generally very low and with noisy signal.

	C460A- Bottom Temp C	C460A- Bottom SpCond mS/cm	C460A- Bottom Sal ppt	C460A- Bottom Depth meters	C460A- Bottom pH	C460A- Bottom Turbid NTU	C460A- Bottom ODOsat %	C460A- Bottom ODO mg/L
Average	32.23	65.74	44.35	1.95	7.97	0.32	76.90	4.39
Median	32.43	65.77	44.38	1.94	7.97	0.30	77.50	4.45
Stand. Dev	0.46	0.16	0.13	0.03	0.08	0.13	27.59	1.56
%DO Sat Exceedances	13%							

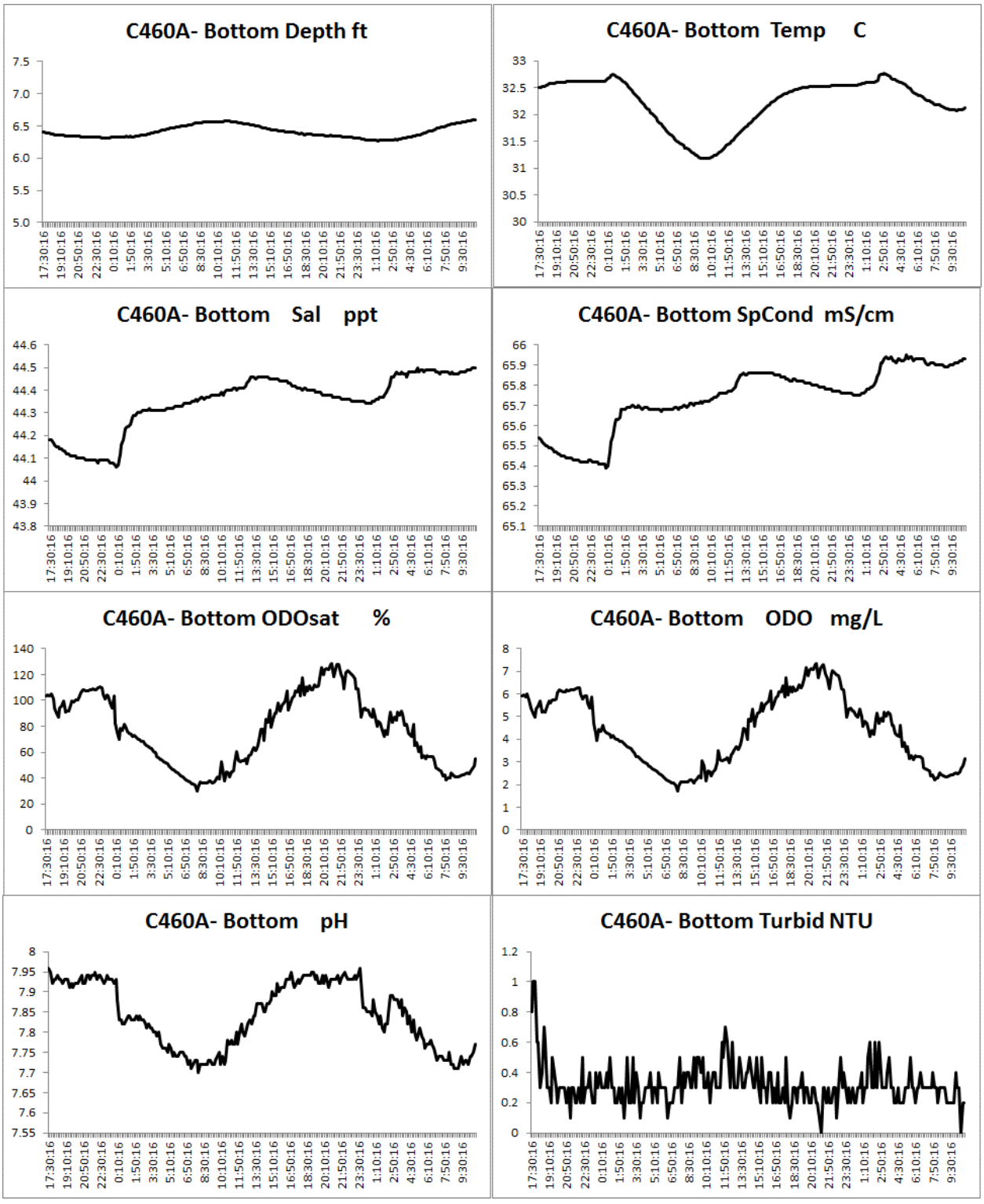

Figure 1.32: Time-series of physical-chemical data for bottom water at site A in canal #460 during a 41-hour cycle (Diel cycle). Survey FKC04 (Aug 2015)

Canal #472. Surface

Water Depth displays a rather flat tidal curve with just 0.1 ft range.

Water Temperature begins to rise in the morning and drop in the afternoon. Range of variation is about 1.5 °C.

Salinity and Specific Conductance remained practically constants from Sunday 8/1/15 to Monday 8//2/2015 when a sudden drop occurred at about 10:30 AM.

Dissolved Oxygen and Oxygen saturation continuously decrease with a set of lower values in the morning between 8:40 and 10:10 AM. Waters remain well oxygenated with only 3% of %DO Sat exceedances.

pH is highly correlated with DO and %DO Sat (r^2= 0.76 and 0.75, respectively).

Turbidity shows low and noisy values. Values are slightly higher after low tides.

	C472A- Surface Temp C	C472A- Surface SpCond mS/cm	C472A- Surface Sal ppt	C472A- Surface Depth meters	C472A- Surface pH	C472A- Surface Turbid	C472A- Surface ODOsat %	C472A- Surface ODO mg/L
Average	32.07	58.01	38.47	0.31	7.87	1.16	83.61	4.95
Median	32.12	58.04	38.50	0.31	7.88	1.20	86.50	5.12
Stand. Dev	0.44	0.47	0.36	0.01	0.04	0.40	15.07	0.87
%DO Sat Exceedances	3%							

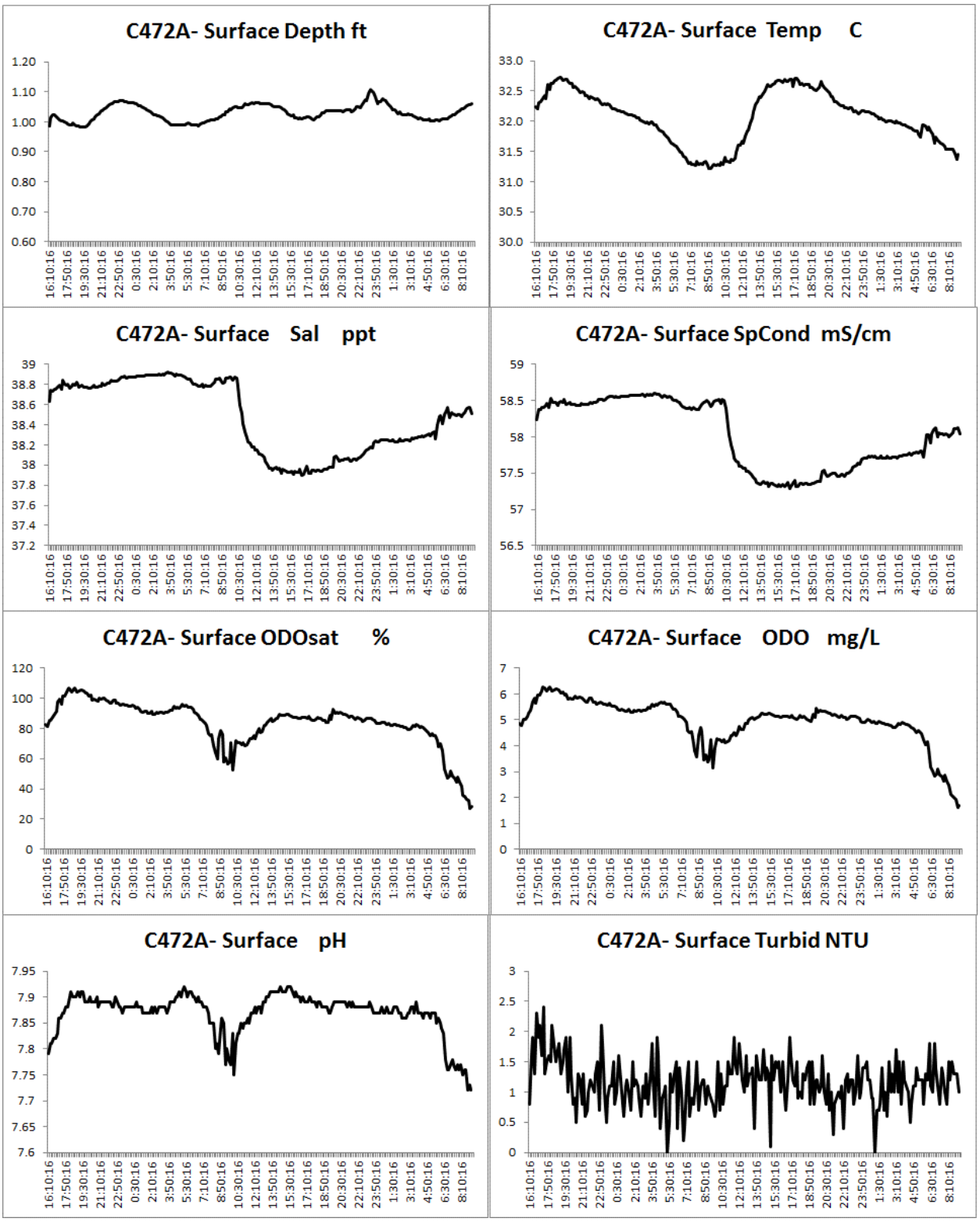

Figure 1.33: Time-series of physical-chemical data for surface water at site A in canal #472 during a 41-hour cycle (Diel cycle). Survey FKC04 (Aug 1, 2015)

Canal #472. Bottom

Water Depth displays a regular tidal cycle with a 2.6 ft tidal range.

Water Temperature remained practically constant with values around 30 °C.

Salinity and Specific Conductance begin to rise in the afternoon and drop again next morning.

Dissolved Oxygen and Oxygen saturation remain very low. %DO Sat exceedances reach 100%.

pH shows noisy values without any specific pattern.

Turbidity show higher values from noon to afternoon hours.

	C472A- Bottom Temp C	C472A- Bottom SpCond mS/cm	C472A- Bottom Sal ppt	C472A- Bottom Depth meters	C472A- Bottom pH	C472A- Bottom Turbid NTU	C472A- Bottom ODOsat %	C472A- Bottom ODO mg/L
Average	30.30	62.90	42.25	3.33	6.70	33.99	2.85	0.17
Median	30.30	62.84	42.21	3.32	6.69	29.00	2.80	0.17
Stand. Dev	0.09	1.02	0.78	0.21	0.04	17.84	0.09	0.01
%DO Sat Exceedances	100%							

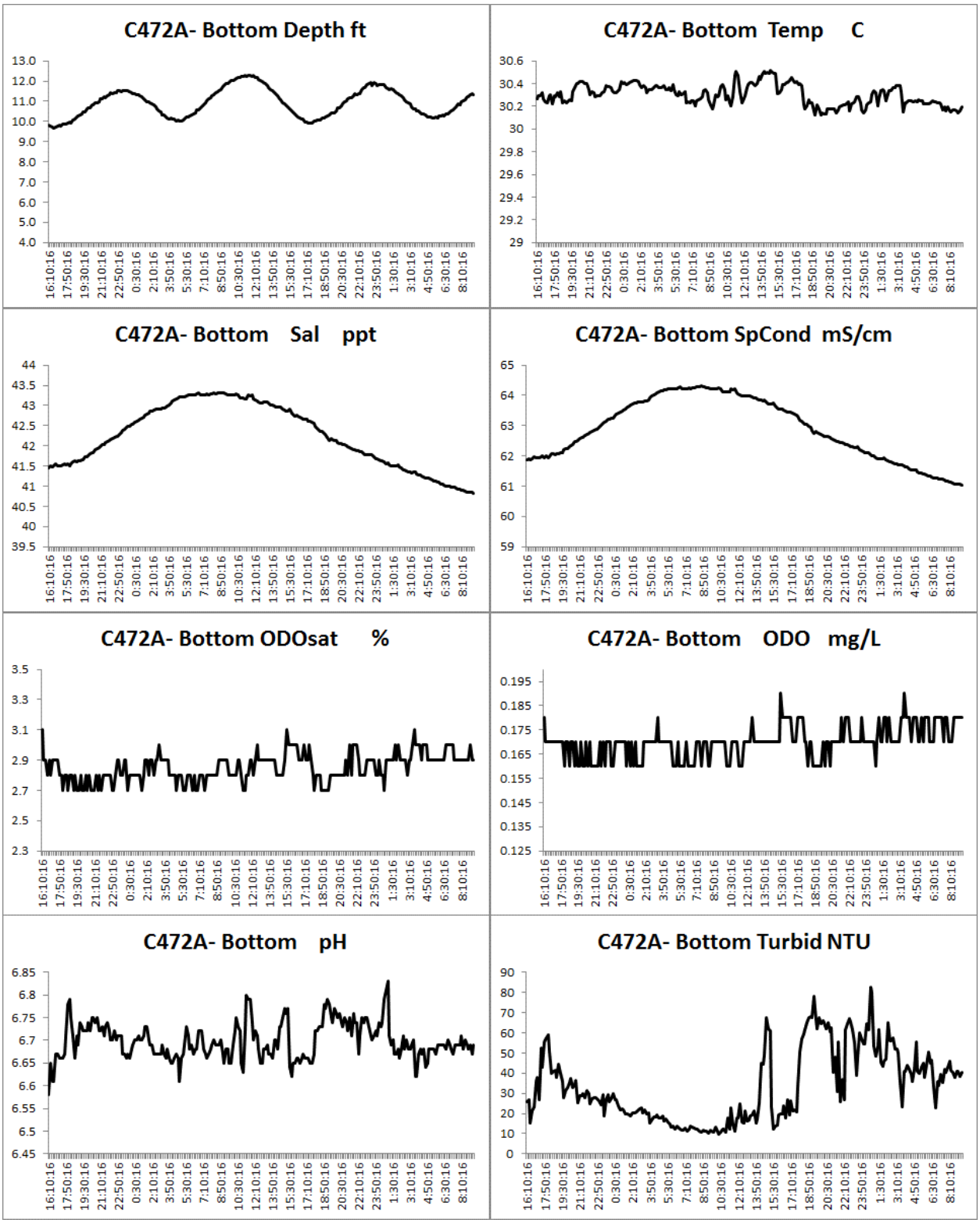

Figure 1.34: Time-series of physical-chemical data for bottom water at site A in canal #472 during a 41-hour cycle (Diel cycle). Survey FKC04 (Aug 1, 2015)

Connection Canal #470. Surface

Water Depth does not display regular tidal cycles.

Water Temperature shows a slight decline in the afternoon extending to midnight, followed by an increase to afternoon hours again. Temperature range is a little over 1.5 °C.

Salinity and Specific Conductance remain high with some decline around noon and midnight.

Dissolved Oxygen and Oxygen saturation remains practically constant and water is well oxygenated. There were no %DO Sat exceedances.

pH remain relatively constant with a drop around midnight.

Turbidity is highly variable but without a defined pattern.

	C470A- Surface Temp C	C470A- Surface SpCond mS/cm	C470A- Surface Sal ppt	C470A- Surface Depth meters	C470A- Surface pH	C470A- Surface Turbid	C470A- Surface ODOsat %	C470A- Surface ODO mg/L
Average	32.92	65.63	44.23	0.36	7.87	0.88	91.85	5.20
Median	32.94	65.65	44.25	0.36	7.87	0.90	92.00	5.23
Stand. Dev	0.43	0.44	0.33	0.01	0.02	0.32	6.66	0.36
%DO Sat Exceedances	0%							

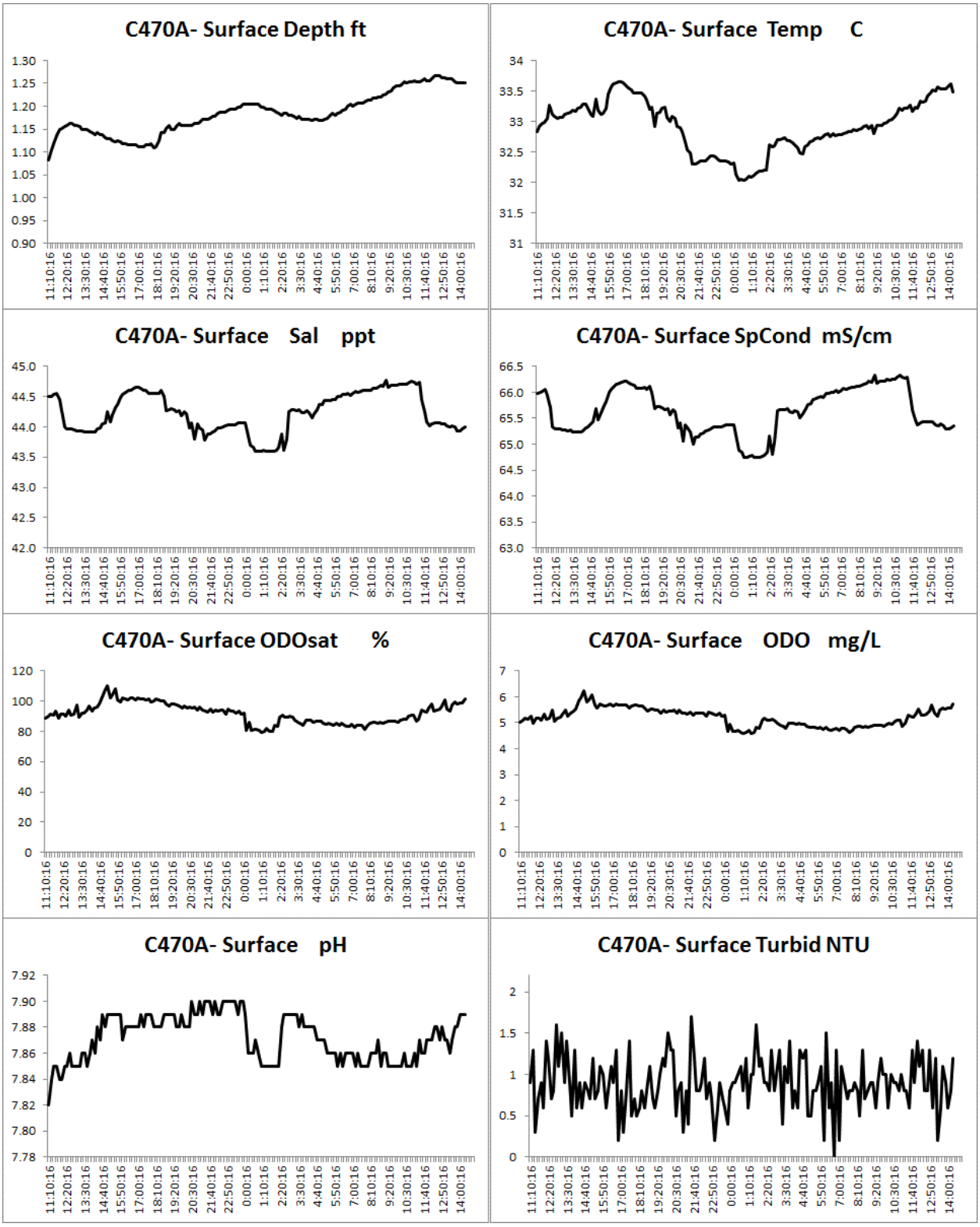

Figure 1.35: Time-series of physical-chemical data for surface water at site A in canal #470 during a 33-hour cycle (Diel cycle). Survey FKC04 (Aug 3, 2015)

Connection Canal #470. Bottom

Water Depth does not display regular tidal cycles.

Water Temperature remains practically constant with a slight increase around noon.

Salinity and Specific Conductance remain high and relatively constant.

Dissolved Oxygen and Oxygen saturation remains practically constant and water is well oxygenated. There were 6 %DO Sat exceedances.

pH remain relatively constant.

Turbidity is highly variable but without a defined pattern.

	C470A- Bottom Temp C	C470A- Bottom SpCond mS/cm	C470A- Bottom Sal ppt	C470A- Bottom Depth meters	C470A- Bottom pH	C470A- Bottom Turbid	C470A- Bottom ODOsat %	C470A- Bottom ODO mg/L
Average	33.27	67.18	45.42	4.66	7.63	0.33	63.81	3.57
Median	33.28	67.18	45.42	4.67	7.63	0.30	67.40	3.78
Stand. Dev	0.04	0.03	0.03	0.02	0.06	0.16	12.03	0.67
%DO Sat Exceedances	6%							

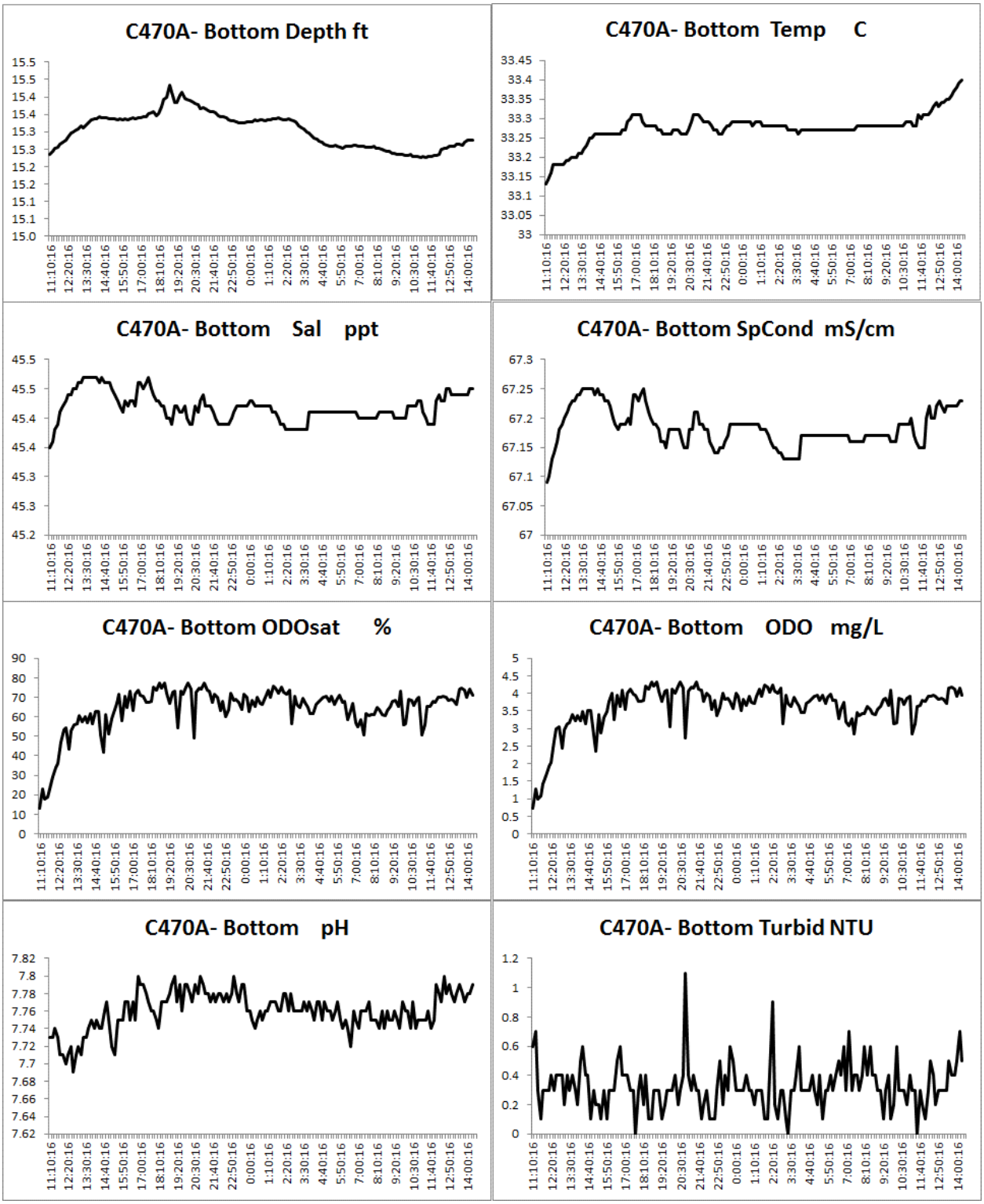

Figure 1.36: Time-series of physical-chemical data for bottom water at site A in canal #470 during a 33-hour cycle (Diel cycle). Survey FKC04 (Aug 3, 2015)

Big Pine, Tropical Bay

Remediation Canal #277. Surface

Water Depth displays what seems to be a lagged tidal cycle with amplitude of only 0.1 ft range.

Water Temperature shows a slight decline in the afternoon extending to the following morning, followed by an increase to afternoon hours again. Temperature range is a little over 1 °C.

Salinity and Specific Conductance drop in the afternoon, followed by a slight increase.

Dissolved Oxygen and Oxygen saturation remains practically constant with a slight increase in the evening. There were no %DO Sat exceedances.

pH follows closely the DO and %DO Saturation patterns with significant linear correlation coefficients of r^2=0.83 and 0.81, respectively.

Turbidity is low and coarsely related to tides.

	C277A- Surface Temp C	C277A- Surface SpCond mS/cm	C277A- Surface Sal ppt	C277A- Surface Depth meters	C277A- Surface pH	C277A- Surface Turbid NTU	C277A- Surface ODOsat %	C277A- Surface ODO mg/L
Average	32.56	58.04	38.47	0.26	7.68	1.28	57.55	3.38
Median	32.35	58.02	38.47	0.26	7.68	1.20	57.80	3.40
Stand. Dev	0.45	0.16	0.13	0.01	0.03	0.41	7.66	0.43
%DO Sat Exceedances	0%							

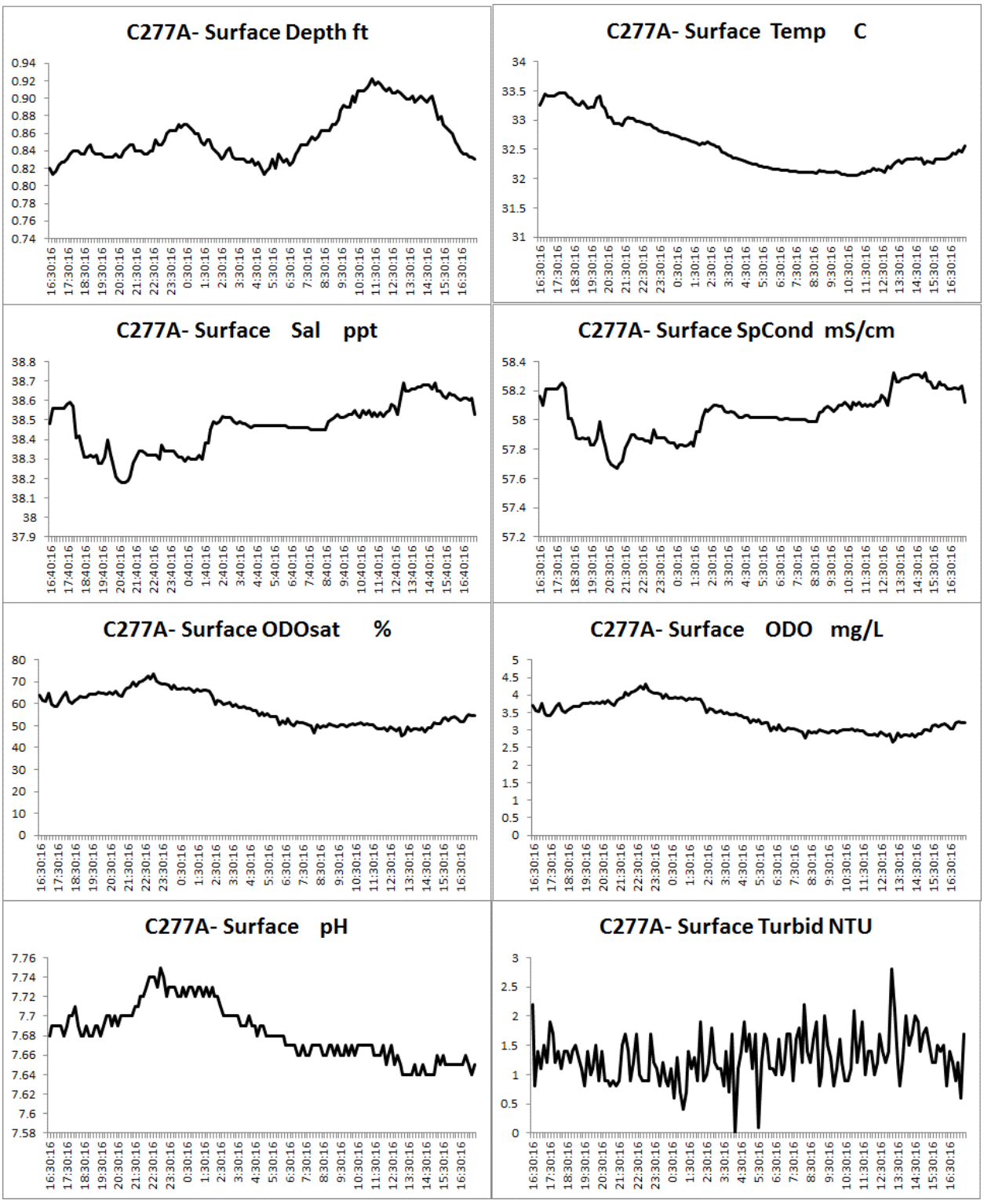

Figure 1.37: Time-series of physical-chemical data for surface water at site A in canal #277 during a 25-hour cycle (Diel cycle). Survey FKC04 (Aug 14, 2015)

Remediation Canal #277. Bottom

Water Depth displays an asymmetrical tidal cycle with about 1 ft range.

Water Temperature remained practically constants from Friday 8/14/15 to Saturday 8/152015 when a sudden drop occurred at about 9:00 AM.

Salinity and Specific Conductance continuously increase with a change of 2 PSU.

Dissolved Oxygen and Oxygen saturation began to drop in the afternoon and rose again in the morning. There are 35% of %DO Sat exceedances.

pH is correlated with DO and %DO Sat (r^2= 0.68 and 0.70, respectively).

Turbidity is coarsely related to tides.

	C277A- Bottom Temp C	C277A- Bottom SpCond mS/cm	C277A- Bottom Sal ppt	C277A- Bottom Depth meters	C277A- Bottom pH	C277A- Bottom Turbid NTU	C277A- Bottom ODOsat %	C277A- Bottom ODO mg/L
Average	32.56	59.19	39.33	1.54	7.67	1.70	48.28	2.82
Median	32.87	59.42	39.54	1.55	7.68	1.40	46.60	2.71
Stand. Dev	0.58	0.78	0.60	0.12	0.06	1.31	14.40	0.84
%DO Sat Exceedances	35%							

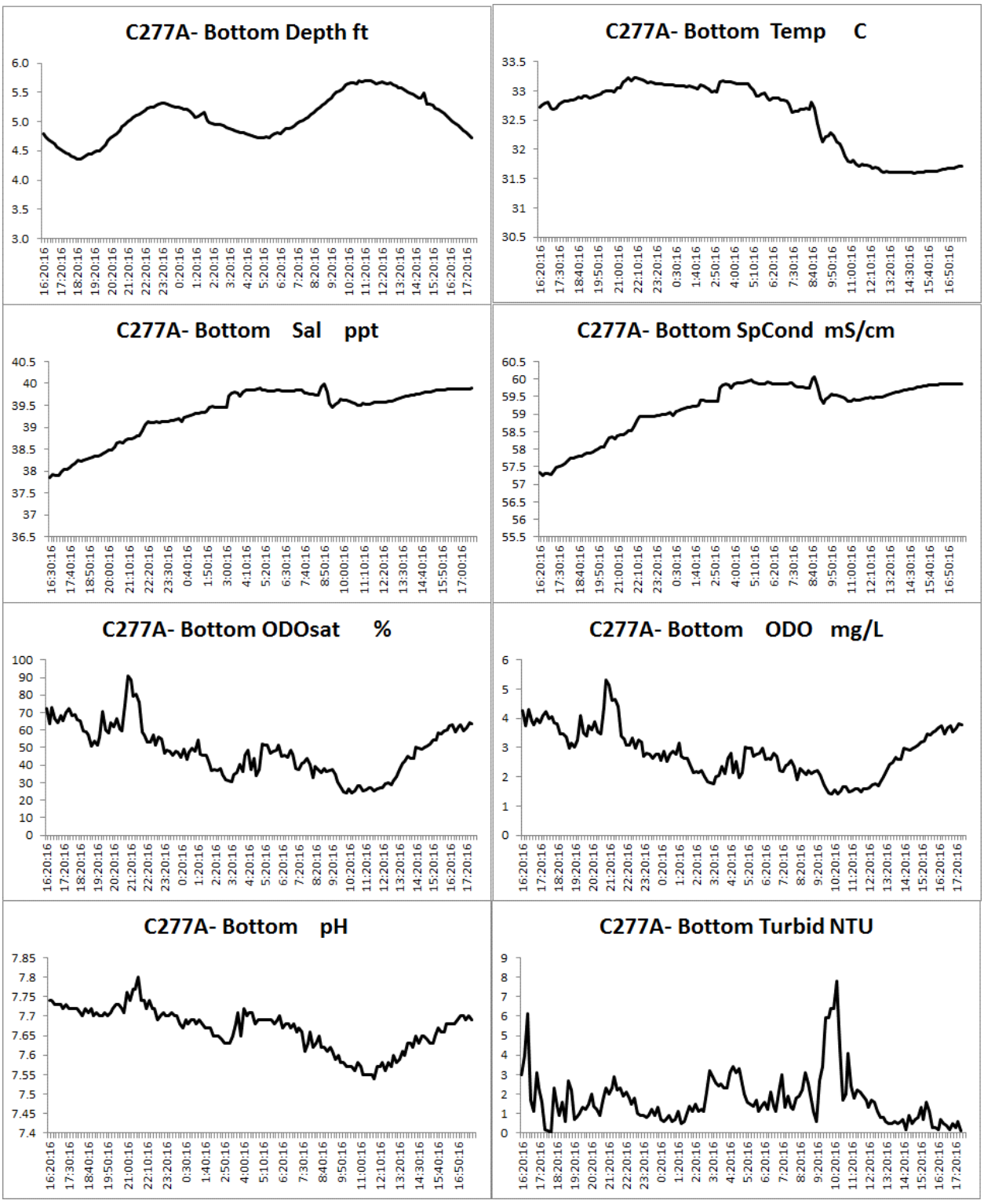

Figure 1.38: Time-series of physical-chemical data for bottom water at site A in canal #277 during a 25-hour cycle (Diel cycle). Survey FKC04 (Aug 14, 2015)

2. CTD Casts

Survey No.3

Water properties were determined along vertical profiles of the water column of canal #472 (remediated) and canal #458 (control). This survey represents after remediation conditions. Vertical profiles of the water column of canal #459 (remediation) are also part of this survey. Profiles for Survey No.3 are shown in figures 2.1 to 1.6.

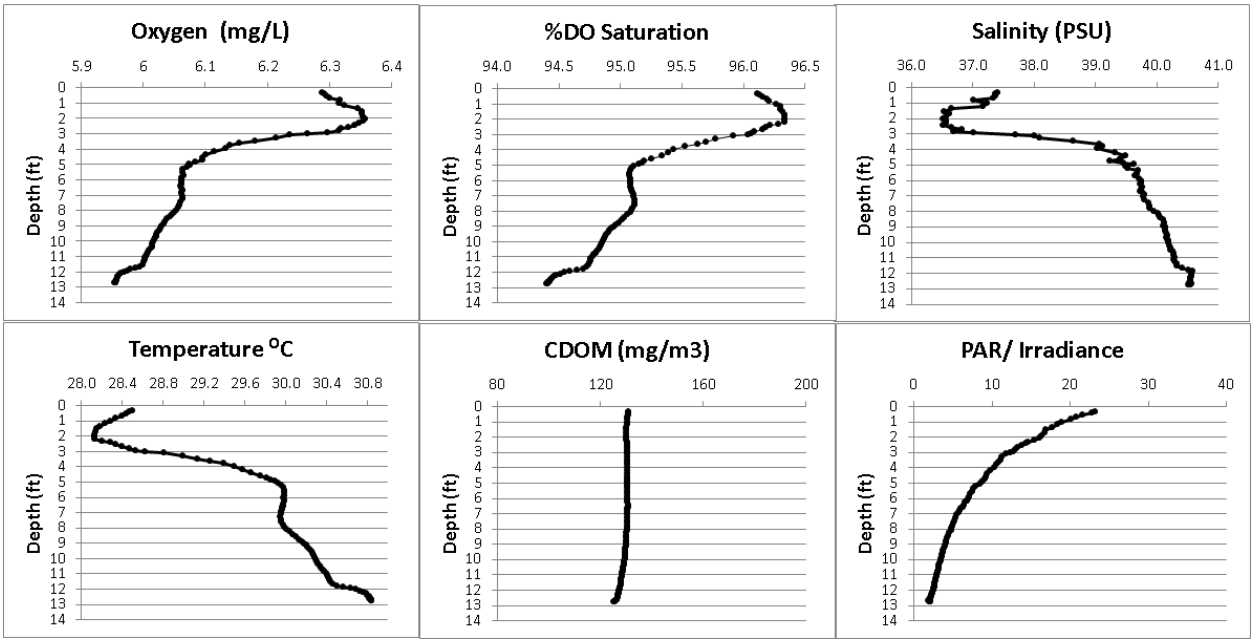

Figure 2.1. Profile of physicochemical properties of station No. 472A (Remediation) FKC003

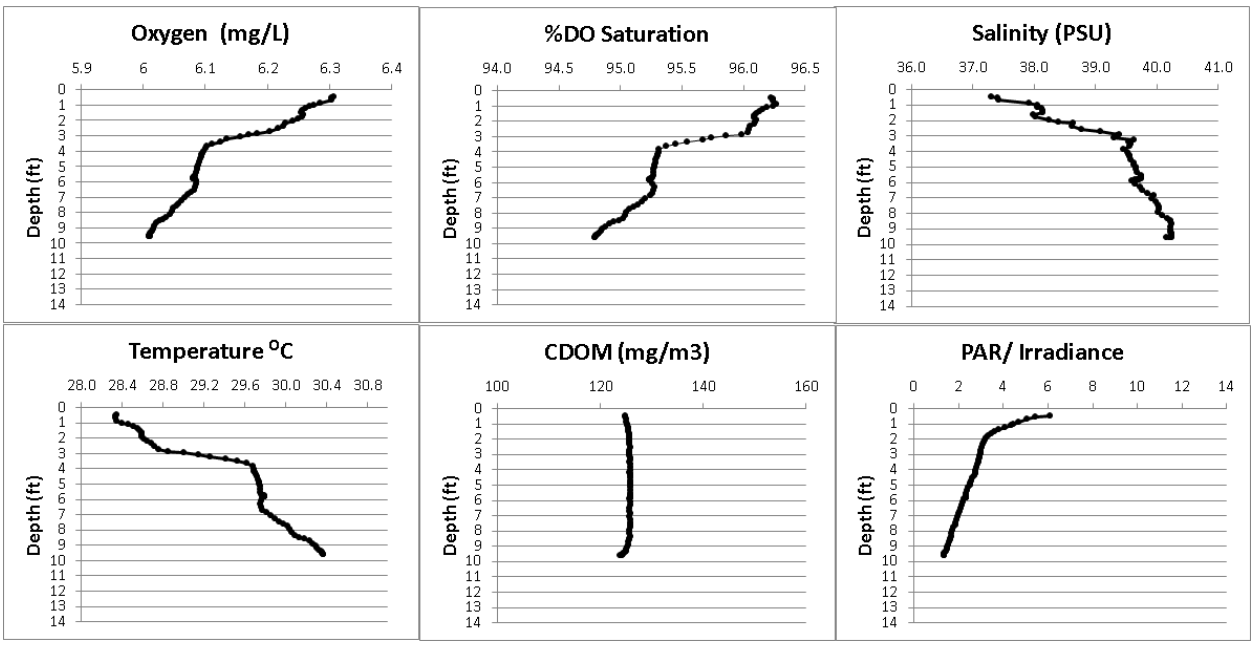

Figure 2.2. Profile of physicochemical properties of station No. 472B (Remediation) FKC003

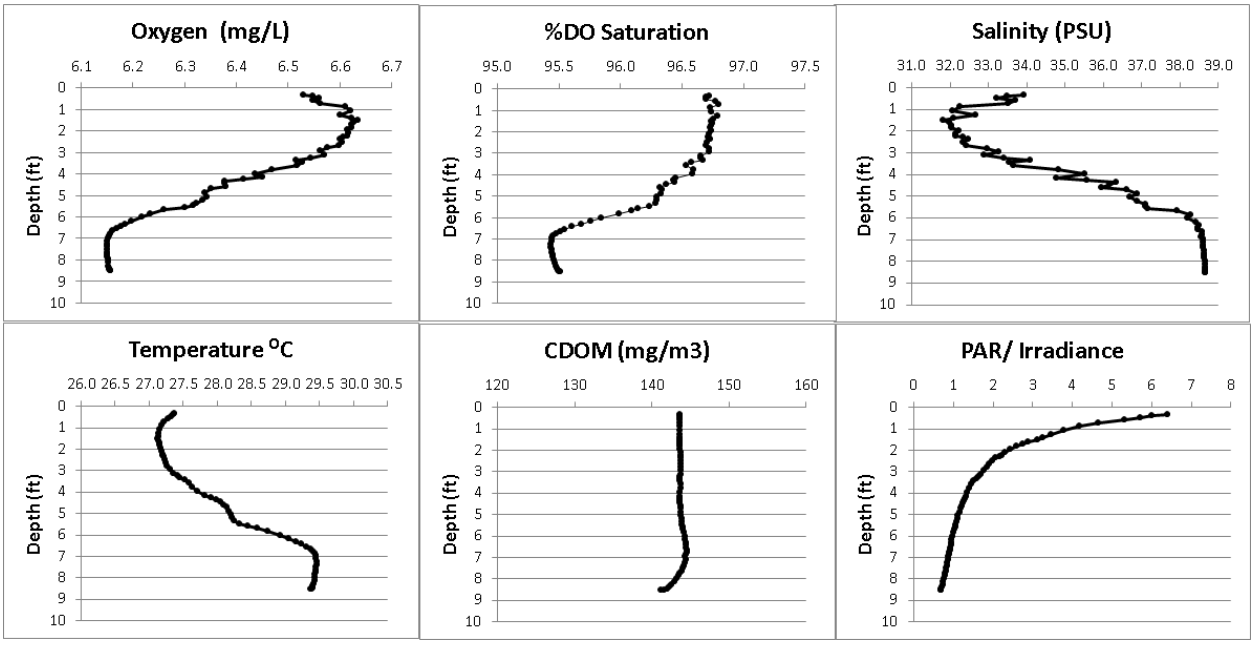

Figure 2.3. Profile of physicochemical properties of station No. 458A (Control) FKC003

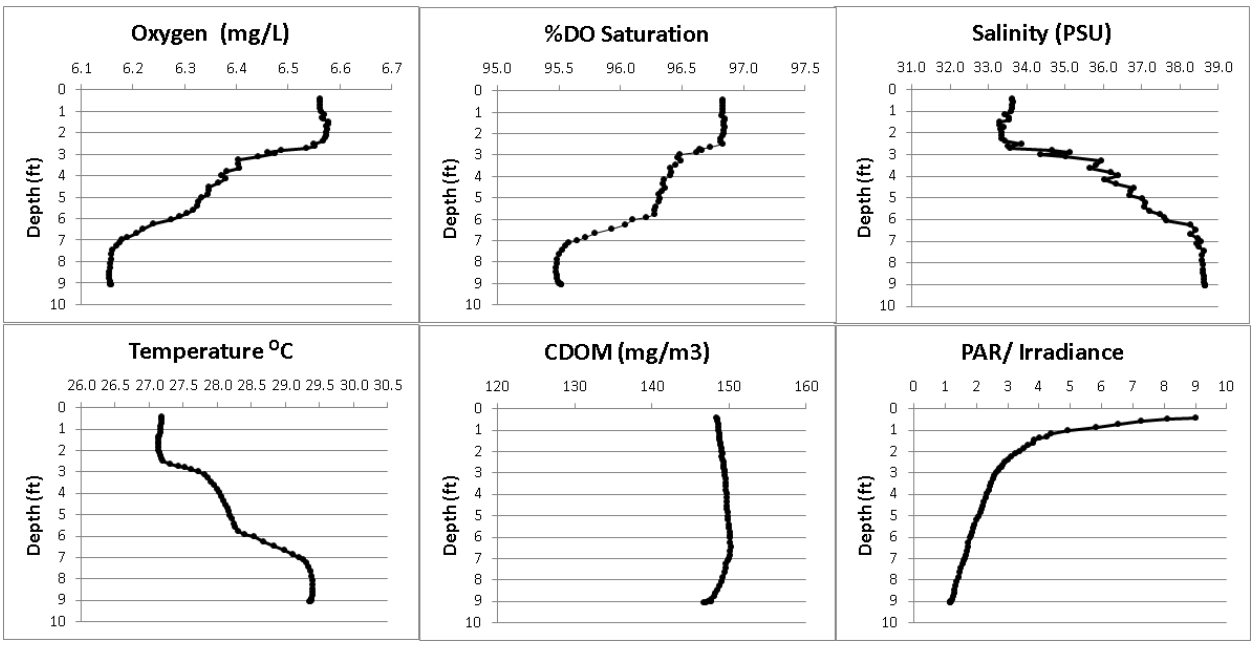

Figure 2.4. Profile of physicochemical properties of station No. 458B (Control) FKC003

Both canals, #472 and #458 have a rather similar behavior as shown in figures 2.1 to 2.4, where their patterns are significantly parallel. That similitude applies to all measured parameters for each survey, pre and post remediation. This fact suggest; 1) observed compositional patterns are not canal specific, but common to both canals; and given the similarities even after culvert construction, then 2) no significant changes have been induced yet by the culvert. Finally, 3) there is more seasonal variability (dates of surveys) that spatial variability (between canals)

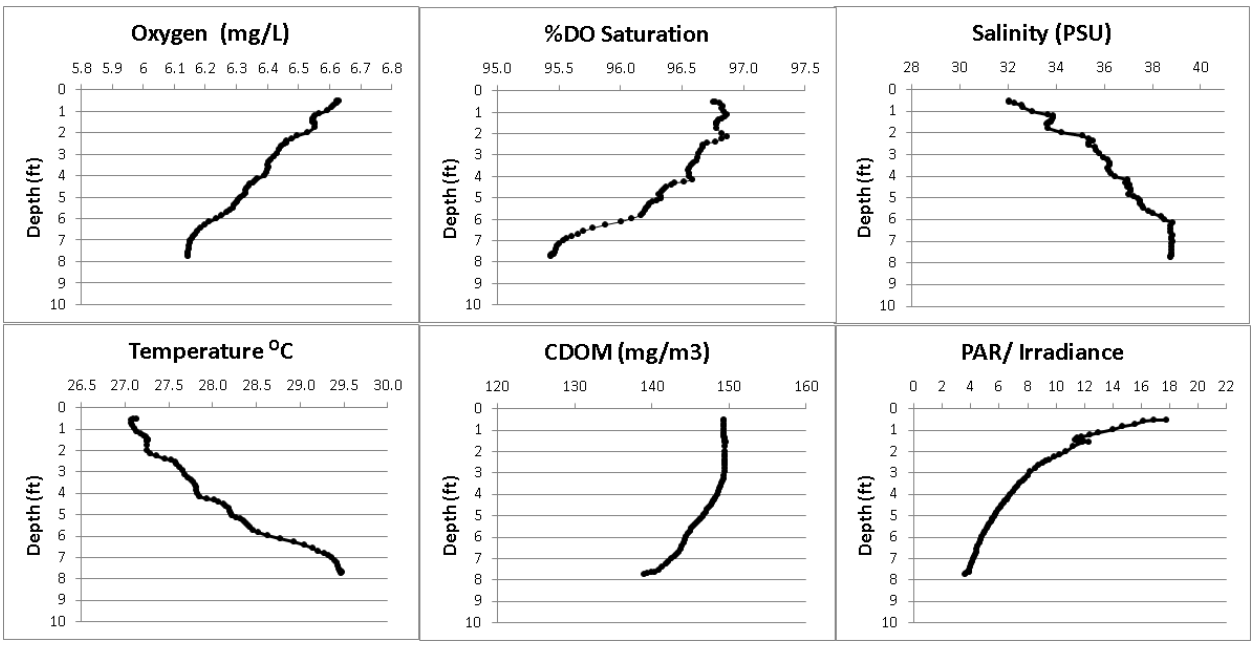

Figure 2.5. Profile of physicochemical properties of station No. 459A (Remediation) FKC003

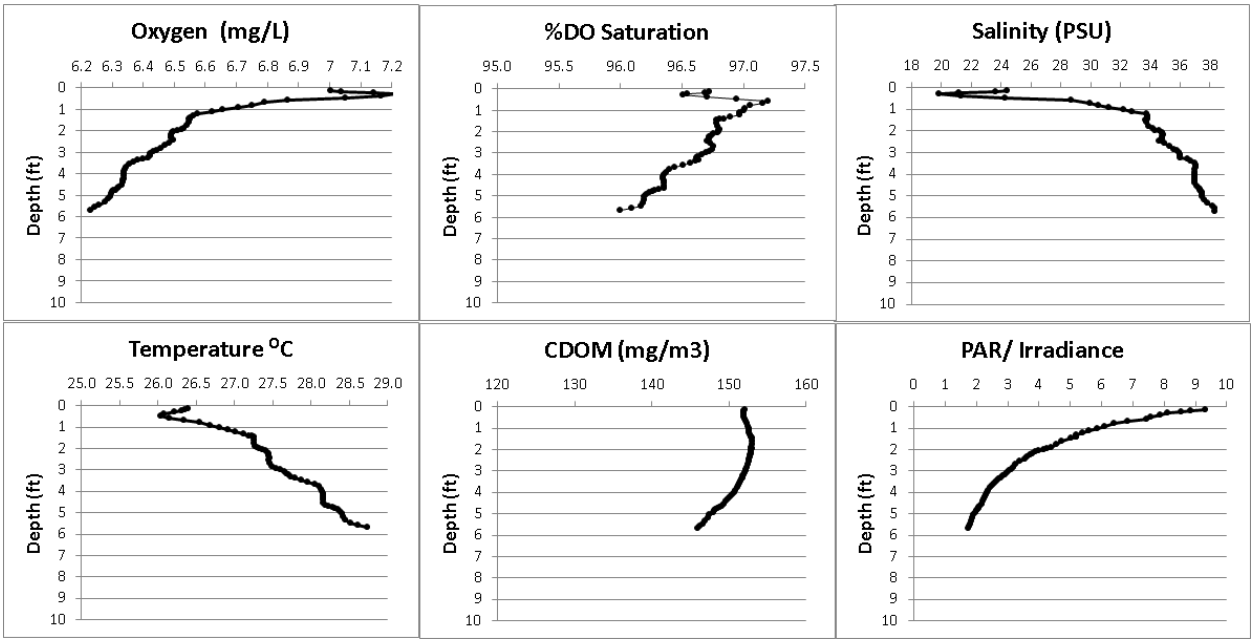

Figure 2.6. Profile of physicochemical properties of station No. 459B (Remediation) FKC003

Survey No 4

Water properties were determined along vertical profiles of the water column of all canal except for 266, 28, and 29. Profiles for Survey No.4 are shown in figures 2.7 to 2.48.

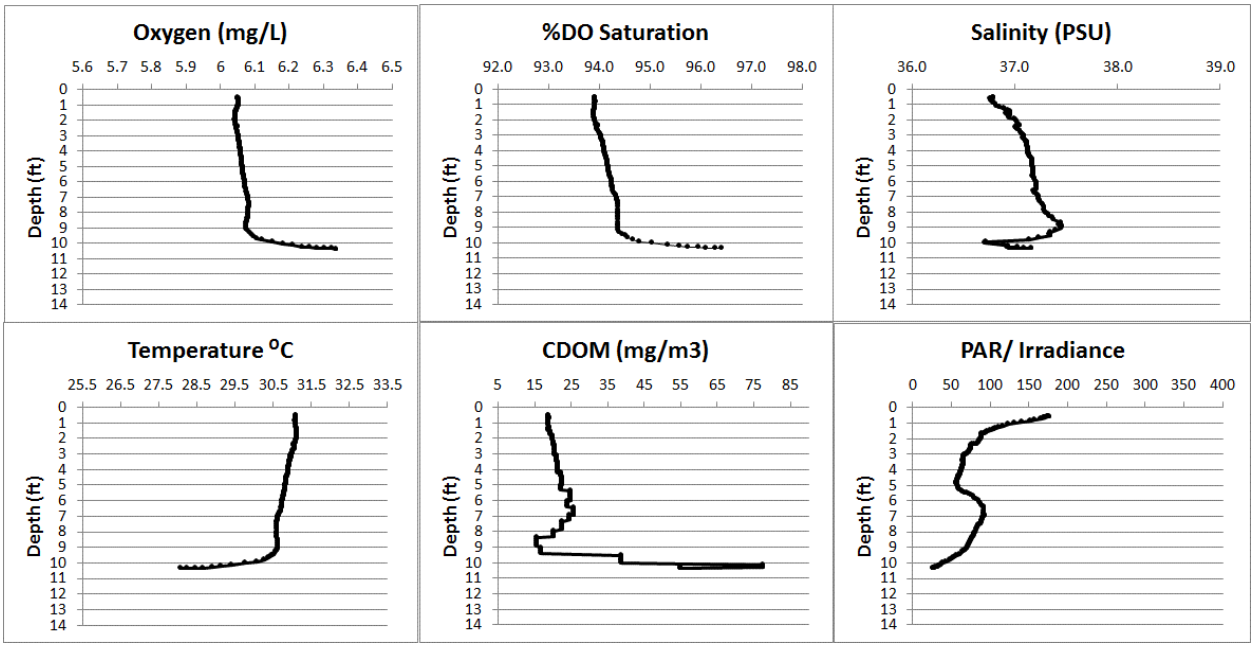

Figure 2.7. Profile of physicochemical properties of station No. 132A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency after 9 ft and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains relatively stable with values around 37. Given the sensitivity of the sensor used, it is possible to define a decreasing trend after 9 ft.

Water Temperature shows a decreasing tendency with water depth.

Colored Dissolved Organic Matter ranges between 15 and 21 mg/m^3 and a slight decrease is observed after 9 ft follows by high values at the bottom reaching up to 77 mg/m^3.

Photosynthetically Active Radiation decreases with water depth with some variations after 5 ft.

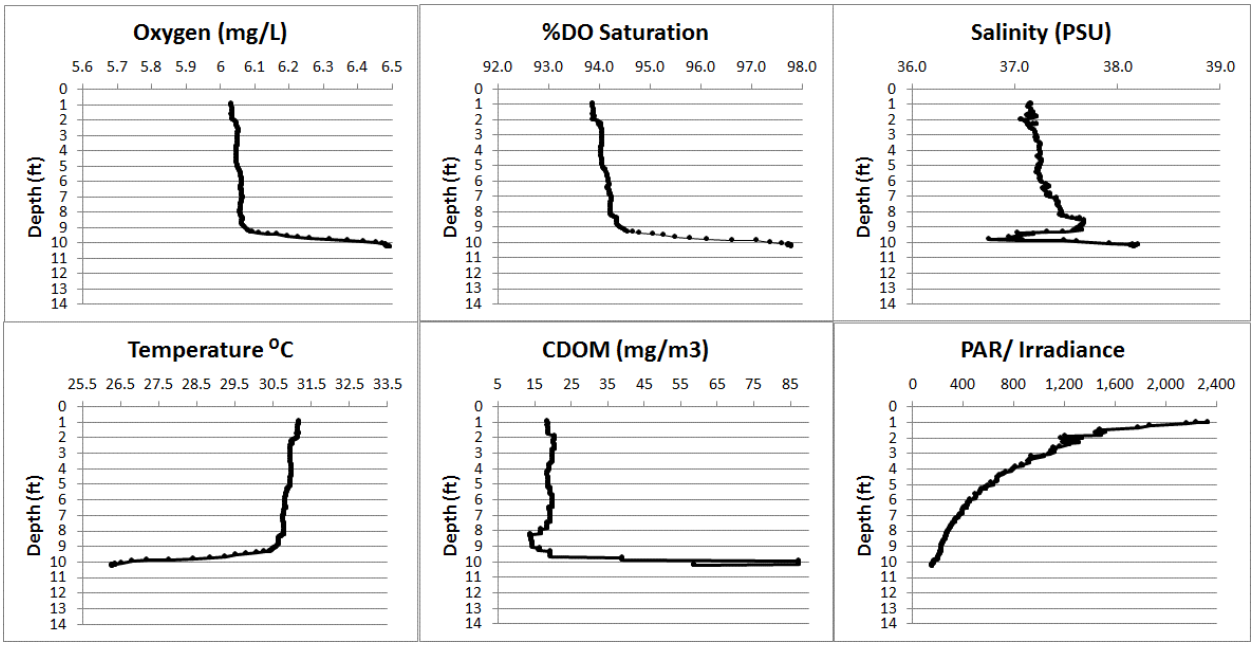

Figure 2.8. Profile of physicochemical properties of station No. 132B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency after 9 ft and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains relatively stable with values around 37. Given the sensitivity of the sensor used, it is possible to define a decreasing trend after 9 ft.

Water Temperature shows a decreasing tendency with water depth with a range of variation of about 5 °C.

Colored Dissolved Organic Matter ranges between 15 and 21 mg/m^3 and a slight decrease is observed after 9 ft follows by high values at the bottom around 85 mg/m^3.

Photosynthetically Active Radiation exponentially decreases with water depth and has a vertical attenuation coefficient of 0.84.

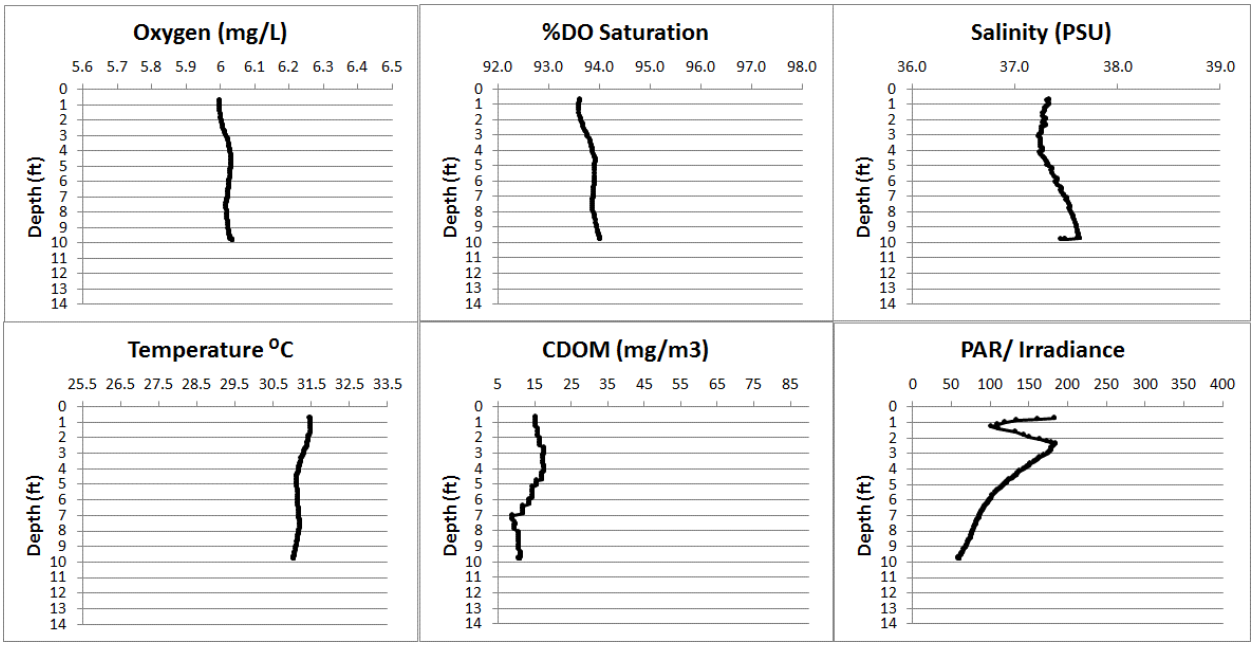

Figure 2.9. Profile of physicochemical properties of station No. 132C (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values within the regulation levels (all values above 42% DO Saturation).

Salinity remains relatively stable with values around 37.4.

Water Temperature remains relatively stable with values around 31 °C.

Colored Dissolved Organic Matter ranges between 9 and 17 mg/m^3 and a slight decrease is observed after 4 ft.

Photosynthetically Active Radiation decreases with water depth with some variations at the surface.

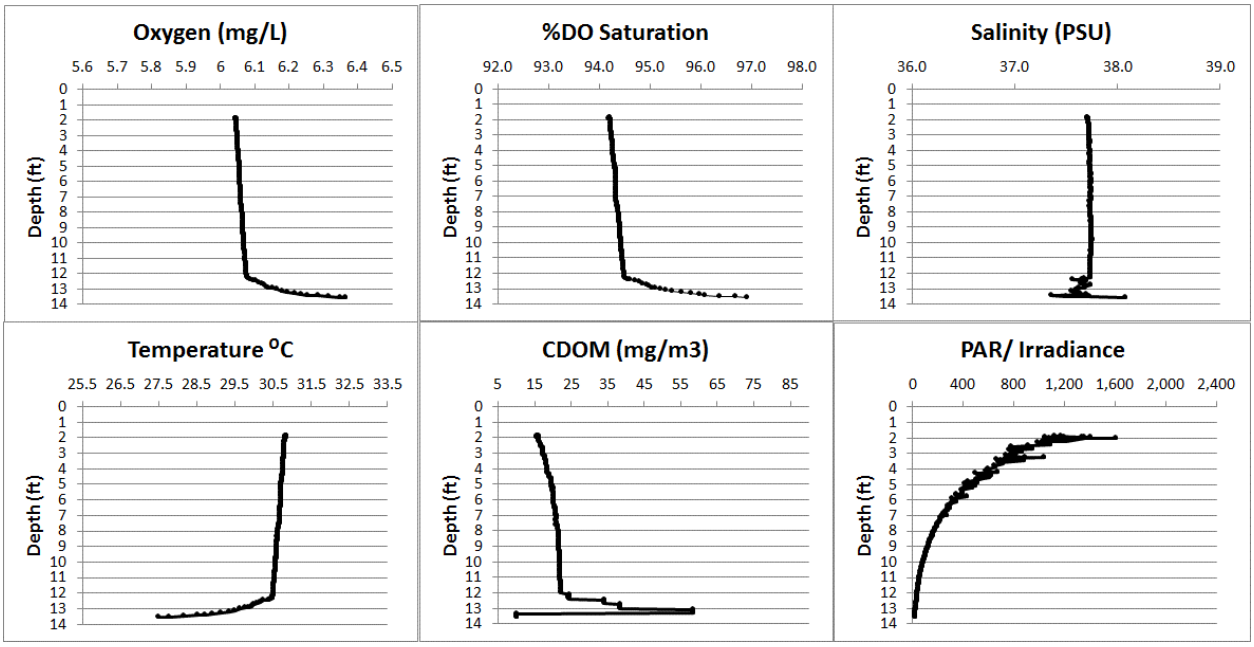

Figure 2.10. Profile of physicochemical properties of station No. 137A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency after 12 ft and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains relatively stable with values around 37.7. Given the sensitivity of the sensor used, it is possible to define oscillations after 12 ft.

Water Temperature shows a decreasing tendency with water depth after 12 ft.

Colored Dissolved Organic Matter ranges between 15 and 21 mg/m^3 and a sudden decrease is observed after 12 ft follows by low values.

Photosynthetically Active Radiation exponentially decreases and has a vertical attenuation coefficient of 1.10.

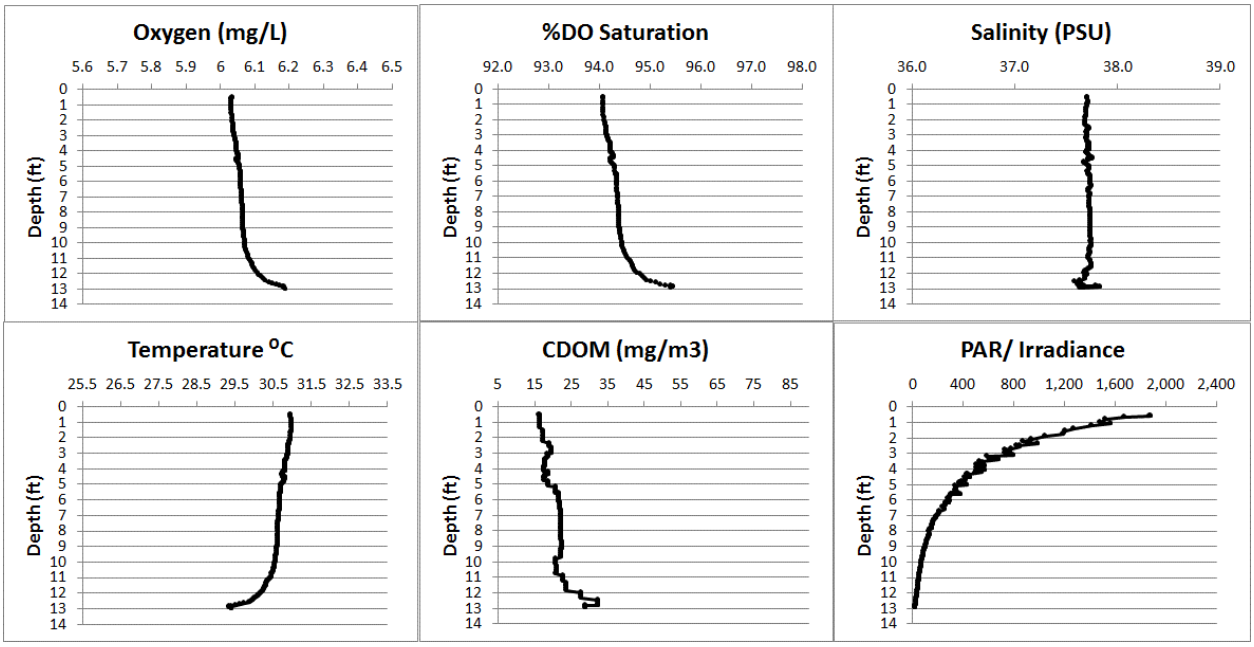

Figure 2.11. Profile of physicochemical properties of station No. 137B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show a slight increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains relatively stable with values around 37.7. Given the sensitivity of the sensor used it is possible to define a decreasing trend.

Water Temperature shows a decreasing tendency with water depth after 12 ft.

Colored Dissolved Organic Matter increases downward from around16 to 32 mg/m^3.

Photosynthetically Active Radiation exponentially decreases and has a vertical attenuation coefficient of 1.08.

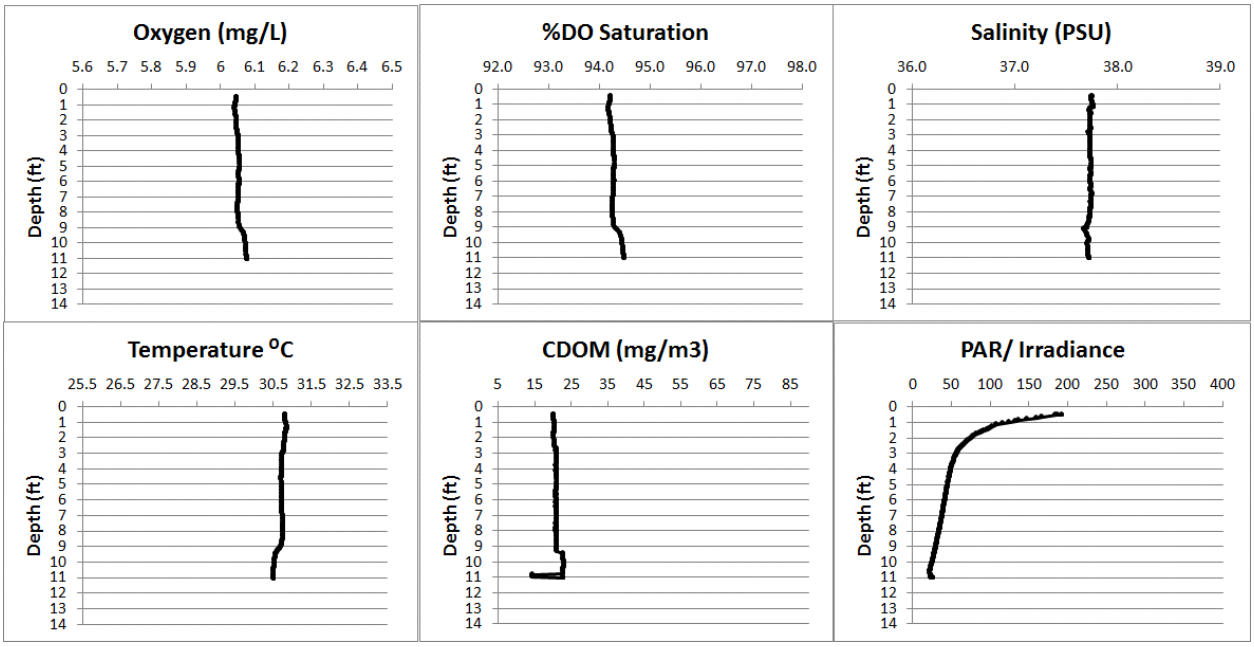

Figure 2.12. Profile of physicochemical properties of station No. 137C (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show a slight increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains relatively stable with values around 37.7.

Water Temperature remains stable. Given the sensitivity of the sensor used it is possible to define a decreasing trend.

Colored Dissolved Organic Matter remains very stable with values around 21 mg/m^3 but show some variability toward the end of the profile.

Photosynthetically Active Radiation decreases with increasing water depth and has a vertical attenuation coefficient of 0.49.

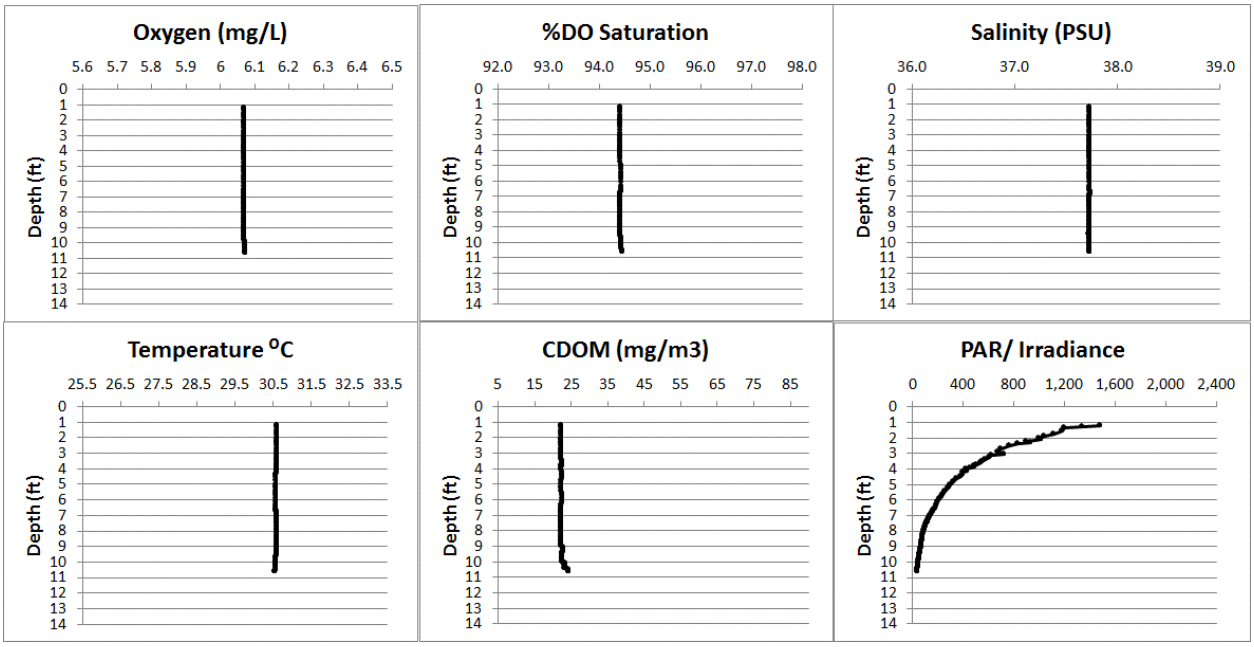

Figure 2.13. Profile of physicochemical properties of station No. 137D (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values around 37.7.

Water Temperature remains also very stable.

Colored Dissolved Organic Matter remains very stable with values around 23 mg/m^3.

Photosynthetically Active Radiation decreases with increasing water depth and has a vertical attenuation coefficient of 1.23.

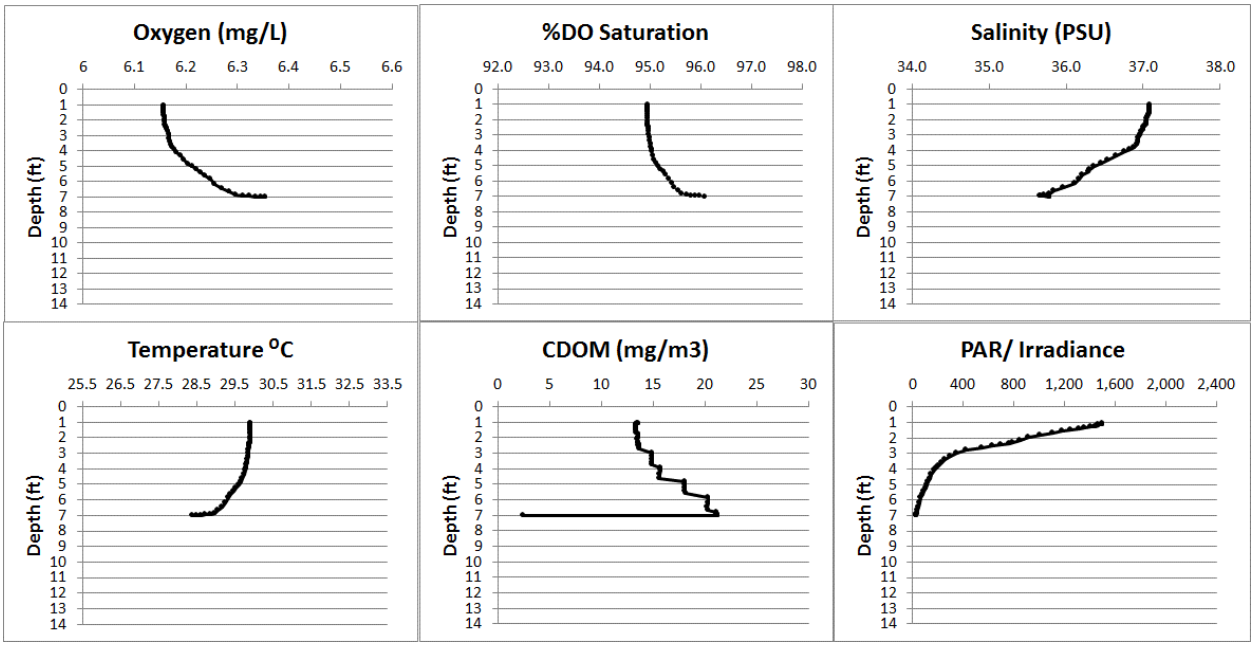

Figure 2.14. Profile of physicochemical properties of station No. 147A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity shows a decreasing tendency with water depth.

Water Temperature shows a decreasing tendency with water depth with a range of variation of about 2 °C.

Colored Dissolved Organic Matter increases along the profile and a sudden decrease occurs at the bottom.

Photosynthetically Active Radiation exponentially decreases with water depth and has a vertical attenuation coefficient of 2.17.

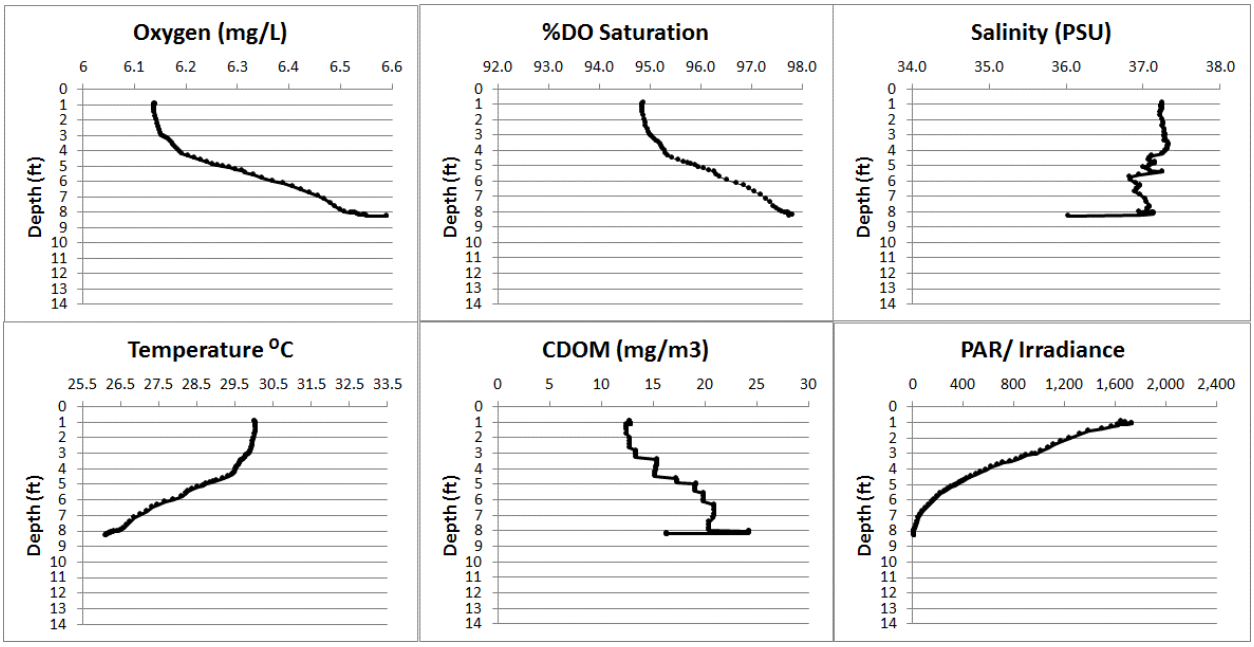

Figure 2.15. Profile of physicochemical properties of station No. 147B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity shows a decreasing tendency with water depth.

Water Temperature shows a decreasing tendency with water depth with a range of variation of about 4 °C.

Colored Dissolved Organic Matter increases along the profile with some variations at the bottom of the water column.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 2.21.

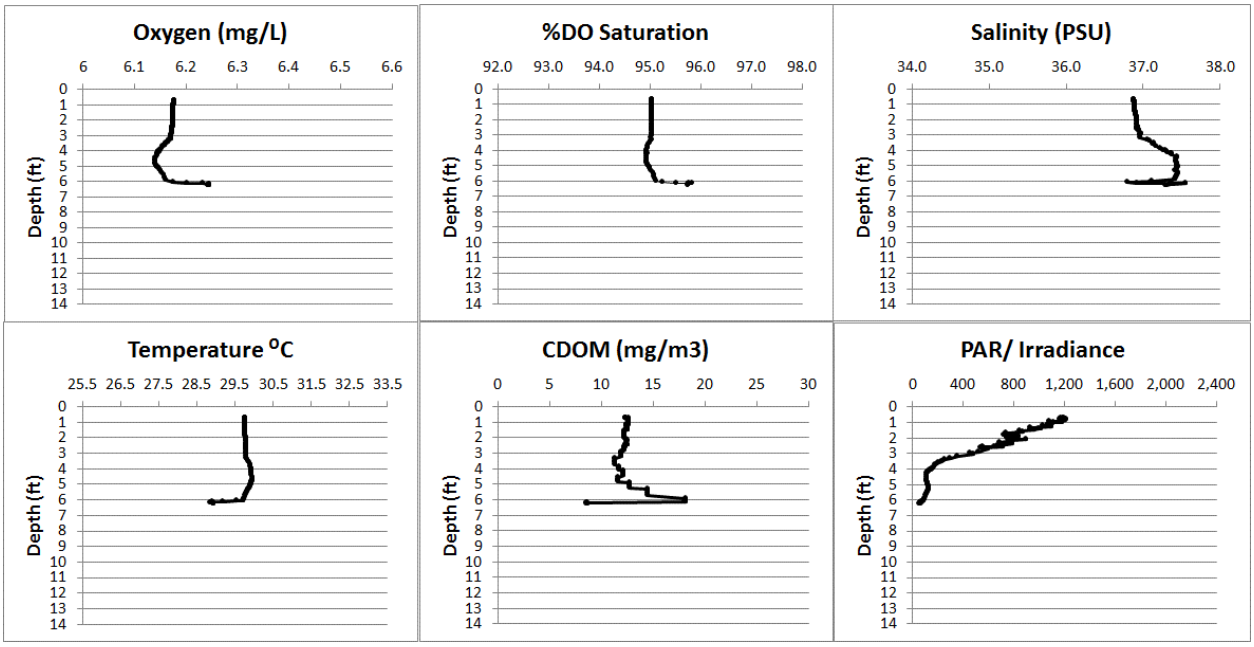

Figure 2.16. Profile of physicochemical properties of station No. 148A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 95% and within the regulation levels (values above 42% DO Saturation).

Salinity remains relatively stable with values around 37. Given the sensitivity of the sensor used, it is possible to define a decreasing trend after 3 ft.

Water Temperature remains also very stable.

Colored Dissolved Organic Matter ranges between 11 and 18 mg/m^3 and a sudden decrease is observed at the bottom of the profile.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 1.85.

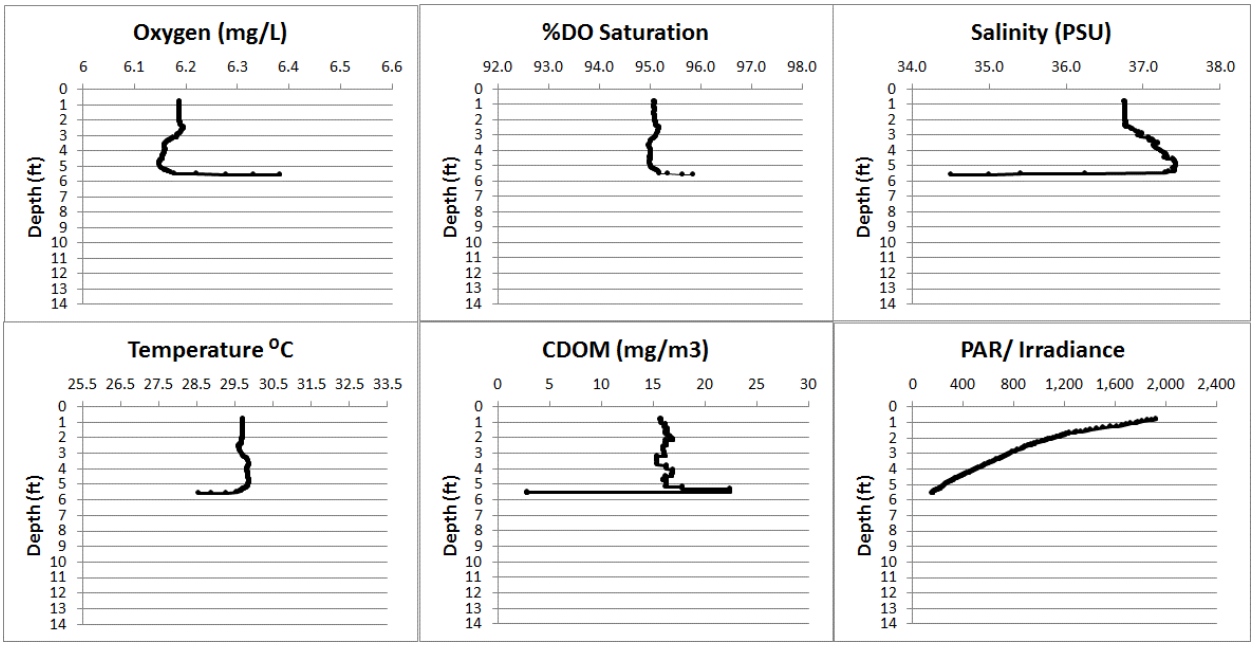

Figure 2.17. Profile of physicochemical properties of station No. 148B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation remains stable until about 5 ft when the values slightly increase. Water remains well oxygenated with values around 95% and within the regulation levels (values above 42% DO Saturation).

Salinity remains relatively stable with values around 37 until about 5 ft when the values decrease.

Water Temperature remains very stable and describes a similar pattern as that of salinity.

Colored Dissolved Organic Matter remains stable with values around 16 mg/m^3 until a sudden decrease is occurs at the bottom of the profile.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 1.58.

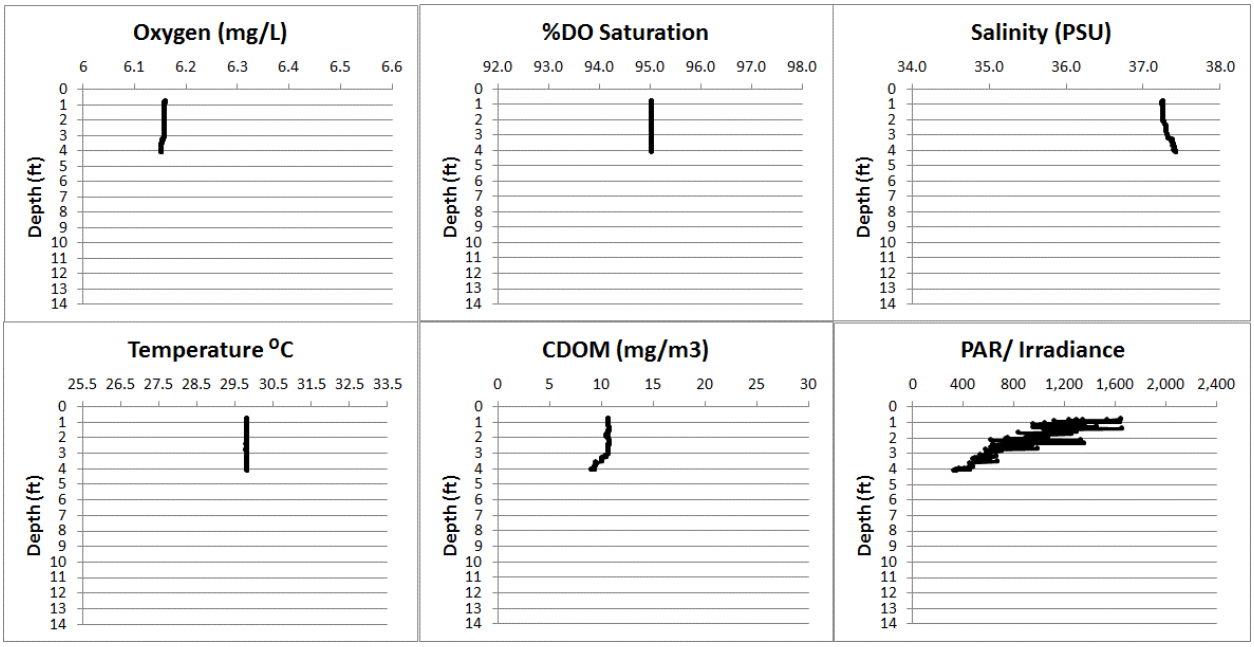

Figure 2.18. Profile of physicochemical properties of station No. 148C (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 95% and within the regulation levels (values above 42% DO Saturation).

Salinity remains stable with values around 37.

Water Temperature remains very stable with and average value of 29.8 °C.

Colored Dissolved Organic Matter remains stable with values around 10 mg/m^3.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 1.27.

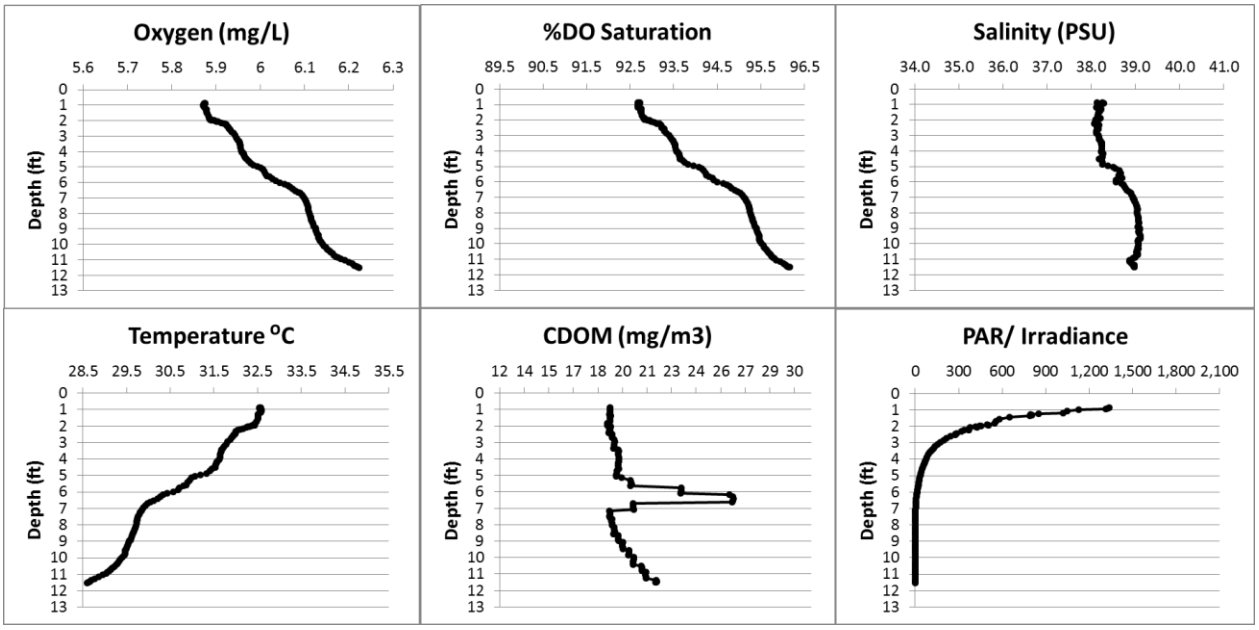

Figure 2.19. Profile of physicochemical properties of station No. 293A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values between 38 and 39.

Water Temperature drops along the profile with a range of variation of about 4 °C.

Colored Dissolved Organic Matter remains stable until about 6 ft, when a sudden increase occurs.

Photosynthetically Active Radiation decrease with water depth and has a vertical attenuation coefficient of 2.70.

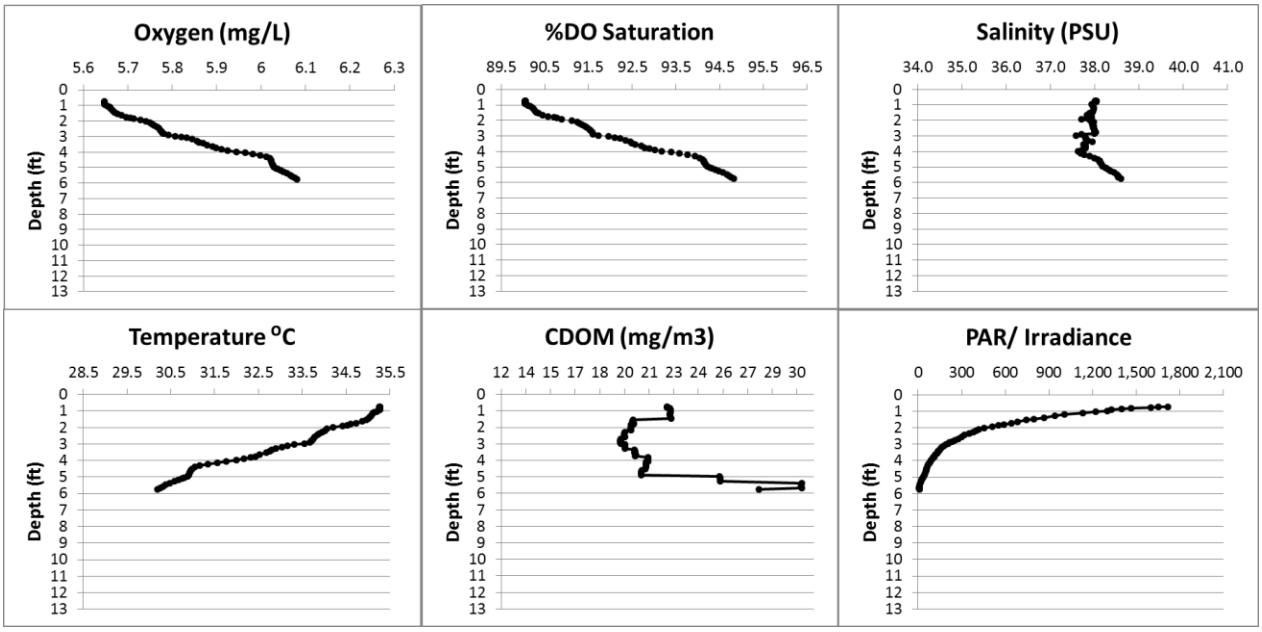

Figure 2.20. Profile of physicochemical properties of station No. 293B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values around 38.

Water Temperature drops along the profile with a range of variation of about 5 °C.

Colored Dissolved Organic Matter remains stable until about 5 ft, when a sudden increase occurs.

Photosynthetically Active Radiation exponentially decrease with water depth and has a vertical attenuation coefficient of 3.14.

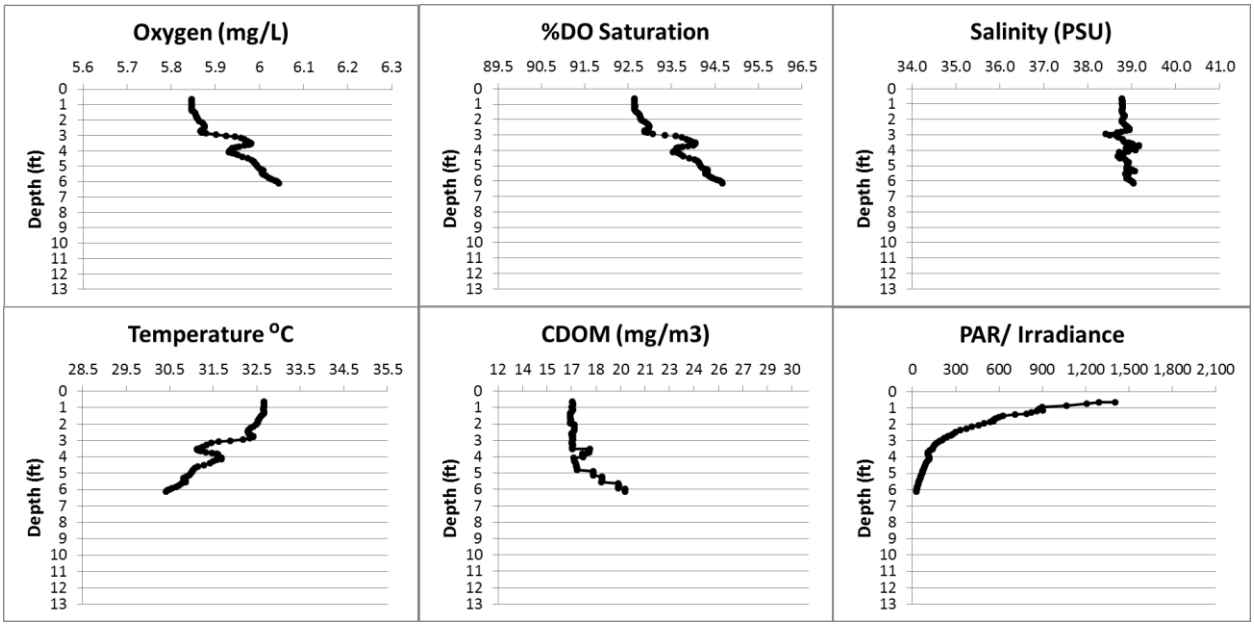

Figure 2.21. Profile of physicochemical properties of station No. 293C (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation). A sudden increase is observed about 3.5 ft.

Salinity remains very stable with values around 39.

Water Temperature drops along the profile with a range of variation of about 2 °C. A sudden decrease is observed about 3.5 ft.

Colored Dissolved Organic Matter remains stable until about 4.5 ft, when values start to increase.

Photosynthetically Active Radiation decrease with water depth and has a vertical attenuation coefficient of 2.22.

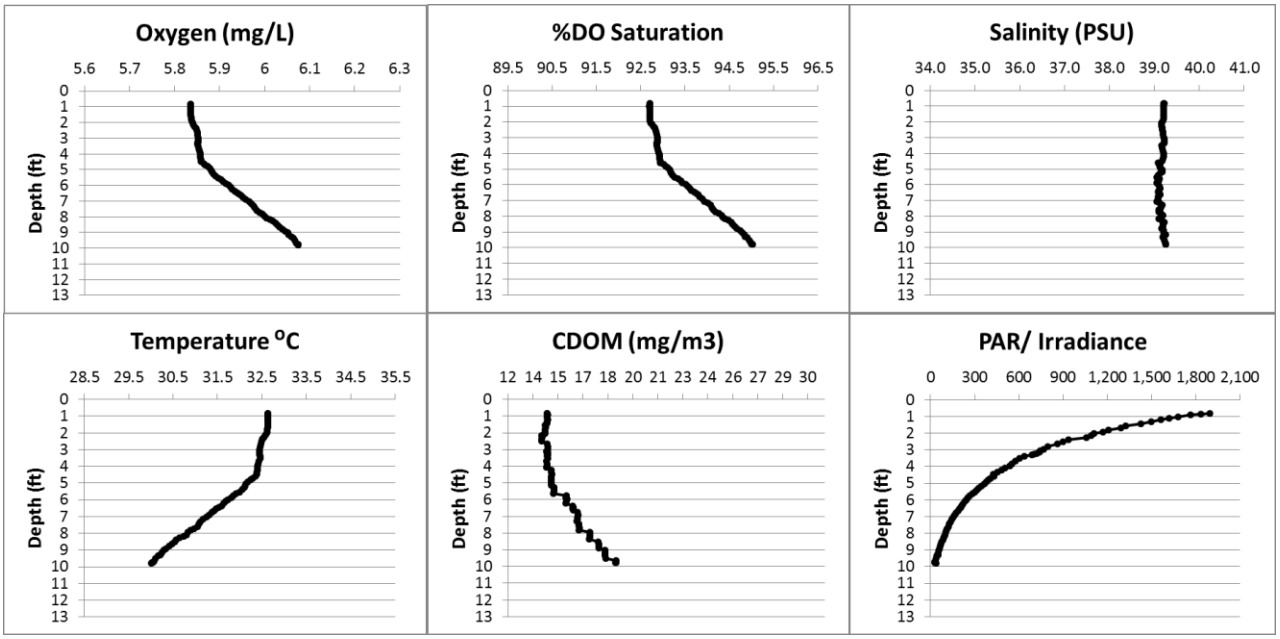

Figure 2.22. Profile of physicochemical properties of station No. 287A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values around 39.

Water Temperature drops along the profile with a range of variation of about 2 °C.

Colored Dissolved Organic Matter slightly increases with water depth from about 14 to 18.5 mg/m^3.

Photosynthetically Active Radiation exponentially decrease with water depth and has a vertical attenuation coefficient of 1.40.

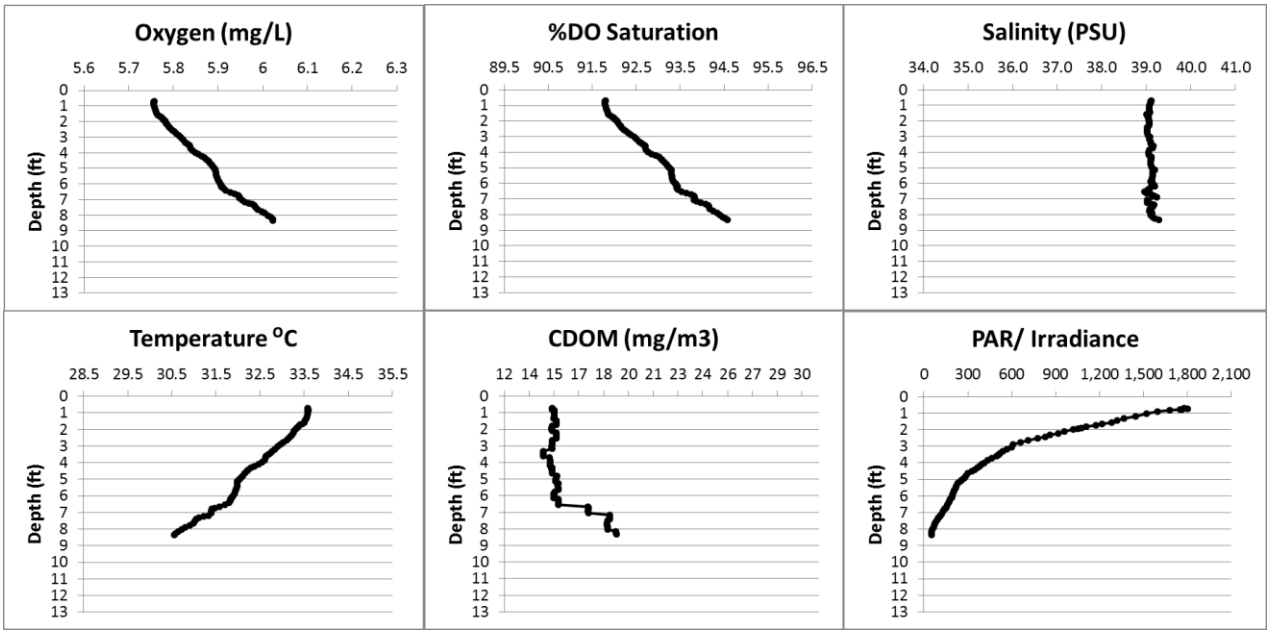

Figure 2.23. Profile of physicochemical properties of station No. 287B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values around 39.

Water Temperature drops along the profile with a range of variation of about 3 °C.

Colored Dissolved Organic Matter remains relatively stable until about 6 ft, when values increase by about 3 mg/m^3.

Photosynthetically Active Radiation exponentially decrease with water depth and has a vertical attenuation coefficient of 1.45.

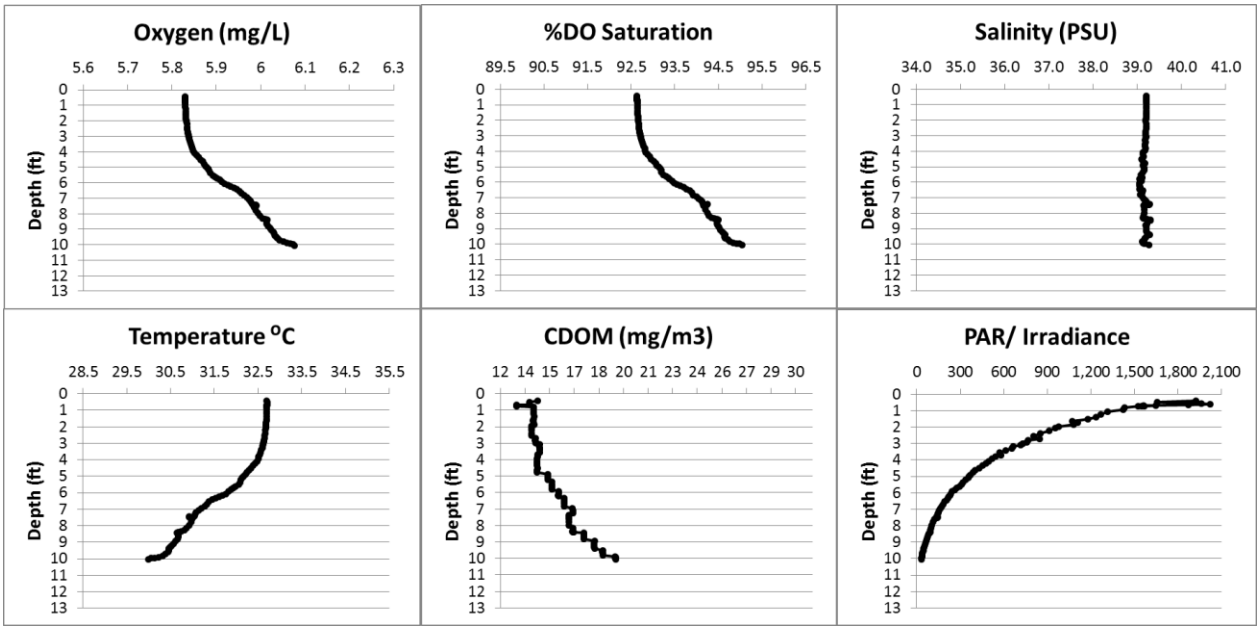

Figure 2.24. Profile of physicochemical properties of station No. 287C (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values around 39.

Water Temperature drops along the profile with a range of variation of about 3 °C.

Colored Dissolved Organic Matter increase along the profile from 13 to 19 mg/m^3.

Photosynthetically Active Radiation exponentially decrease with water depth and has a vertical attenuation coefficient of 1.29.

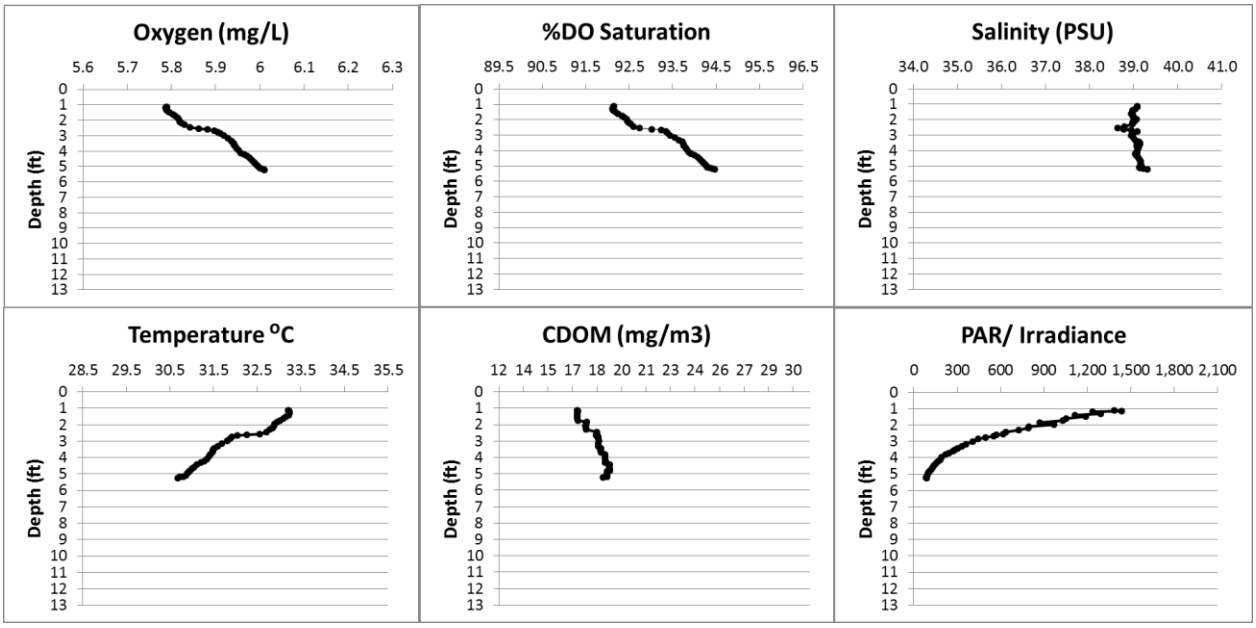

Figure 2.25. Profile of physicochemical properties of station No. 290A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values around 39.

Water Temperature drops along the profile with a range of variation of about 3 °C.

Colored Dissolved Organic Matter increase along the profile with a range of variation of about 2 mg/m^3.

Photosynthetically Active Radiation decrease with water depth and has a vertical attenuation coefficient of 2.31.

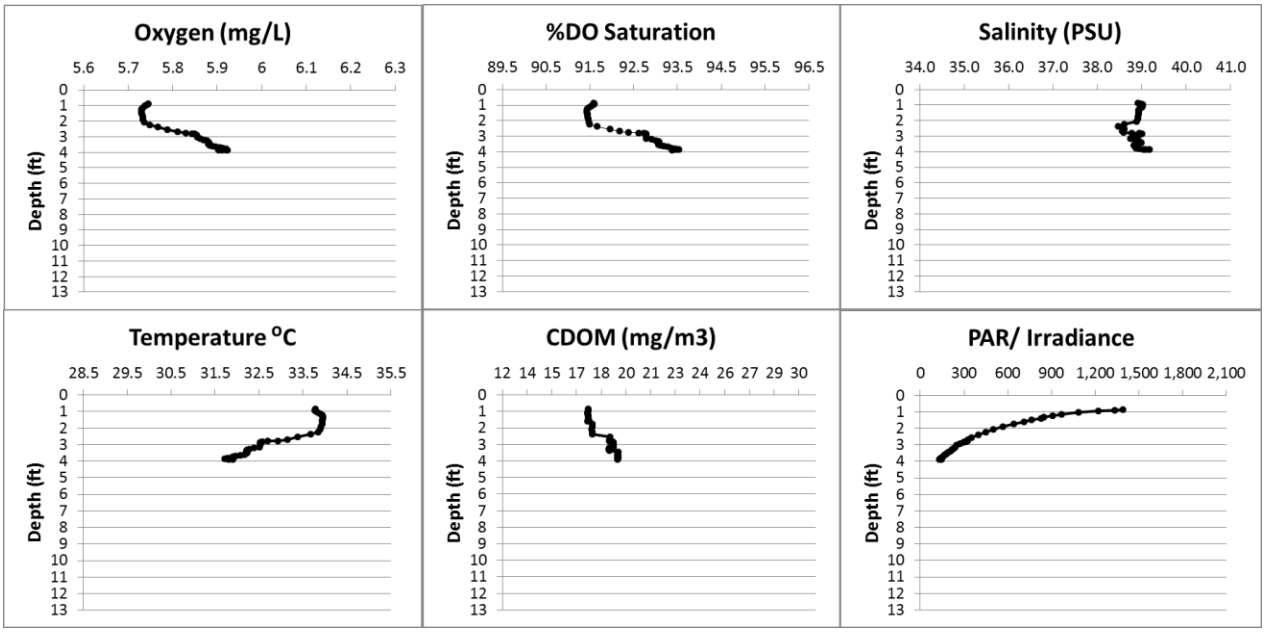

Figure 2.26. Profile of physicochemical properties of station No. 290B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency after 2 ft and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values around 39.

Water Temperature drops along the profile with a range of variation of about 3 °C.

Colored Dissolved Organic Matter increase along the profile with a range of variation of about 2 mg/m^3.

Photosynthetically Active Radiation decrease with water depth and has a vertical attenuation coefficient of 2.40.

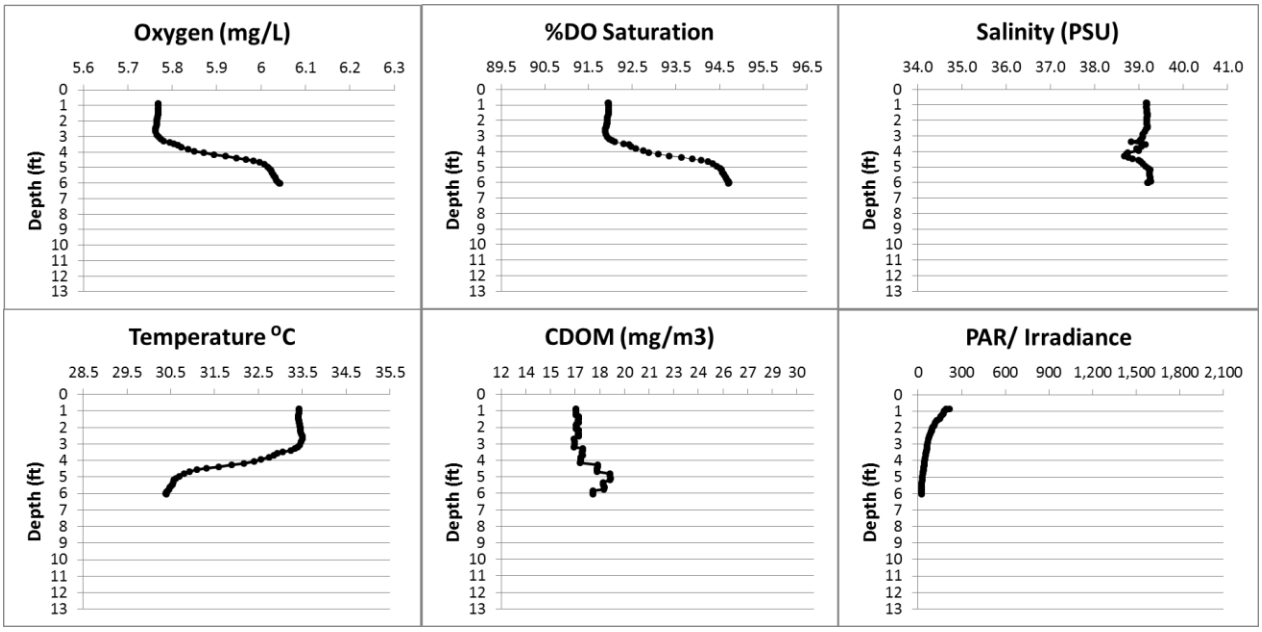

Figure 2.27. Profile of physicochemical properties of station No. 290C (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values around 39.

Water Temperature drops along the profile with a range of variation of about 3 °C.

Colored Dissolved Organic Matter increase along the profile with a range of variation of about 2 mg/m^3.

Photosynthetically Active Radiation decrease with water depth and has a vertical attenuation coefficient of 1.38.

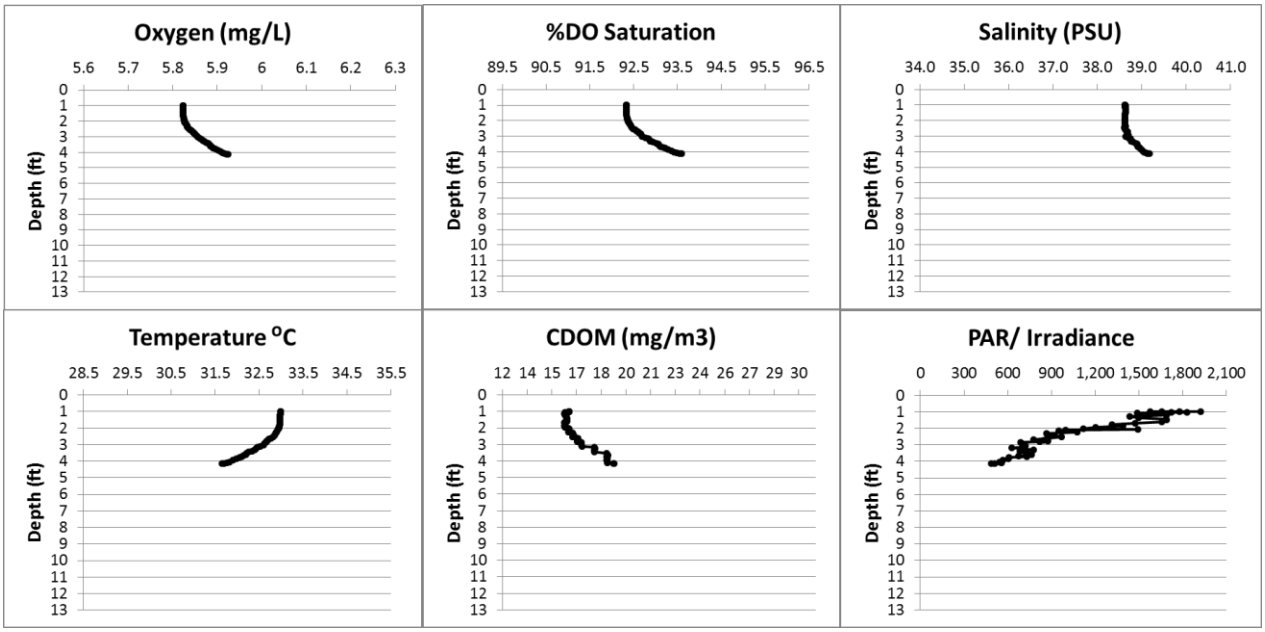

Figure 2.28. Profile of physicochemical properties of station No. 282A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with an average value of 38.7

Water Temperature shows a decreasing tendency with water depth

Colored Dissolved Organic Matter slightly increase along the profile with values between 16 and 19 mg/m^3.

Photosynthetically Active Radiation decrease with water depth and has a vertical attenuation coefficient of 1.26.

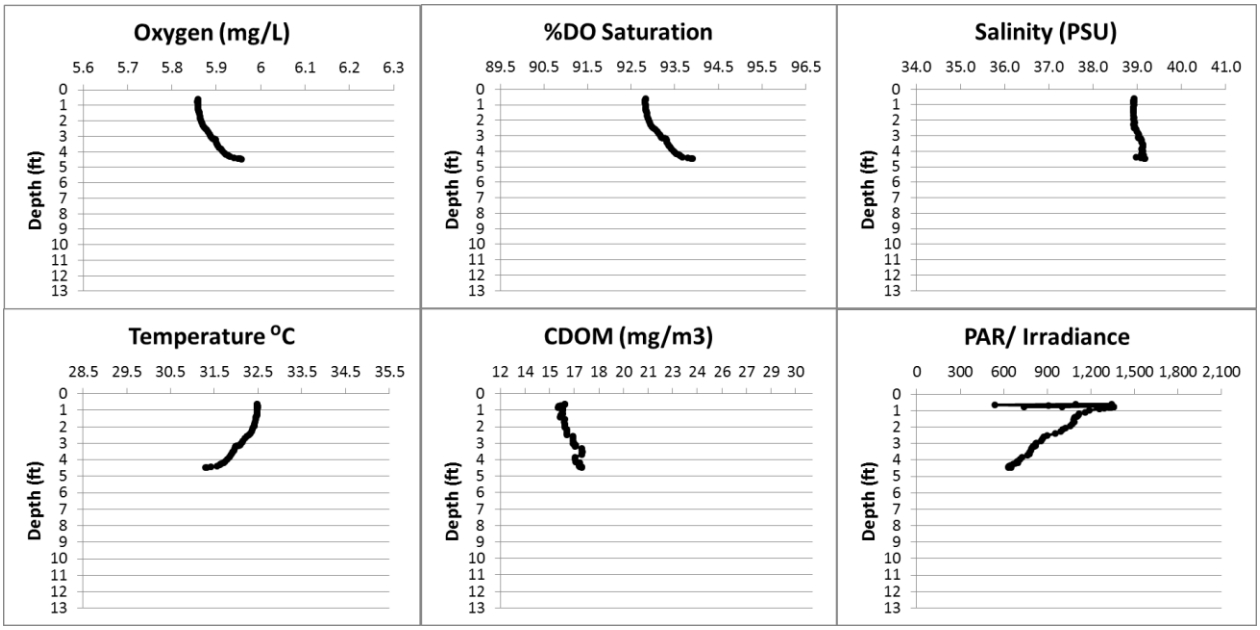

Figure 2.29. Profile of physicochemical properties of station No. 282B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values around 39.

Water Temperature shows a decreasing tendency with water depth

Colored Dissolved Organic Matter remains stable along the profile

Photosynthetically Active Radiation varies with water depth with some variations at the surface and have a vertical attenuation coefficient of 0.5.

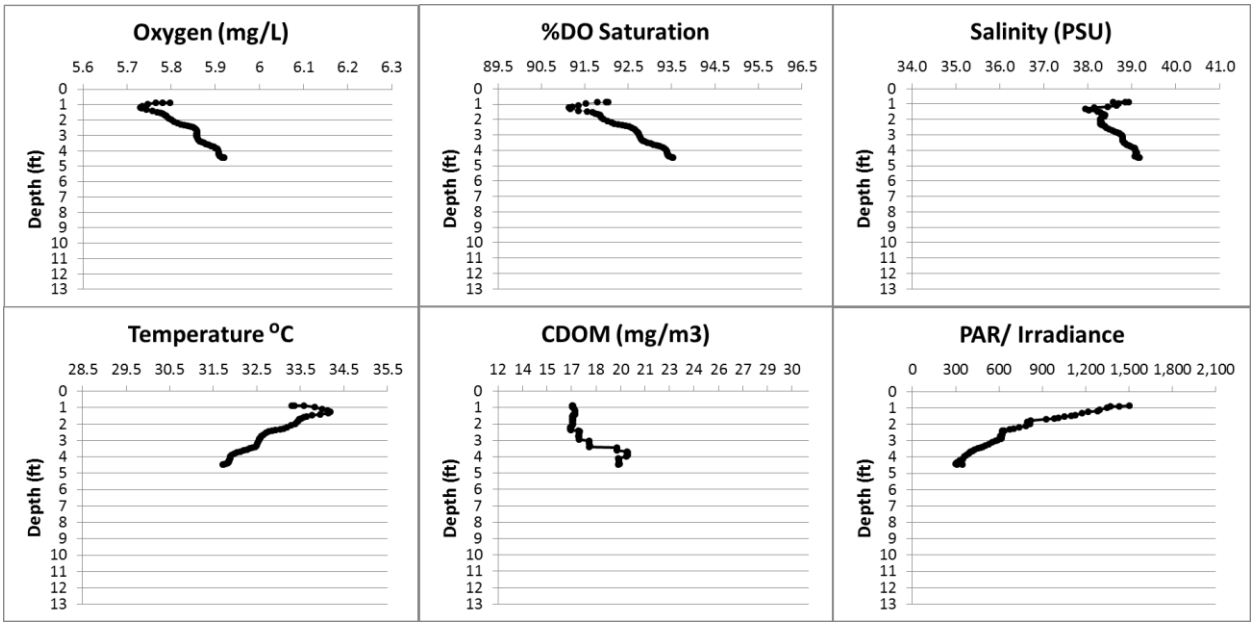

Figure 2.30. Profile of physicochemical properties of station No. 282C (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show an increasing tendency and water remains within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values between 38 and 39.

Water Temperature shows a decreasing tendency along the profile with a range of variation of about 2.5 °C.

Colored Dissolved Organic Matter increases downward from 16 to 20 mg/m^3.

Photosynthetically Active Radiation decreases exponentially with water depth and has a vertical attenuation coefficient of 1.39.

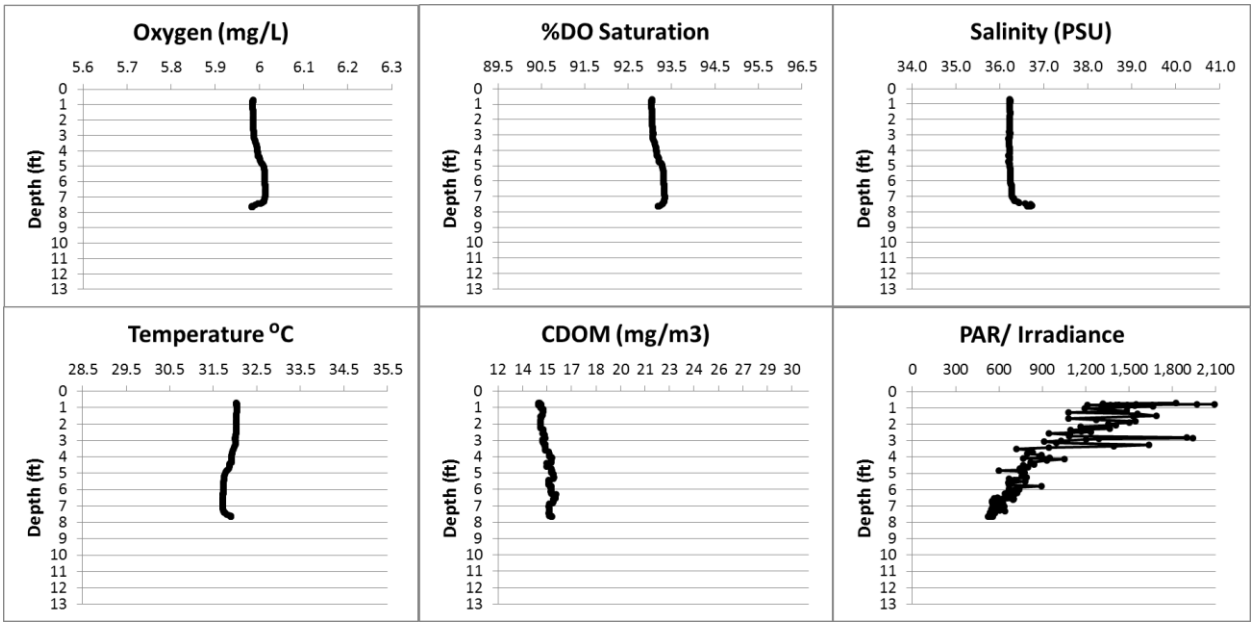

Figure 2.31. Profile of physicochemical properties of station No. 278A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 93% and within the regulation levels (all values above 42% DO Saturation).

Salinity remains stable along the profile with values around 36.

Water Temperature remains very stable with values around 32 °C

Colored Dissolved Organic Matter remains stable throughout the profile between 14.5 and 15.5 mg/m^3.

Photosynthetically Active Radiation decreases with water depth with some oscillations and has a vertical attenuation coefficient of 0.5.

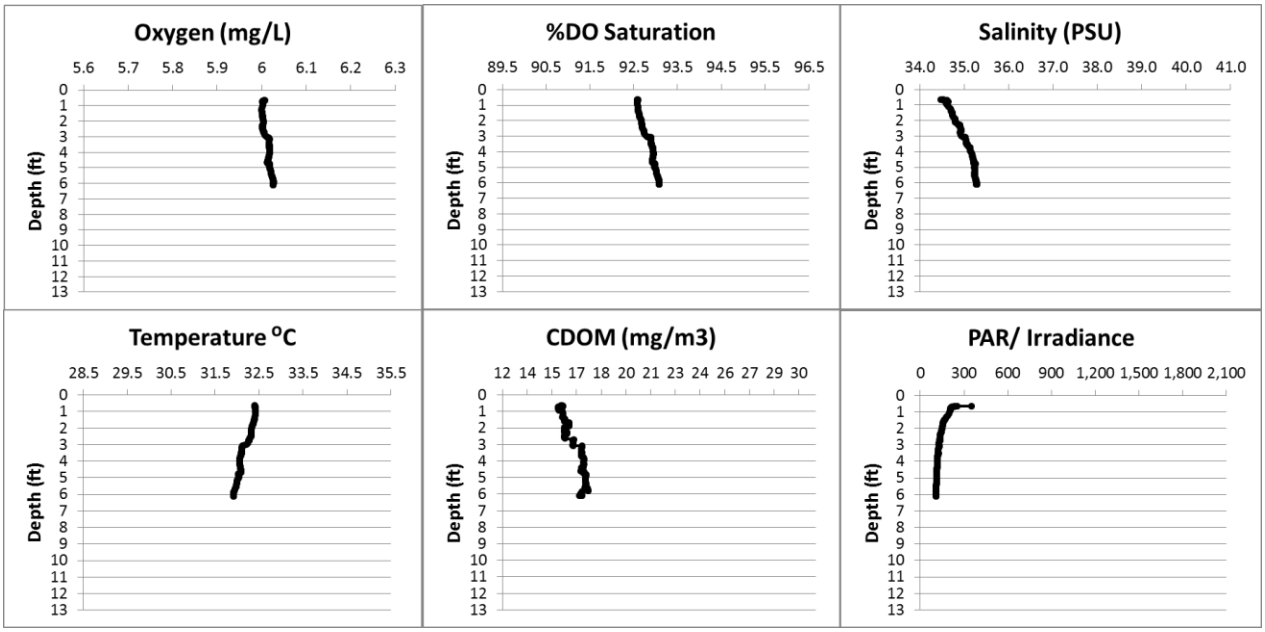

Figure 2.32. Profile of physicochemical properties of station No. 278B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 93% and within the regulation levels (all values above 42% DO Saturation).

Salinity remains stable along the profile with values between 34.5 and 35.3.

Water Temperature slightly decreases downward with values around 32 °C.

Colored Dissolved Organic Matter shows an increasing tendency with water depth with values between 15.4 and 17.2 mg/m^3.

Photosynthetically Active Radiation decreases with water depth with some oscillations has a vertical attenuation coefficient of 0.41.

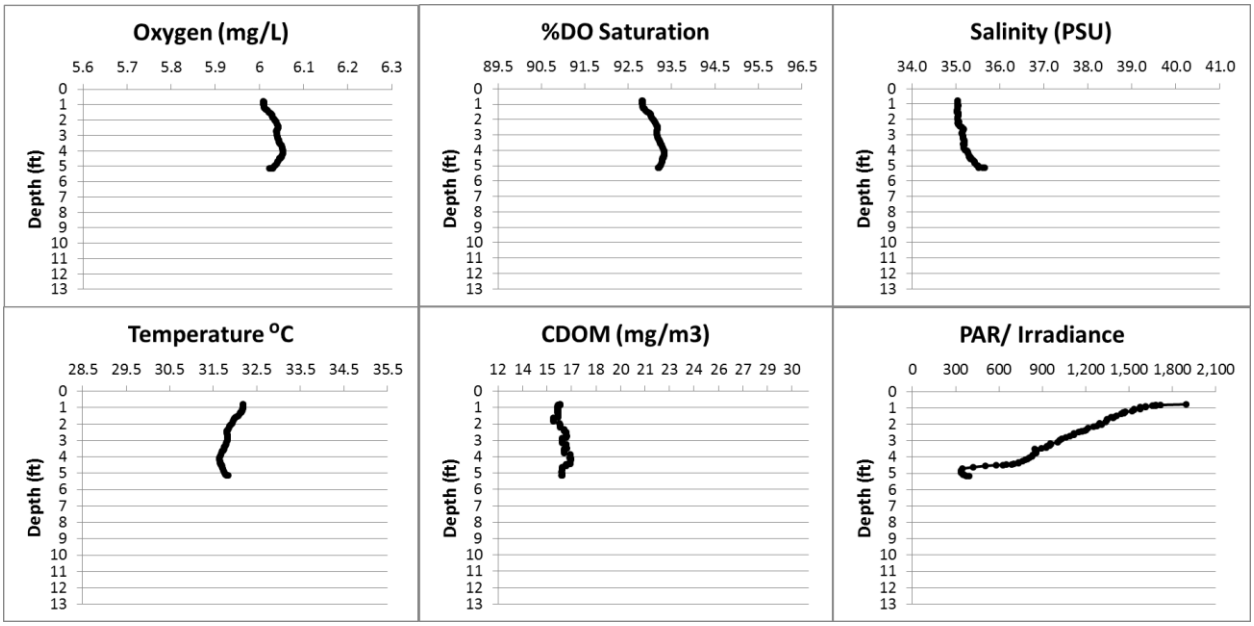

Figure 2.33. Profile of physicochemical properties of station No. 278C (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 93% and within the regulation levels (all values above 42% DO Saturation).

Salinity remains stable along the profile with values between 35.

Water Temperature slightly decreases downward with values around 32 °C and a slight increase is observed after 4 ft.

Colored Dissolved Organic Matter remains stable with values around 16 mg/m^3.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 1.03.

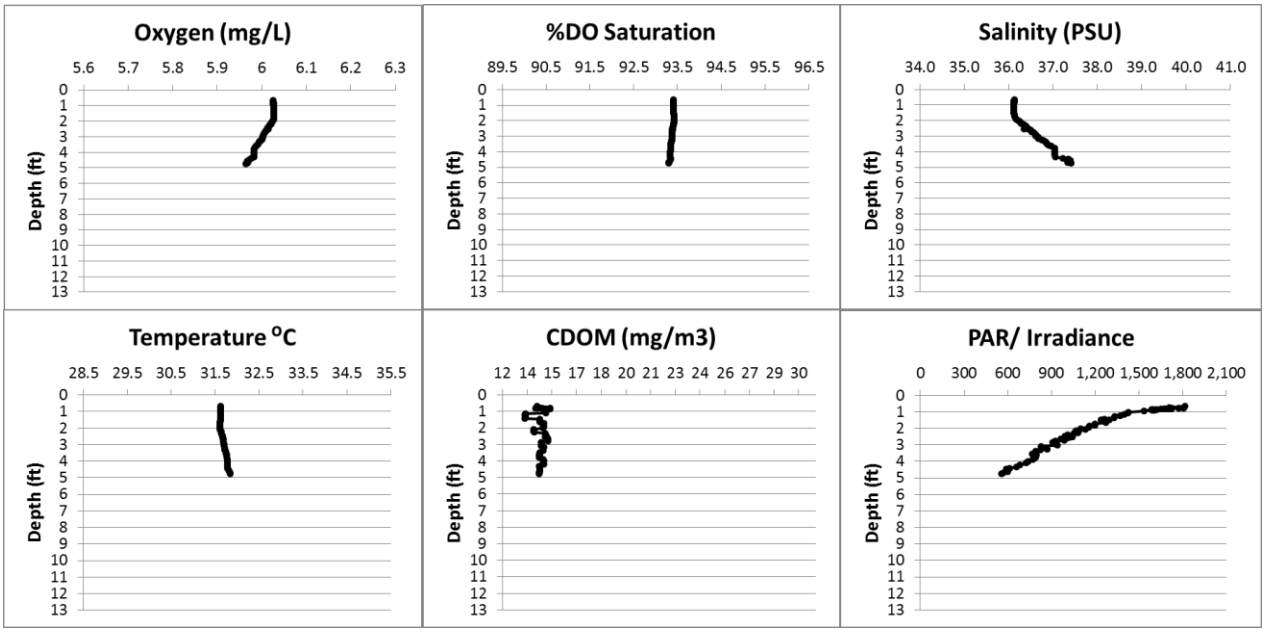

Figure 2.34. Profile of physicochemical properties of station No. 278D (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation decrease slightly along the profile but water remains well oxygenated with values around 93% and within the regulation levels (all values above 42% DO Saturation).

Salinity increases slightly along the profile.

Water Temperature slightly decreases downward with values around 32 °C.

Colored Dissolved Organic Matter remains stable with values around 14 mg/m^3.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 0.88.

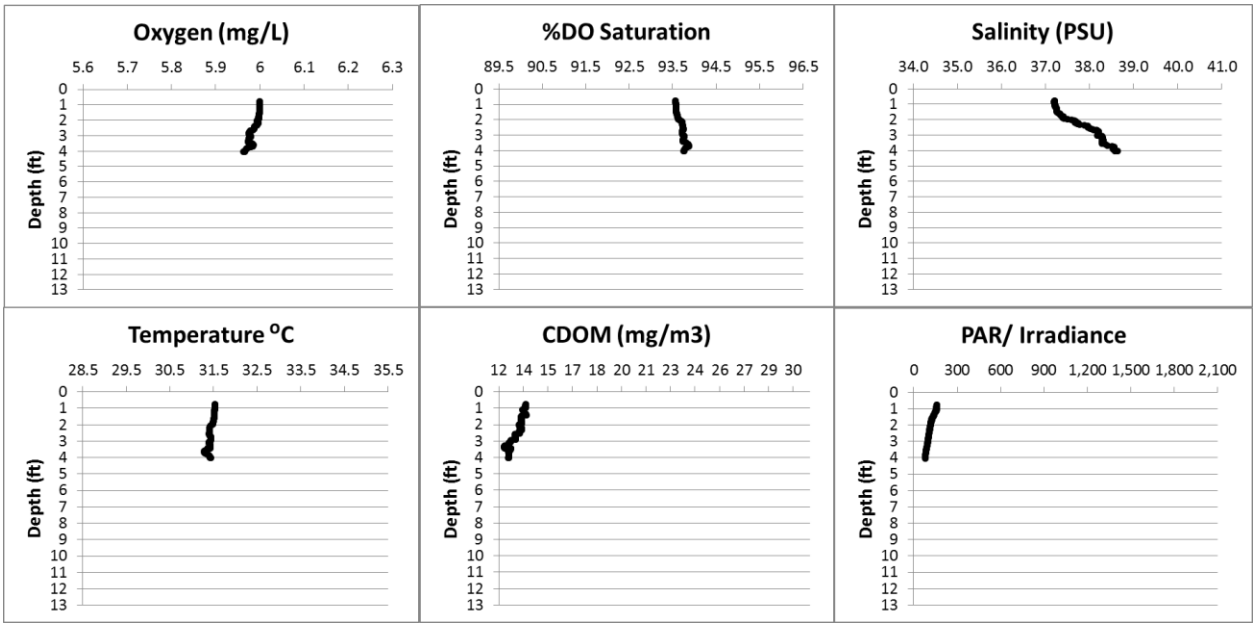

Figure 2.35. Profile of physicochemical properties of station No. 278E (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 93.5% and within the regulation levels (all values above 42% DO Saturation).

Salinity increases slightly along the profile.

Water Temperature remains very stable with values around 31.5 °C**.**

Colored Dissolved Organic Matter slightly decreases along the profile from values around 14 to around 12 mg/m^3.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 0.73.

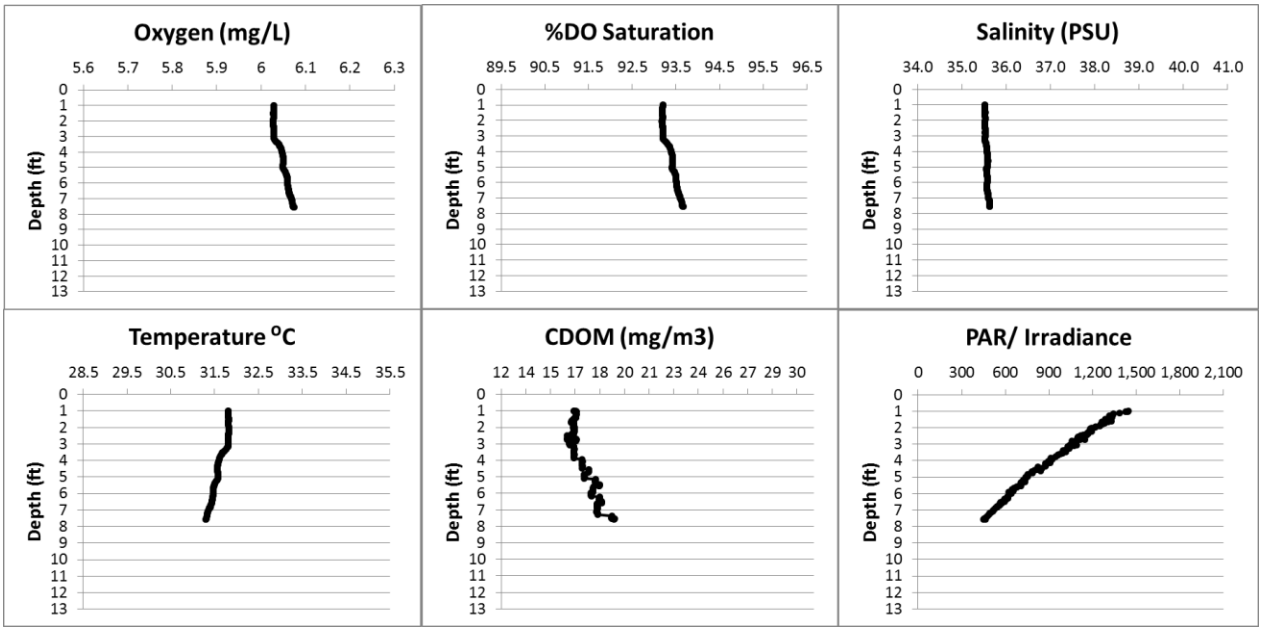

Figure 2.36. Profile of physicochemical properties of station No. 278F (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 93% and within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable along the profile.

Water Temperature remains very stable with values around 31.5 °C**.**

Colored Dissolved Organic Matter slightly increases along the profile with values between 16 and 19 mg/m^3.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 0.55.

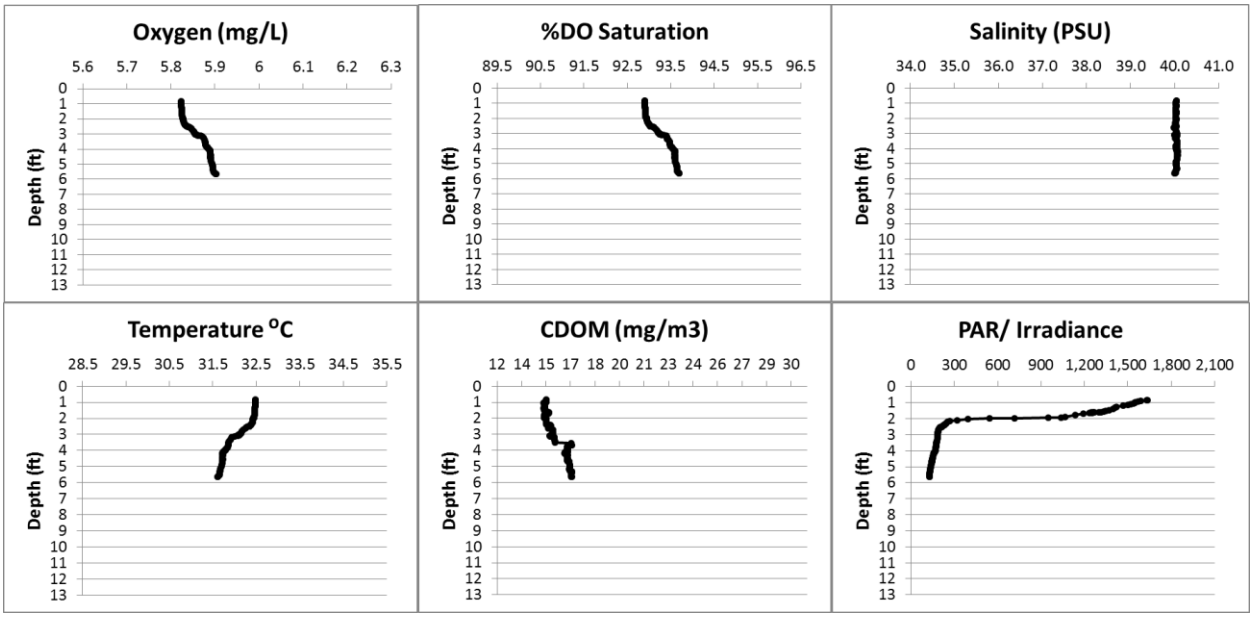

Figure 2.37. Profile of physicochemical properties of station No. 277A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 93% and within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable along profile with values around 40.

Water Temperature decreases slightly with water depth with a range of variation of about 1 °C.

Colored Dissolved Organic Matter increases downward from around 15 to 17 mg m^{-3}.

Photosynthetically Active Radiation decreases with increasing water depth and has a vertical attenuation coefficient of 1.89.

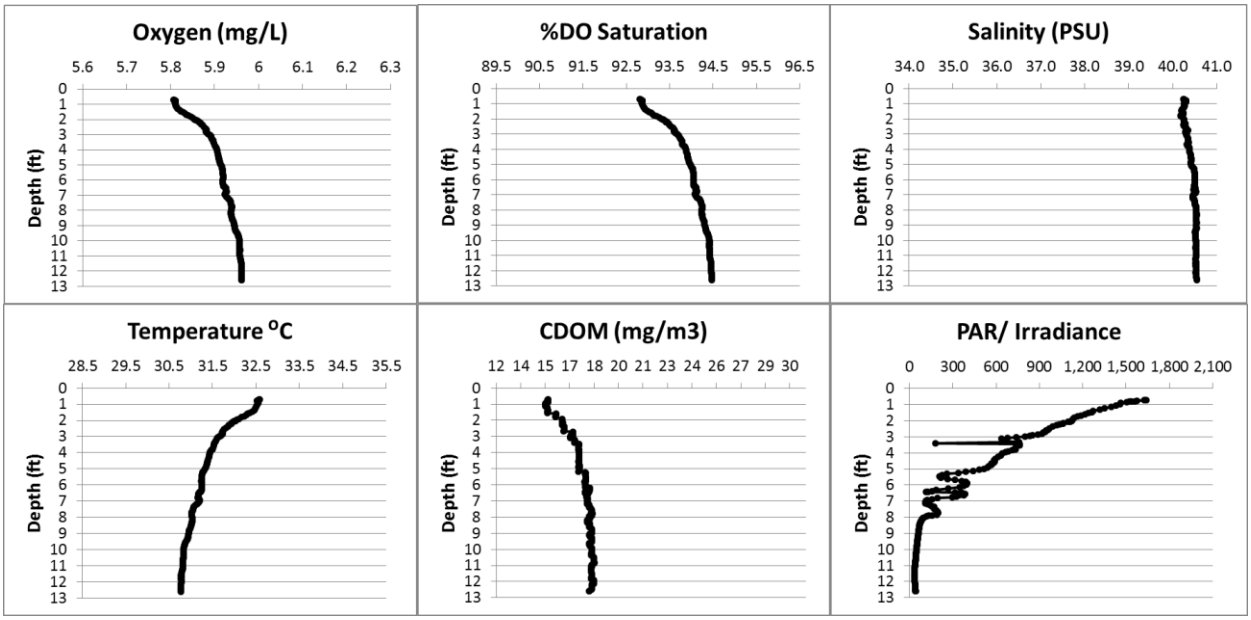

Figure 2.38. Profile of physicochemical properties of station No. 277B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation slightly vary by water depth and water remains well oxygenated, without exceeding the regulation levels (above 42% DO Saturation).

Salinity remains stable along the profile with values around 40

Water Temperature decreases slightly with water depth with a range of variation of about 2 °C.

Colored Dissolved Organic Matter increases downward from values between 15 to 18 mg m^{-3}.

Photosynthetically Active Radiation decreases with water depth from values around 1660 to 33 and has a vertical attenuation coefficient of 1.21.

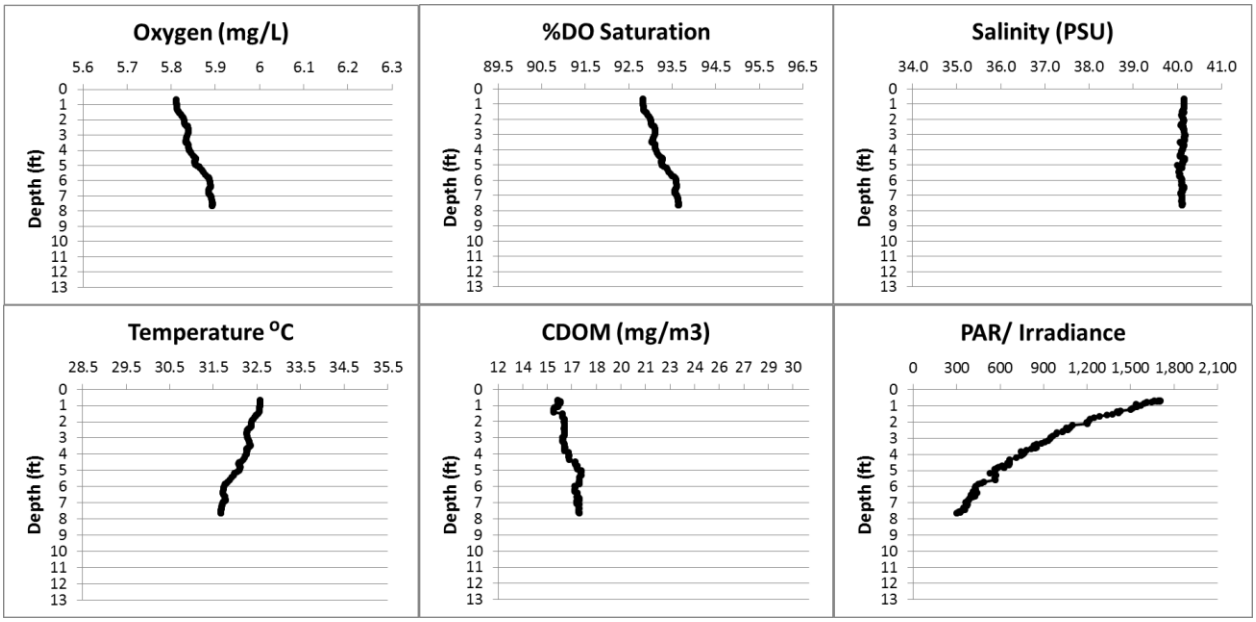

Figure 2.39. Profile of physicochemical properties of station No. 277C (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation slightly vary by water depth and water remains well oxygenated, without exceeding the regulation levels (above 42% DO Saturation).

Salinity remains stable along the profile, with values around 40

Water Temperature drops along the profile with a range of variation of about 1 °C.

Colored Dissolved Organic Matter increases along the profile from 15 to 17 mg m^{-3}.

Photosynthetically Active Radiation exponentially decreases with water depth and has a vertical attenuation coefficient of 0.78.

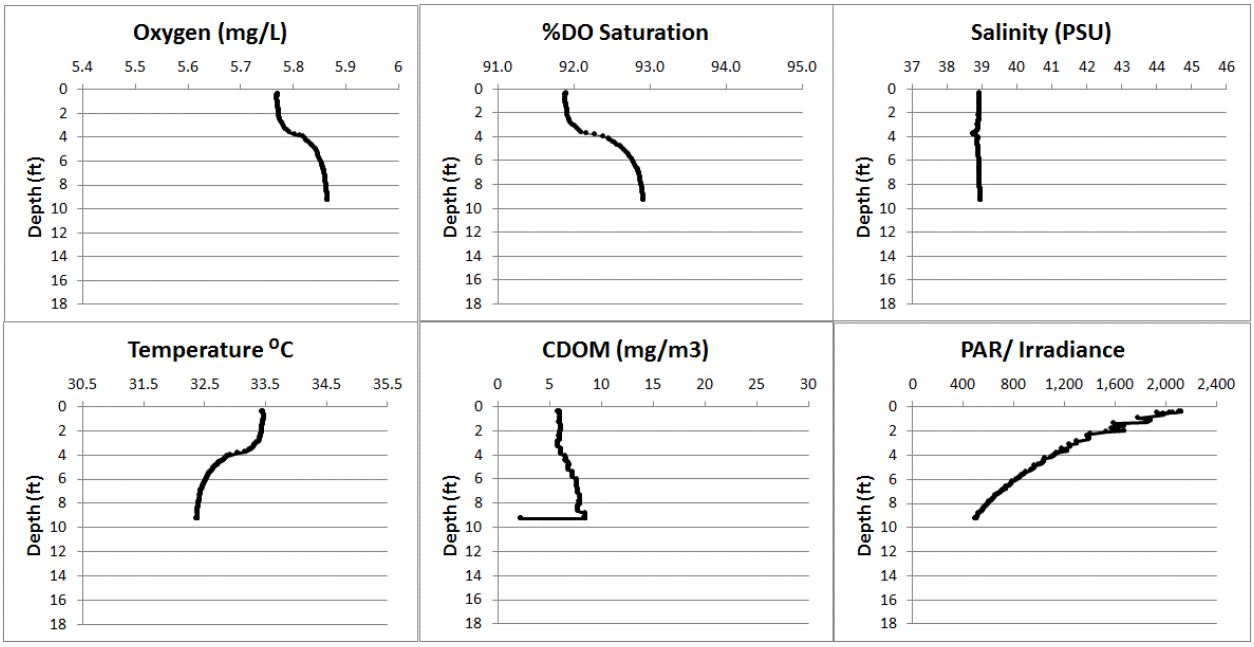

Figure 2.40. Profile of physicochemical properties of station No. 458A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 92% and within the regulation levels (values above 42% DO Saturation).

Salinity remains relatively stable with values around 39.

Water Temperature slightly decrease with a range of variations of about 1 °C.

Colored Dissolved Organic Matter ranges between 6 and 8 mg/m^3 and a sudden decrease is observed at the bottom of the profile.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 0.52.

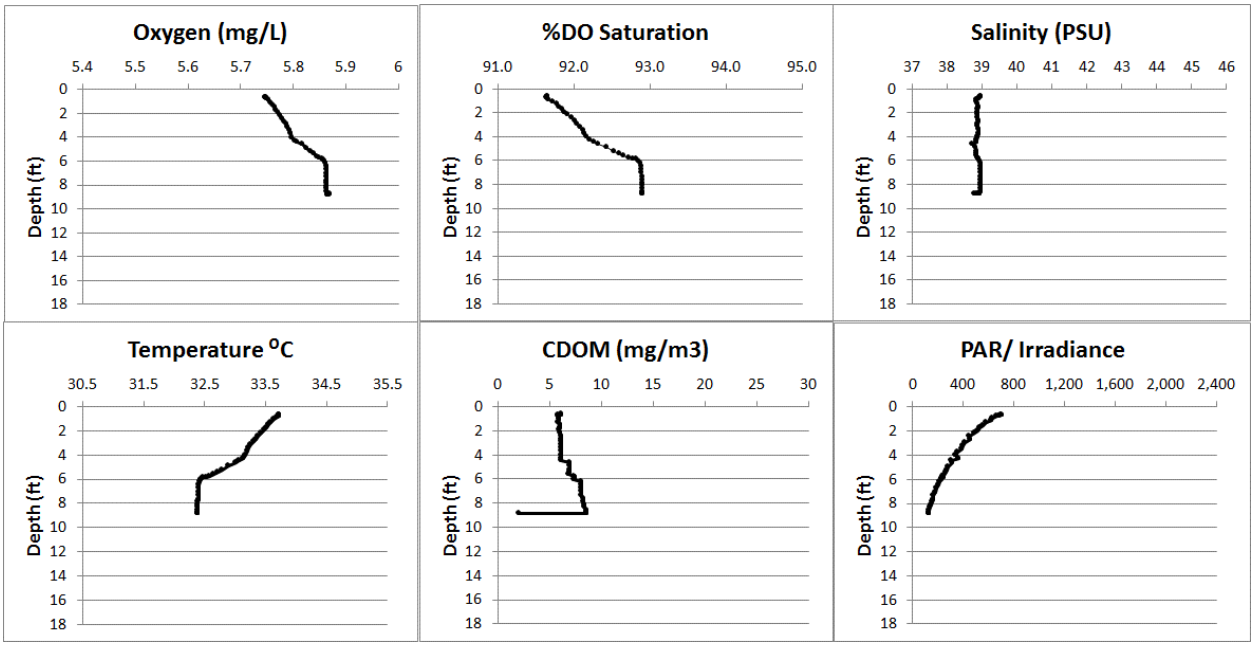

Figure 2.41. Profile of physicochemical properties of station No. 458B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 92% and within the regulation levels (values above 42% DO Saturation).

Salinity remains relatively stable with values around 39.

Water Temperature slightly decrease with a range of variations of about 1 °C.

Colored Dissolved Organic Matter ranges between 6 and 9 mg/m^3 and a sudden decrease is observed at the bottom of the profile.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 0.67.

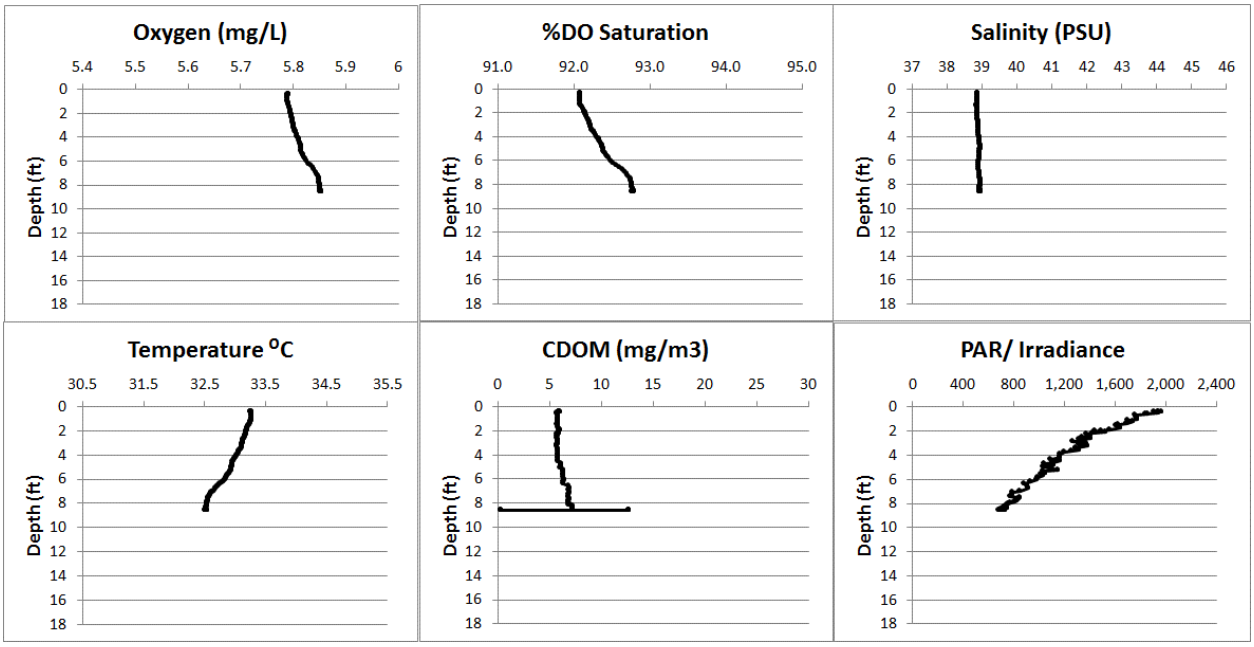

Figure 2.42. Profile of physicochemical properties of station No. 459A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 92% and within the regulation levels (values above 42% DO Saturation).

Salinity remains relatively stable with values around 39.

Water Temperature slightly decrease with a range of variations of about 1 °C.

Colored Dissolved Organic Matter ranges between 6 and 12 mg/m^3 and a sudden decrease is observed at the bottom of the profile.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 0.38.

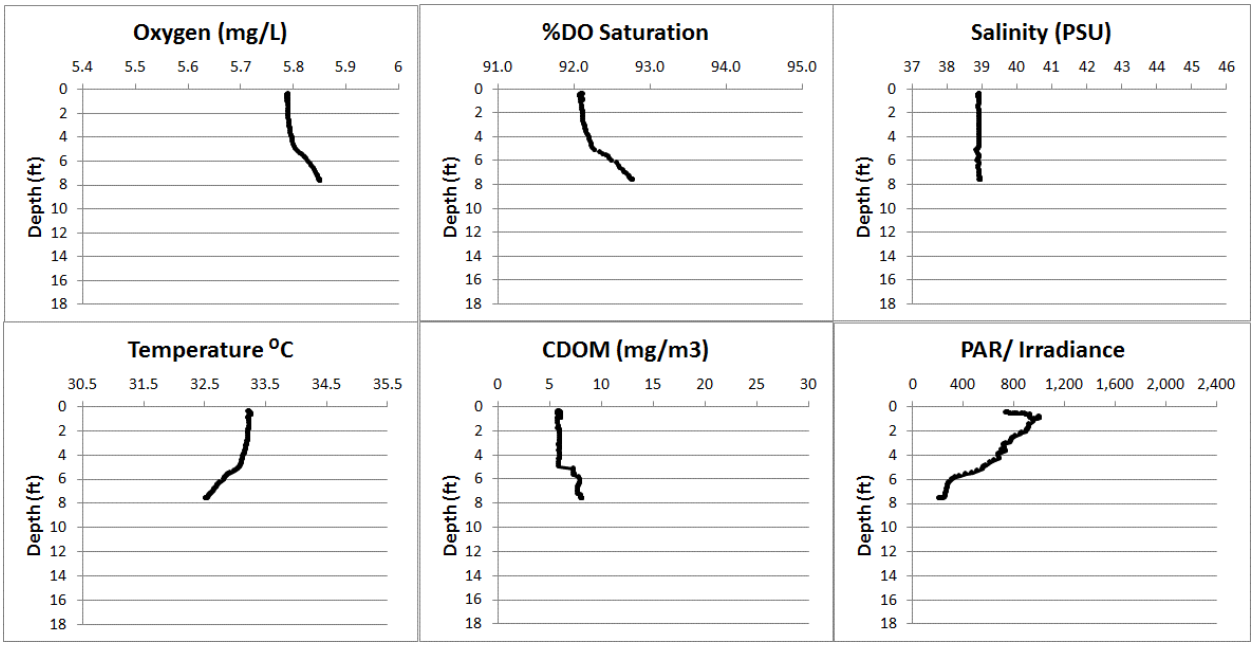

Figure 2.43. Profile of physicochemical properties of station No. 459B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 92% and within the regulation levels (values above 42% DO Saturation).

Salinity remains relatively stable with values around 39.

Water Temperature slightly decrease with a range of variations of less than 1 °C.

Colored Dissolved Organic Matter ranges between 6 and 8 mg/m^3.

Photosynthetically Active Radiation varies with water depth and has a vertical attenuation coefficient of 0.58.

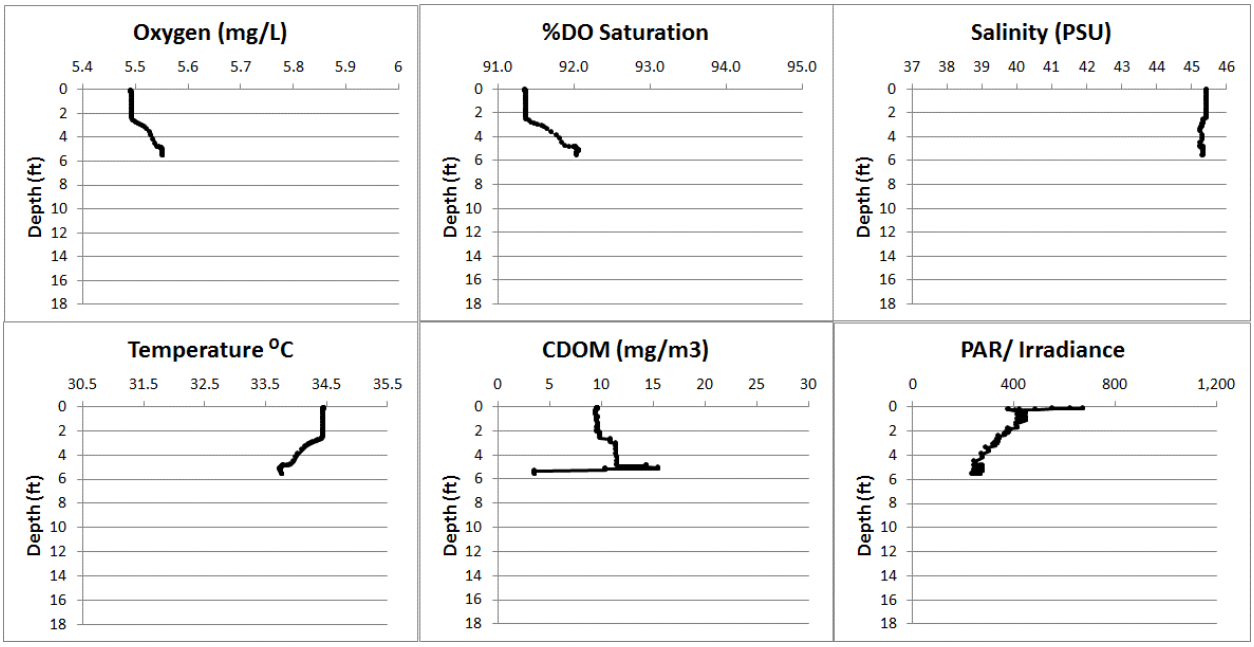

Figure 2.44. Profile of physicochemical properties of station No. 460A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated without exceeding the regulation levels (values above 42% DO Saturation).

Salinity remains relatively stable with values around 45.

Water Temperature slightly decrease with a range of variations of less than 1 °C.

Colored Dissolved Organic Matter ranges between 10 and 16 mg/m^3 and a sudden decrease is observed at the bottom of the profile.

Photosynthetically Active Radiation varies with water depth and has a vertical attenuation coefficient of 0.41.

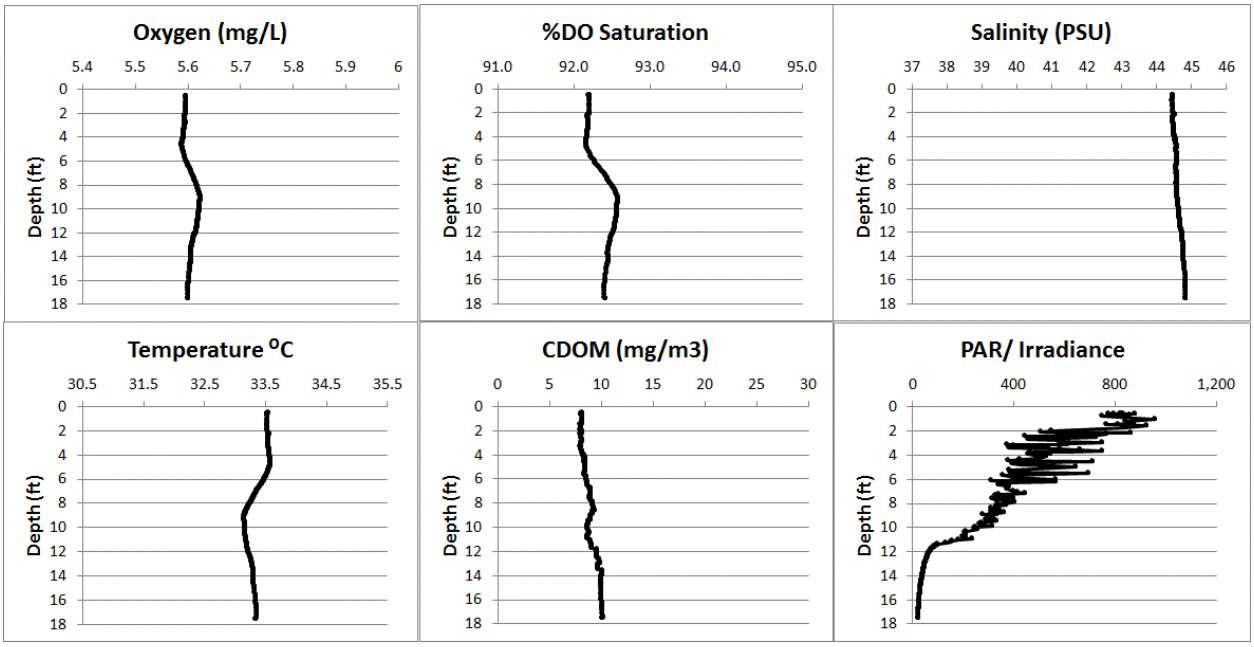

Figure 2.45. Profile of physicochemical properties of station No. 470A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 92% and within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values around 44.

Water Temperature remains very stable with values around 33 °C.

Colored Dissolved Organic Matter slightly increases throughout the profile from 8 to 10 mg/m^3.

Photosynthetically Active Radiation decreases with water depth with some oscillations and has a vertical attenuation coefficient of 0.74.

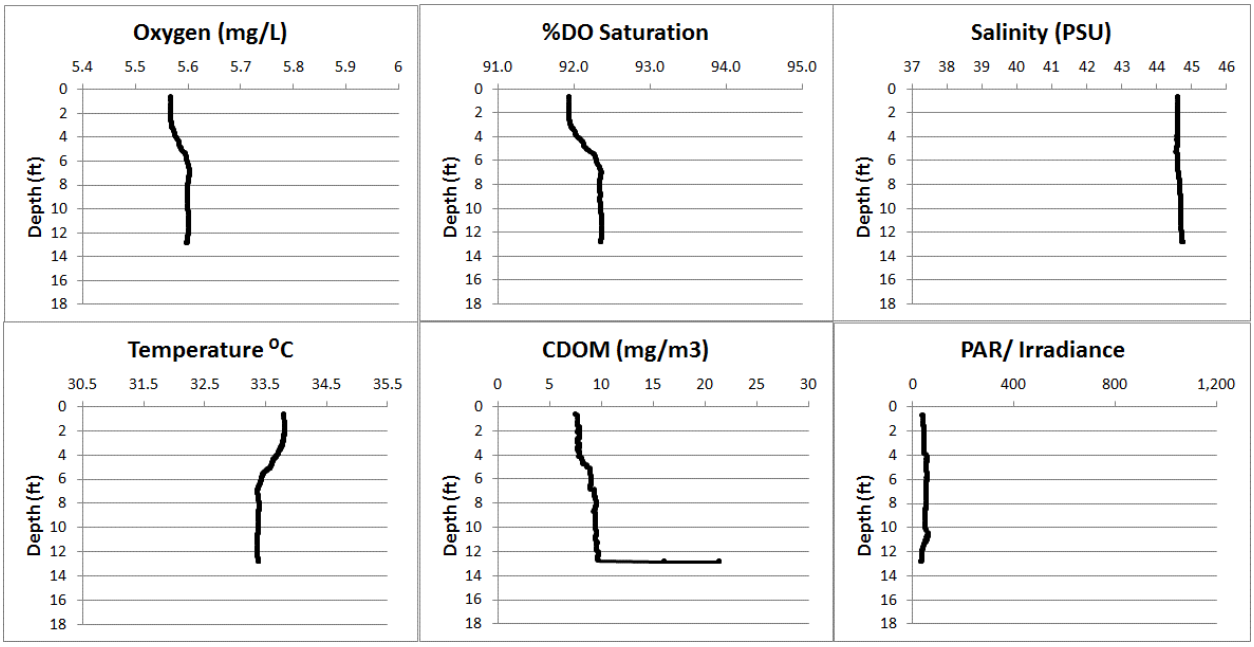

Figure 2.46. Profile of physicochemical properties of station No. 470B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with values around 92% and within the regulation levels (all values above 42% DO Saturation).

Salinity remains very stable with values close to 45.

Water Temperature remains very stable with values around 33.5 °C.

Colored Dissolved Organic Matter slightly increases throughout the profile from 8 to 10 mg/m^3.

Photosynthetically Active Radiation decreases with water depth with some oscillations and has a vertical attenuation coefficient of 0.74.

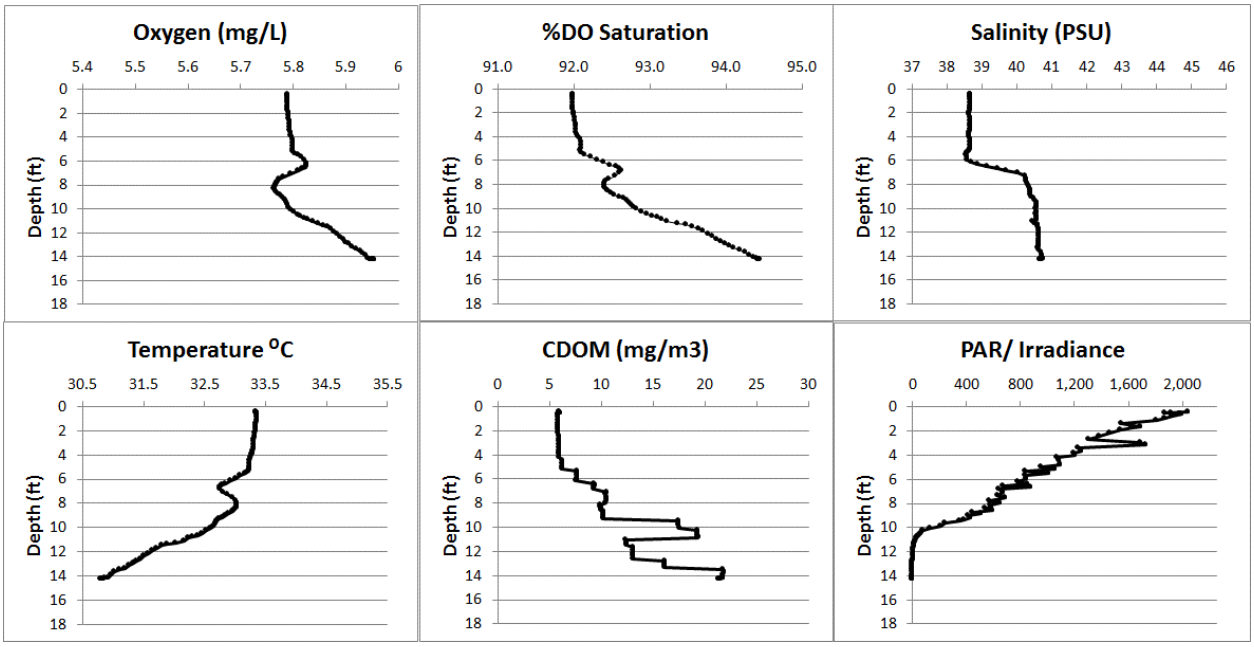

Figure 2.47. Profile of physicochemical properties of station No. 472A (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation do not change significantly and water remains well oxygenated with an average value of 92.8%, without exceeding the regulation levels (all values above 42% DO Saturation).

Salinity remains relatively stable with values around 38.8 until about 6 ft when the values increase.

Water Temperature drops along the profile with a range of variation of about 3 °C.

Colored Dissolved Organic Matter increases along the profile and shows a steep increase at about 10 ft.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 1.86.

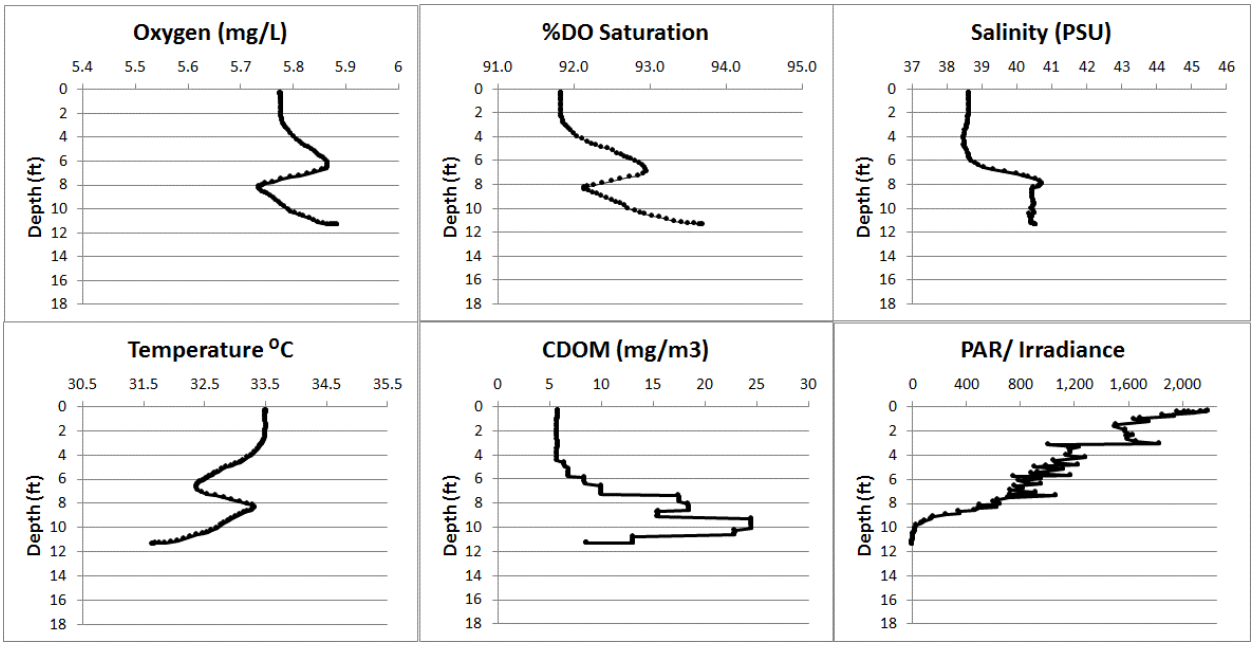

Figure 2.48. Profile of physicochemical properties of station No. 472B (FKC-04, Jun-July 2015)

Dissolved Oxygen and Oxygen saturation show a slight declining trend until about 7 ft, when values decrease followed by an increase. Water remains well oxygenated without exceeding the regulation levels (all values above 42% DO Saturation).

Salinity remains relatively stable with values around 38.6 until about 6 ft when the values increase and stabilize after 8 ft.

Water Temperature drops along the profile with a range of variation of about 2 °C.

Colored Dissolved Organic Matter increases along the profile and shows a steep increase at about 10 ft.

Photosynthetically Active Radiation decreases with water depth and has a vertical attenuation coefficient of 1.69.

Summary of associated files and datasets

1. Diel experiments

Survey No. 3

Associated file: DIEL FKC03

Survey No. 4

Associated file: DIEL FKC04

2. CTD Casts

Survey No. 3

Survey No.4

Associated file: CTD 001_002_003_004

PO950000_Task 3.1-2 SET test 2014-2015.The occurrence of values lower than those established by the Rule 62-302.533 of the Florida Administrative Code for Dissolved Oxygen has been the cause of impairment of most canal waters in the Florida Keys. According to this Rule for Class III predominantly marine waters, and Class III-Limited predominantly marine waters …"*Minimum DO saturation levels shall be as follows: ….The daily average percent DO saturation shall not be below 42 percent saturation in more than 10 percent of the values; and "a full day of diel data shall consist of 24 hours of measurements collected at a regular time interval of no longer than one hour*."

Additionally, according to this same Rule, "*…pH. Shall not vary more than one unit above or below natural background of predominantly fresh waters and coastal waters as defined in paragraph 62-302.520(3)(b), F.A.C. or more than two-tenths unit above or below natural background of open waters as defined in paragraph 62-302.520(3)(f), F.A.C., provided that the pH is not lowered to less than 6 units in predominantly fresh waters, or less than 6.5 units in predominantly marine waters."* Hence, to monitor compliance with the Rule, two YSI sondes (surface and bottom) were displayed to collect data (DO, %DO Saturation, Turbidity, Specific Conductivity, Salinity, Temperature and pH) every 15 minutes for the 24-hour diel experiments. Water samples were collected from surface (1 ft) and bottom (1 ft above canal bottom) of the water column using Niskin bottles. Water samples were analyzed for total nitrogen (TN), total phosphorus (TP), and Dissolved Inorganic Nitrogen (DIN) using standard laboratory methods described above. Finally, upon recommendation from FDEP and EPA consent, Enterococcus content was assessed with ENTEROLERT® for surface and bottom waters at one station per canal. Water quality monitoring program for Canals adhered to existing rules and regulations governing QA and QC procedures as described in EPA guidance documents, given that FIU-SERC Nutrient Laboratory maintains NELAP certification.