

SmartAqM Mobile App with ThingSpektral Cloud Integration

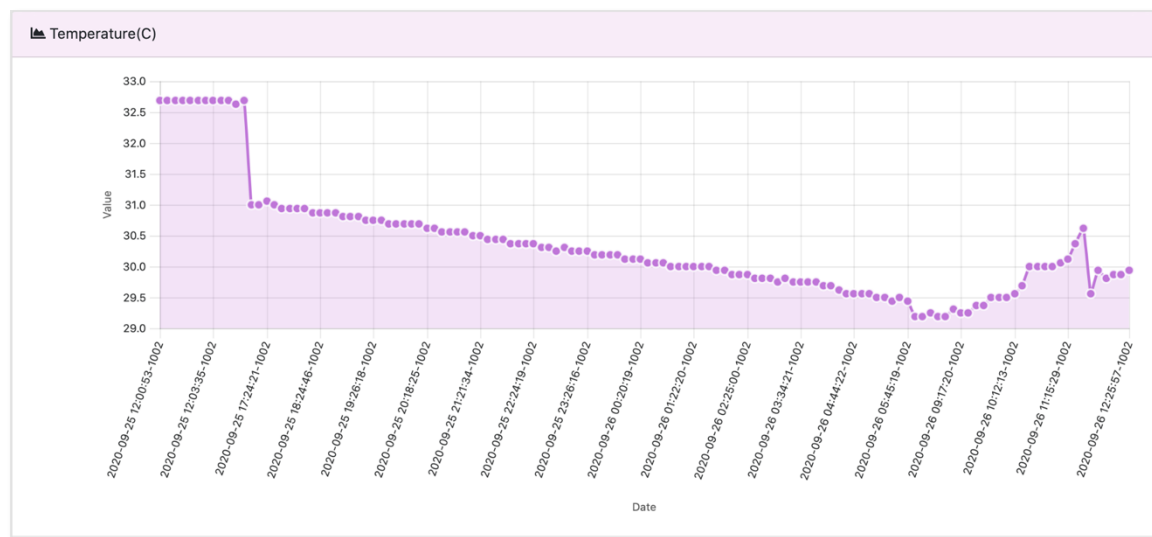
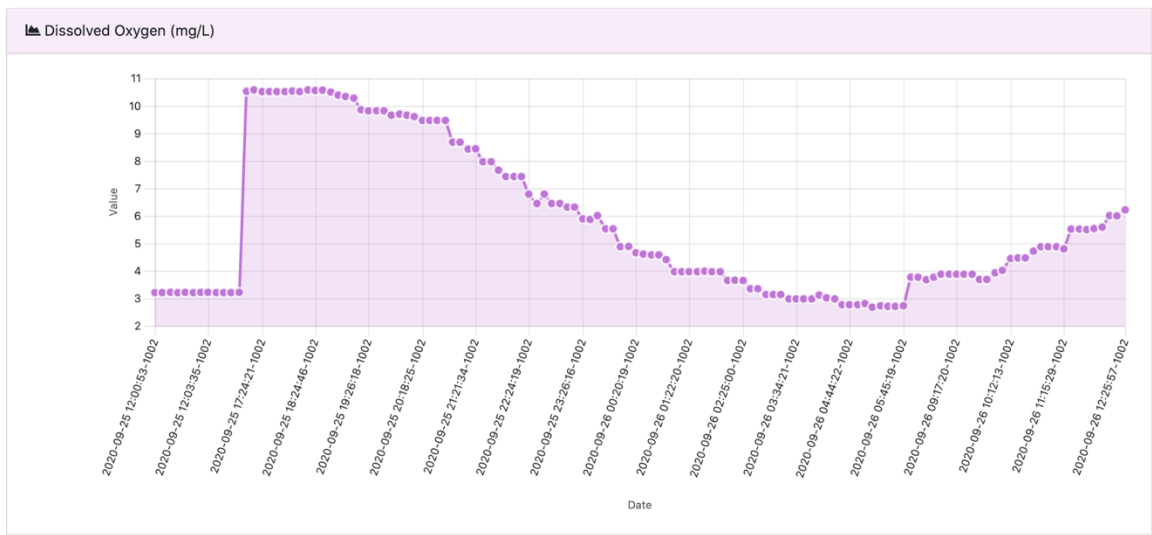
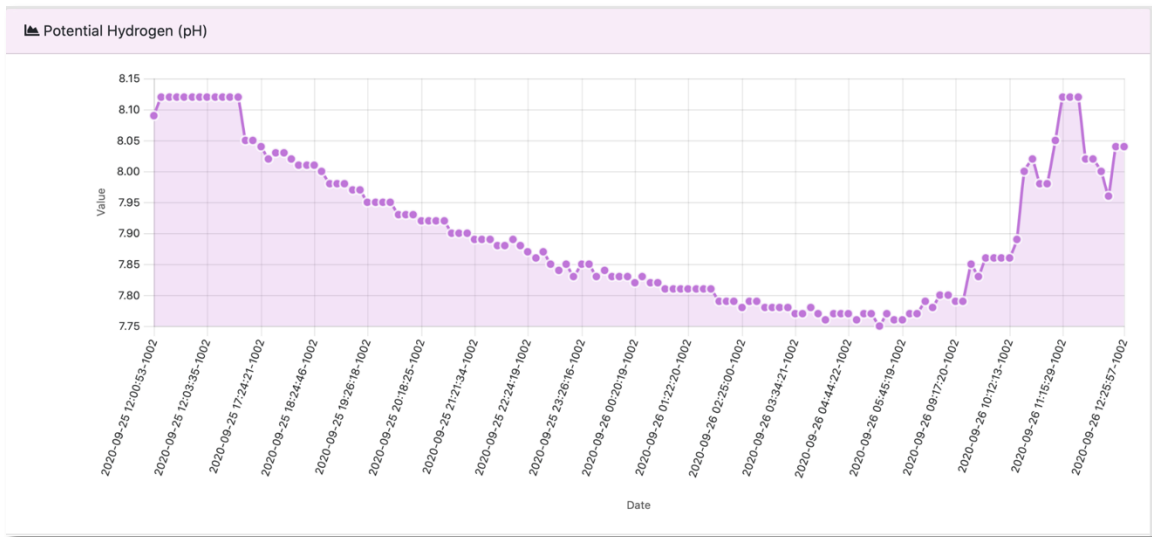
The SmartAqM mobile app has successfully integrated with ThingSpektral Cloud as a user3 (ThingSpektral USM's account) to push all sensor data of pH, Dissolved Oxygen (DO) and temperature into cloud database. USM was appointed by DFJ Livestock Sdn. Bhd. whom has been interested to participate in this project to install at one of their Talapia fish farm (around 200m² of each fish pond) in Bukit Selambau, Kedah from 01 September until 31 December 2020. One set of Smart Aquaculture Monitoring prototype of wireless sensor node and a reader are allowed and installed in there to autonomously monitor the fish pond water quality. USM agreed to install this project in there after considering a few main factors regarding the readiness of site facility. This site is well equipped with electric fencing, CCTV monitoring, internet WIFI and wired main power supply from TNB. Four dedicated workers are stationed on this fish farm.

The fish farm management (DFJ Livestock Sdn. Bhd.) has stressed out that the most critical water parameter to be concerned in preserving safe environment for Talapia farming are pH and dissolved oxygen level. Before installing this project, the conventional method was used to check the fish pond water quality. The frequency of water quality checking is twice a day using pH meter and DO meter. There are total four fish ponds in there and each of its water quality must be checked daily. Each of these fish ponds are also equipped with four aerator paddlewheels in order to sustain the fish pond oxygen level to achieve more than 2.00ppm all the time. These paddlewheels are mostly turned on during daytime and in specific time during night. In July of 2020, DFJ Livestock has experienced an unprecedented incident where they have lost around 2 tons of fish due to a critical sudden drop in dissolved oxygen levels of one of their fish pond. The last recorded dissolved oxygen was 0.67ppm which is far from allowed 2.5ppm. the pH level however is in safe range between 6 to 9.

Therefore, they are interested to involve in this project in monitoring their fish pond water quality with Smart Aquaculture Monitoring system. USM has successfully installed one set of this system there on 25 of September 2020. The first-time sensor capturing time interval was configured to transmit every 2 minutes. This event was to gather the initial fish pond water parameter level. The average of captured pH level was 8.12 and the DO level was 3.21ppm. After that, the measuring time interval was changed to capture the sensors data for every 8 minutes daily. Only two aerator paddlewheels were turned on during the initial measurement. After a while, total of four paddlewheels were operated where another 2 were also turned on in order to compare and analyze the current DO level with initial measurement. The average captured DO level was 10.5ppm from 5.00pm until 6.30pm. Two paddlewheels then were shut down at 7.00PM as normal routine for night operation period. However, starting 10.54PM onwards the DO level start decreasing and averaged at 2.42ppm until morning. The DO level keeps rising up on 26 September 2020 from 8.00am onward as the sunrise and four paddlewheels are operated. The pH level seems has same pattern with DO level. It will increase during the day when sunlight is most abundant but will decrease if otherwise.

As a conclusion from this result, the pH and DO level of this fish pond are most affected to the presence of daily sunlight. The pH level however only changes slightly during this monitoring which is between 7.75 and 8.12. The DO level turns out to be very noticeable between daylight which has the most sunlight compared to night time. The highest DO level is 10.58ppm during daytime and decreases to 2.68ppm only on night time. Based on this study, the current standard of procedure of aerator paddlewheel operation must be changed for better environment of Talapia fish pond and should be

decided by the fish farm management. Below are the screenshots of captured data of this result from ThingSpektral which is integrated with SmartAqM mobile application between 25 to 26 September 2020.



ThingSpektral (Data Log)/user3

Record	Date	Sensor Node	Potential Hydrogen (pH)	Dissolved Oxygen (mg/L)	Temperature(C)
4899	2020-09-25 12:00:53	1002	8.09	3.21	32.69
4900	2020-09-25 12:01:10	1002	8.12	3.21	32.69
4901	2020-09-25 12:01:35	1002	8.12	3.22	32.69
4902	2020-09-25 12:02:01	1002	8.12	3.21	32.69
4903	2020-09-25 12:02:28	1002	8.12	3.22	32.69
4904	2020-09-25 12:02:52	1002	8.12	3.21	32.69
4905	2020-09-25 12:03:10	1002	8.12	3.22	32.69
4906	2020-09-25 12:03:35	1002	8.12	3.22	32.69
4907	2020-09-25 12:04:36	1002	8.12	3.21	32.69
4908	2020-09-25 12:05:01	1002	8.12	3.21	32.69
4909	2020-09-25 12:05:27	1002	8.12	3.21	32.63
4910	2020-09-25 12:05:53	1002	8.12	3.22	32.69
4911	2020-09-25 17:09:16	1002	8.05	10.53	31
4912	2020-09-25 17:16:48	1002	8.05	10.58	31
4913	2020-09-25 17:24:21	1002	8.04	10.52	31.06
4914	2020-09-25 17:32:18	1002	8.02	10.52	31
4915	2020-09-25 17:47:00	1002	8.03	10.52	30.94
4916	2020-09-25 17:54:34	1002	8.03	10.52	30.94
4917	2020-09-25 18:02:17	1002	8.02	10.54	30.94
4918	2020-09-25 18:09:40	1002	8.01	10.52	30.94
4919	2020-09-25 18:18:16	1002	8.01	10.58	30.87
4920	2020-09-25 18:24:46	1002	8.01	10.56	30.87
4921	2020-09-25 18:32:19	1002	8	10.57	30.87
4922	2020-09-25 18:40:19	1002	7.98	10.5	30.87
4923	2020-09-25 18:47:24	1002	7.98	10.39	30.81
4924	2020-09-25	1002	7.98	10.34	30.81

Record	Date	Sensor Node	Potential Hydrogen (pH)	Dissolved Oxygen (mg/L)	Temperature(C)
	18:55:01				
4925	2020-09-25 19:10:17	1002	7.97	10.28	30.81
4926	2020-09-25 19:18:21	1002	7.97	9.86	30.75
4927	2020-09-25 19:26:18	1002	7.95	9.82	30.75
4928	2020-09-25 19:32:51	1002	7.95	9.82	30.75
4929	2020-09-25 19:40:24	1002	7.95	9.82	30.69
4930	2020-09-25 19:48:05	1002	7.95	9.66	30.69
4931	2020-09-25 19:56:17	1002	7.93	9.7	30.69
4932	2020-09-25 20:04:18	1002	7.93	9.66	30.69
4933	2020-09-25 20:10:53	1002	7.93	9.61	30.69
4934	2020-09-25 20:18:25	1002	7.92	9.47	30.62
4935	2020-09-25 20:26:20	1002	7.92	9.47	30.62
4936	2020-09-25 20:33:40	1002	7.92	9.47	30.56
4937	2020-09-25 20:41:21	1002	7.92	9.47	30.56
4938	2020-09-25 20:58:22	1002	7.9	8.68	30.56
4939	2020-09-25 21:06:17	1002	7.9	8.68	30.56
4940	2020-09-25 21:14:18	1002	7.9	8.43	30.5
4941	2020-09-25 21:21:34	1002	7.89	8.44	30.5
4942	2020-09-25 21:29:15	1002	7.89	7.97	30.44
4943	2020-09-25 21:44:47	1002	7.89	7.97	30.44
4944	2020-09-25 21:52:28	1002	7.88	7.66	30.44
4945	2020-09-25 22:00:18	1002	7.88	7.43	30.37
4946	2020-09-25 22:08:19	1002	7.89	7.43	30.37
4947	2020-09-25 22:15:33	1002	7.88	7.43	30.37
4948	2020-09-25 22:24:19	1002	7.87	6.79	30.37
4949	2020-09-25 22:38:55	1002	7.86	6.45	30.31
4950	2020-09-25 22:46:36	1002	7.87	6.79	30.31

Record	Date	Sensor Node	Potential Hydrogen (pH)	Dissolved Oxygen (mg/L)	Temperature(C)
4951	2020-09-25 22:54:18	1002	7.85	6.45	30.25
4952	2020-09-25 23:02:19	1002	7.84	6.45	30.31
4953	2020-09-25 23:09:41	1002	7.85	6.32	30.25
4954	2020-09-25 23:18:18	1002	7.83	6.32	30.25
4955	2020-09-25 23:26:16	1002	7.85	5.89	30.25
4956	2020-09-25 23:32:54	1002	7.85	5.87	30.19
4957	2020-09-25 23:40:36	1002	7.83	6.01	30.19
4958	2020-09-25 23:48:19	1002	7.84	5.53	30.19
4959	2020-09-25 23:55:59	1002	7.83	5.53	30.19

ThingSpektral (Data Log)/user3

Record	Date	Sensor Node	Potential Hydrogen (pH)	Dissolved Oxygen (mg/L)	Temperature(C)
4960	2020-09-26 00:04:17	1002	7.83	4.88	30.12
4961	2020-09-26 00:12:20	1002	7.83	4.89	30.12
4962	2020-09-26 00:20:19	1002	7.82	4.66	30.12
4963	2020-09-26 00:26:53	1002	7.83	4.61	30.06
4964	2020-09-26 00:34:26	1002	7.82	4.58	30.06
4965	2020-09-26 00:49:49	1002	7.82	4.58	30.06
4966	2020-09-26 00:58:20	1002	7.81	4.41	30
4967	2020-09-26 01:06:17	1002	7.81	3.97	30
4968	2020-09-26 01:14:16	1002	7.81	3.97	30
4969	2020-09-26 01:22:20	1002	7.81	3.97	30
4970	2020-09-26 01:29:25	1002	7.81	3.97	30
4971	2020-09-26 01:37:07	1002	7.81	3.99	30
4972	2020-09-26 01:54:16	1002	7.81	3.97	29.94
4973	2020-09-26 02:01:47	1002	7.79	3.97	29.94
4974	2020-09-26 02:10:18	1002	7.79	3.65	29.87
4975	2020-09-26 02:17:18	1002	7.79	3.66	29.87
4976	2020-09-26 02:25:00	1002	7.78	3.65	29.87
4977	2020-09-26 02:40:17	1002	7.79	3.35	29.81
4978	2020-09-26 02:48:18	1002	7.79	3.35	29.81
4979	2020-09-26 02:56:18	1002	7.78	3.14	29.81
4980	2020-09-26 03:03:36	1002	7.78	3.14	29.75
4981	2020-09-26 03:11:18	1002	7.78	3.14	29.81
4982	2020-09-26 03:18:58	1002	7.78	2.98	29.75
4983	2020-09-26 03:34:21	1002	7.77	2.98	29.75
4984	2020-09-26 03:42:21	1002	7.77	2.98	29.75
4985	2020-09-26	1002	7.78	2.98	29.75

Record	Date	Sensor Node	Potential Hydrogen (pH)	Dissolved Oxygen (mg/L)	Temperature(C)
	03:50:21				
4986	2020-09-26 03:57:34	1002	7.77	3.12	29.69
4987	2020-09-26 04:05:24	1002	7.76	3.02	29.69
4988	2020-09-26 04:28:29	1002	7.77	2.98	29.62
4989	2020-09-26 04:36:09	1002	7.77	2.77	29.56
4990	2020-09-26 04:44:22	1002	7.77	2.77	29.56
4991	2020-09-26 04:51:31	1002	7.76	2.77	29.56
4992	2020-09-26 04:59:14	1002	7.77	2.81	29.56
4993	2020-09-26 05:14:36	1002	7.77	2.68	29.5
4994	2020-09-26 05:22:19	1002	7.75	2.73	29.5
4995	2020-09-26 05:30:18	1002	7.77	2.71	29.44
4996	2020-09-26 05:37:40	1002	7.76	2.71	29.5
4997	2020-09-26 05:45:19	1002	7.76	2.73	29.44
4998	2020-09-26 08:15:25	1002	7.77	3.77	29.19
4999	2020-09-26 08:23:15	1002	7.77	3.77	29.19
5000	2020-09-26 08:38:48	1002	7.79	3.68	29.25
5001	2020-09-26 08:46:30	1002	7.78	3.77	29.19
5002	2020-09-26 08:54:19	1002	7.8	3.88	29.19
5003	2020-09-26 09:09:37	1002	7.8	3.88	29.31
5004	2020-09-26 09:17:20	1002	7.79	3.88	29.25
5005	2020-09-26 09:26:20	1002	7.79	3.88	29.25
5006	2020-09-26 09:32:53	1002	7.85	3.88	29.37
5007	2020-09-26 09:40:45	1002	7.83	3.69	29.37
5008	2020-09-26 09:48:37	1002	7.86	3.69	29.5
5009	2020-09-26 09:56:28	1002	7.86	3.93	29.5
5010	2020-09-26 10:04:21	1002	7.86	4.02	29.5
5011	2020-09-26 10:12:13	1002	7.86	4.45	29.56

Record	Date	Sensor Node	Potential Hydrogen (pH)	Dissolved Oxygen (mg/L)	Temperature(C)
5012	2020-09-26 10:20:19	1002	7.89	4.47	29.69
5013	2020-09-26 10:28:20	1002	8	4.47	30
5014	2020-09-26 10:43:45	1002	8.02	4.72	30
5015	2020-09-26 10:51:44	1002	7.98	4.88	30
5016	2020-09-26 11:00:24	1002	7.98	4.88	30
5017	2020-09-26 11:08:21	1002	8.05	4.88	30.06
5018	2020-09-26 11:15:29	1002	8.12	4.8	30.12
5019	2020-09-26 11:23:11	1002	8.12	5.52	30.37
5020	2020-09-26 11:31:04	1002	8.12	5.52	30.62
5021	2020-09-26 11:38:57	1002	8.02	5.5	29.56
5022	2020-09-26 11:54:44	1002	8.02	5.54	29.94
5023	2020-09-26 12:02:27	1002	8	5.59	29.81
5024	2020-09-26 12:10:19	1002	7.96	6.01	29.87
5025	2020-09-26 12:18:23	1002	8.04	6	29.87
5026	2020-09-26 12:25:57	1002	8.04	6.22	29.94

ThingSpektral (Data Log)/user5 (capture by UTP)

Record	Date	Sensor Node	Potential Hydrogen (pH)	Dissolved Oxygen (mg/L)	Temperature (°C)
4898	2020-09-25 08:55:31	1002	7.12	12.12	30.01
6722	2020-10-20 17:18:24	1002	9.41	3.42	30.44
6723	2020-10-20 17:45:26	1002	9.43	2.81	30.44
6724	2020-10-20 18:12:29	1002	9.45	2.43	27.81
6726	2020-10-20 18:39:31	1002	9.46	2.18	27.81
6727	2020-10-20 20:59:25	1002	8.36	0.03	24.62
6732	2020-10-21 10:58:47	1002	6.17	38.2	23.81
6733	2020-10-21 10:59:38	1002	6.13	38.19	23.75
6734	2020-10-21 11:00:14	1002	6.1	38.19	23.69
6781	2020-10-25 11:25:56	1002	11.99	38.19	31.25
6782	2020-10-25 11:32:47	1002	12.1	38.19	33.25
6783	2020-10-25 11:37:13	1002	12.1	38.19	32.06
6784	2020-10-25 12:02:04	1002	12.09	38.19	30.56
6785	2020-10-25 12:06:38	1002	12.11	38.19	33.06
6786	2020-10-25 12:26:11	1002	12.11	38.19	31.62
6787	2020-10-25 13:43:26	1002	9.9	38.19	29.44
6788	2020-10-25 13:50:33	1002	9.75	38.19	29.31
6789	2020-10-25 13:57:40	1002	9.63	38.19	29.06
6790	2020-10-25 14:04:51	1002	9.43	38.19	30.81
6791	2020-10-25 14:36:40	1002	9.29	38.19	30.69
6792	2020-10-25 14:43:49	1002	9.25	38.19	30.37
6793	2020-10-25 14:50:56	1002	9.21	38.19	30.31
6794	2020-10-25 14:58:06	1002	9.13	38.19	30.19
6795	2020-10-25 15:05:12	1002	9.09	38.19	29.56
6796	2020-10-25 15:12:25	1002	9.06	38.19	27.94
6797	2020-10-25 15:19:30	1002	8.97	38.19	27.44
6798	2020-10-25 15:26:36	1002	8.82	38.19	26.56
6799	2020-10-25 15:33:42	1002	8.67	38.19	26.06
6800	2020-10-25 15:40:56	1002	8.46	38.19	25.69
6801	2020-10-25 15:48:00	1002	8.24	38.19	25.5
6802	2020-10-25 15:55:08	1002	8.04	38.19	24.62
6803	2020-10-25 16:09:17	1002	7.61	38.19	24

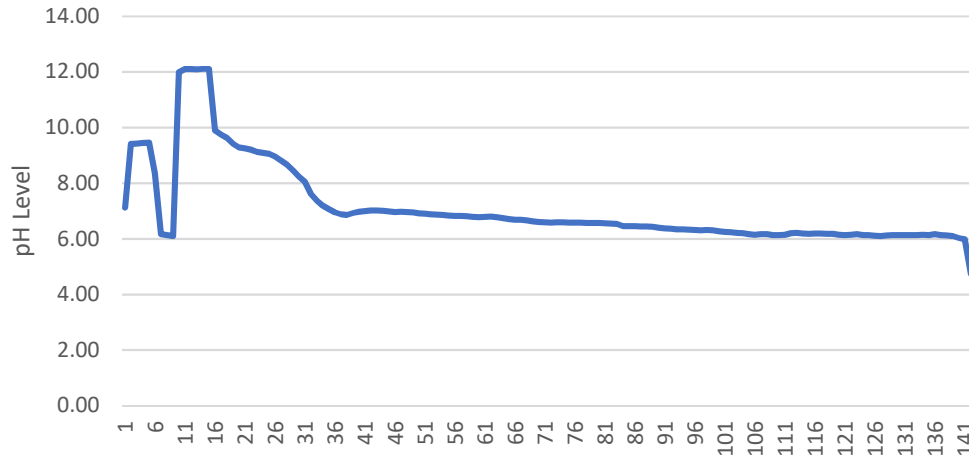
6804	2020-10-25 16:16:24	1002	7.37	38.19	24.06
6805	2020-10-25 16:23:31	1002	7.19	38.19	24.25
6806	2020-10-25 16:30:37	1002	7.07	38.19	24.06
6810	2020-10-25 16:38:00	1002	6.95	38.19	24.37
6812	2020-10-25 16:45:24	1002	6.88	38.19	24.56
6814	2020-10-25 16:52:30	1002	6.86	38.19	24.75
6816	2020-10-25 16:59:37	1002	6.93	38.19	24.81
6817	2020-10-25 17:06:44	1002	6.97	38.19	24.75
6819	2020-10-25 17:14:07	1002	7	38.19	24.81
6821	2020-10-25 17:21:14	1002	7.02	38.19	24.75
6823	2020-10-25 17:28:37	1002	7.02	38.19	24.81
6825	2020-10-25 17:35:46	1002	7.01	38.19	24.81
6827	2020-10-25 17:42:51	1002	6.99	38.19	24.94
6829	2020-10-25 17:50:14	1002	6.96	38.19	25
6831	2020-10-25 17:57:37	1002	6.98	38.18	25.06
6833	2020-10-25 18:04:44	1002	6.96	38.18	25.25
6835	2020-10-25 18:11:50	1002	6.95	38.18	25.31
6837	2020-10-25 18:18:57	1002	6.92	38.18	25.37
6839	2020-10-25 18:26:05	1002	6.91	38.18	25.44
6840	2020-10-25 18:33:11	1002	6.88	38.18	25.5
6842	2020-10-25 18:40:18	1002	6.87	38.18	25.56
6843	2020-10-25 18:47:24	1002	6.86	38.19	25.56
6845	2020-10-25 18:54:31	1002	6.84	38.19	25.56
6847	2020-10-25 19:01:54	1002	6.83	38.19	25.62
6849	2020-10-25 19:09:01	1002	6.82	38.19	25.56
6851	2020-10-25 19:16:12	1002	6.81	38.19	25.56
6853	2020-10-25 19:23:14	1002	6.79	38.19	25.5
6855	2020-10-25 19:30:22	1002	6.78	38.19	25.56
6857	2020-10-25 19:37:28	1002	6.79	38.19	25.56
6859	2020-10-25 19:44:35	1002	6.8	38.19	25.56
6861	2020-10-25 19:51:42	1002	6.78	38.19	25.5
6863	2020-10-25 19:58:48	1002	6.75	38.19	25.5
6865	2020-10-25 20:06:14	1002	6.71	38.19	25.44
6867	2020-10-25 20:13:42	1002	6.69	38.19	25.44

6869	2020-10-25 20:20:59	1002	6.69	38.19	25.37
6870	2020-10-25 20:28:06	1002	6.66	38.19	25.31
6872	2020-10-25 20:35:17	1002	6.63	38.19	25.31
6874	2020-10-25 20:42:36	1002	6.61	38.19	25.44
6876	2020-10-25 20:49:59	1002	6.59	38.19	25.44
6878	2020-10-25 20:57:05	1002	6.58	38.19	25.37
6880	2020-10-25 21:04:11	1002	6.59	38.19	25.37
6882	2020-10-25 21:11:34	1002	6.59	38.19	25.37
6884	2020-10-25 21:18:44	1002	6.58	38.19	25.37
6886	2020-10-25 21:25:47	1002	6.58	38.19	25.37
6888	2020-10-25 21:33:10	1002	6.58	38.19	25.37
6890	2020-10-25 21:40:19	1002	6.57	38.19	25.37
6892	2020-10-25 21:47:40	1002	6.57	38.19	25.31
6894	2020-10-25 21:55:03	1002	6.57	38.19	25.25
6896	2020-10-25 22:02:29	1002	6.56	38.19	25.25
6898	2020-10-25 22:09:32	1002	6.55	38.19	25.25
6900	2020-10-25 22:16:56	1002	6.54	38.19	25.25
6901	2020-10-25 22:24:03	1002	6.46	38.19	25.37
6903	2020-10-25 22:31:09	1002	6.46	38.19	25.37
6905	2020-10-25 22:38:16	1002	6.46	38.19	25.31
6907	2020-10-25 22:45:40	1002	6.45	38.19	25.31
6909	2020-10-25 22:52:45	1002	6.44	38.19	25.31
6911	2020-10-25 23:00:08	1002	6.43	38.19	25.19
6913	2020-10-25 23:07:32	1002	6.4	38.19	25.19
6915	2020-10-25 23:14:37	1002	6.38	38.19	25.19
6917	2020-10-25 23:21:44	1002	6.36	38.19	25.19
6919	2020-10-25 23:28:53	1002	6.34	38.19	25.19
6921	2020-10-25 23:36:14	1002	6.34	38.19	25.19
6923	2020-10-25 23:43:39	1002	6.33	38.19	25.25
6925	2020-10-25 23:50:43	1002	6.32	38.19	25.19
6927	2020-10-25 23:58:06	1002	6.31	38.19	25.25
6929	2020-10-26 00:05:29	1002	6.32	38.19	25.12
6931	2020-10-26 00:12:36	1002	6.31	38.19	25.19
6932	2020-10-26 00:19:46	1002	6.27	38.19	25.12

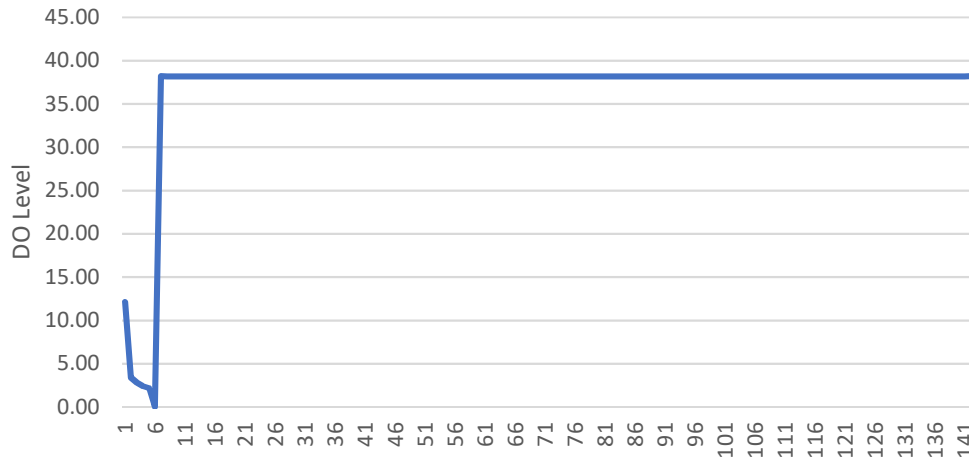
6934	2020-10-26 00:27:05	1002	6.25	38.19	25.12
6936	2020-10-26 00:34:13	1002	6.24	38.19	25.12
6938	2020-10-26 00:41:17	1002	6.22	38.19	25
6940	2020-10-26 00:48:41	1002	6.2	38.19	25
6942	2020-10-26 00:56:04	1002	6.17	38.19	25
6944	2020-10-26 01:03:27	1002	6.15	38.19	24.94
6946	2020-10-26 01:10:50	1002	6.17	38.19	25
6948	2020-10-26 01:17:56	1002	6.17	38.19	25
6950	2020-10-26 01:25:03	1002	6.13	38.19	25.06
6952	2020-10-26 01:32:09	1002	6.13	38.19	25.12
6954	2020-10-26 01:39:16	1002	6.15	38.19	25.06
6956	2020-10-26 01:46:39	1002	6.2	38.19	25
6958	2020-10-26 01:54:02	1002	6.21	38.19	25.06
6960	2020-10-26 02:01:24	1002	6.19	38.19	25.06
6962	2020-10-26 02:08:48	1002	6.18	38.19	25.06
6964	2020-10-26 02:16:15	1002	6.19	38.19	24.94
6966	2020-10-26 02:23:17	1002	6.19	38.19	24.94
6967	2020-10-26 02:30:40	1002	6.18	38.19	24.81
6969	2020-10-26 02:37:46	1002	6.18	38.19	24.87
6971	2020-10-26 02:45:09	1002	6.15	38.19	24.87
6973	2020-10-26 02:52:32	1002	6.14	38.19	24.94
6975	2020-10-26 02:59:55	1002	6.15	38.19	24.87
6977	2020-10-26 03:07:01	1002	6.17	38.19	24.94
6979	2020-10-26 03:14:08	1002	6.14	38.19	24.81
6981	2020-10-26 03:21:30	1002	6.13	38.19	24.94
6983	2020-10-26 03:28:37	1002	6.11	38.19	25
6985	2020-10-26 03:36:01	1002	6.1	38.19	24.94
6987	2020-10-26 03:43:23	1002	6.12	38.19	25
6989	2020-10-26 03:50:53	1002	6.13	38.19	25
6991	2020-10-26 03:58:08	1002	6.14	38.19	24.87
6993	2020-10-26 04:05:31	1002	6.14	38.19	25
6995	2020-10-26 04:12:40	1002	6.13	38.19	25.06
6997	2020-10-26 04:20:01	1002	6.14	38.19	25
6999	2020-10-26 04:27:07	1002	6.15	38.19	25

7001	2020-10-26 04:34:16	1002	6.14	38.19	24.94
7002	2020-10-26 04:41:37	1002	6.17	38.19	24.87
7004	2020-10-26 04:49:00	1002	6.14	38.19	24.87
7006	2020-10-26 04:56:23	1002	6.12	38.19	24.75
7008	2020-10-26 05:03:45	1002	6.1	38.19	24.81
7010	2020-10-26 05:10:51	1002	6.03	38.19	24.75
7012	2020-10-26 05:18:14	1002	5.98	38.19	24.81
7013	2020-10-26 08:18:31	1002	4.74	38.2	25

Potential Hydrogen (pH)



Dissolved Oxygen (mg/L)



Temperature (°C)

