

Final 2018 Kenai River Turbidity Monitoring Project Report



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Report

Executive Summary

ADEC initially proposed to list 7.5 miles of the lower Kenai River as being impaired by turbidity (applicable criteria are exceeded) for the designated uses of contact recreation, drinking water and secondary recreation in the Public Notice Draft 2014/2016 Integrated Water Quality Monitoring and Assessment Report Integrated Report (2014/16 IR) (December 2017)¹ based on data from Kenai Watershed Forum (KWF) 2008-2010 Turbidity Monitoring Study. Several comments received during the public notice comment period indicated that river use practices on the lower Kenai River have changed since the 2008-2010 Turbidity Monitoring Study. Most comments included information about how the recreational fishery is now primarily a Sockeye salmon sport fishery instead of a Chinook salmon sport fishery and that motorized boats are operated differently to target the different salmon species. Other comments stated that new boat motor regulations, implemented after 2010, may have lowered turbidity.

In response to these comments ADEC requested that KWF monitor turbidity in the Kenai River for a consecutive two-week period in July 16–31, 2018 (2018 monitoring). The 2018 turbidity monitoring project was undertaken as part of an Alaska Clean Water Actions (ACWA) grant. The purpose of the 2018 monitoring was to perform a limited investigation on the present-day turbidity profile of the lower Kenai River. This monitoring was not intended to replicate the complete methodology employed in the 2008-2010 KWF Turbidity Monitoring Study² (nor did it meet all of the requirements of the turbidity Listing Methodology for Determining Water Quality Impairments from Turbidity³ (three week, two year data set minimum).

Analysis of the 2018 turbidity data was unable to confirm the previous impairment nor does the study indicate attainment of the turbidity criteria in the lower Kenai River. While the study was limited, the data does suggest turbidity patterns on the lower Kenai River were different in 2018 due to changes in the fishery and boat use patterns. Average daily values ranged from 4.2 to 28.7 NTUs. At these low values, instrument accuracy is reported at 5 NTU. When the accuracy of the instruments is taken into consideration ADEC is unable to determine if the average daily value exceed the threshold of turbidity impairment for the most stringent water quality criteria (e.g., greater than 5 NTU over natural condition for drinking water and contact recreation).

Therefore, the final 2014/16 IR leaves the lower Kenai River in Category 3 (insufficient information) for turbidity until further information becomes available to reassess the current condition of the river. ADEC will work with local stakeholders to create a prioritized watershed plan to address potential water quality issues affecting the Kenai River.

¹ <http://dec.alaska.gov/water/water-quality/integrated-report/>

² KWF.2012.Turbidity Monitoring on the Lower Kenai River, 2008-2010, prepared for the Alaska Department of Environmental Conservation

³ <http://dec.alaska.gov/water/wqsar/waterbody/docs/turbidity-listing-methodology-final-09-09-2016.pdf>

Introduction

This study was funded in part by funding from ADEC through ACWA grants and the data resulting from this study was used in the turbidity impairment assessment for the ADEC's 2014/16 IR.

KWF/ADEC's 2018 limited turbidity monitoring project endeavored to replicate the field conditions employed in the 2008-2010 KWF Turbidity Monitoring Study, in order to make data assessment comparisons between the two studies as reliable as possible. The purpose, methodology, and conclusions from KWF's 2008-2010 turbidity monitoring study are summarized below.

Comparison of Turbidity Studies: KWF 2008 – 2010 and KWF/ ADEC 2018

2008 – 2010 KWF Turbidity Study

Purpose

During the month of July in 2008-2010, the KWF monitored turbidity at several sites on the lower Kenai River. The objectives of this three-year study were to: (1) observe and determine key characteristics of turbidity in the lower Kenai River; (2) collect relevant data to define baseline conditions for turbidity in the lower Kenai River; and (3) to analyze how often if ever, ADEC water quality standards for turbidity were exceeded at each sampling location.

Methodology

Turbidity was monitored at several locations in the lower Kenai River, but was monitored at two locations continuously through the month of July during all three years of the 2008 – 2010 KWF Turbidity Study. The two locations where turbidity was continually monitored were at River Mile (RM) 23 and RM 11.5. RM 23 was selected as a natural conditions site because the site does not receive heavy boat traffic, has comparable biologic and hydrologic conditions, and although it is outside the tidally-influenced zone, is in relative geographical proximity to the suspected sites of impairment by turbidity caused by boat activity on the lower section of the Kenai River. RM 11.5, near the boat launch site at Eagle Rock, was selected as a site that represents the part of the lower Kenai River impacted by motorized boat activity. It was also the site for the 2005-2007 Army Corps of Engineers study about the effects of boat wakes on erosion.

The ADEC approved a Quality Assurance Project Plan (QAPP) for the 2008 – 2010 KWF Turbidity Monitoring Study. Hydrolab MS-5 multi-parameter sondes (sondes or instruments) were deployed to collect turbidity data in the 2008 – 2010 KWF Turbidity Study. In both the 2008-2010 and limited 2018 KWF turbidity studies, measurements of pH, conductivity, salinity, dissolved oxygen levels, and temperature were collected along with the turbidity measurements. Prior to each deployment, all sondes were calibrated using established protocols. The instruments were programmed to record data every 15 minutes. Continuous field replicate samples were collected for approximately 10% of the data collection period. Field replicate data was collected by deploying side by side sondes (<6" apart) for a period of time; usually several days or more. A dedicated field notebook was kept with data that included date of deployment, position, sensor depth and total water depth. Upon retrieval, instruments were returned to the KWF laboratory, where data was downloaded from the instrument's memory and the calibration was checked.

Data Quality Control

Prior to analysis, data were processed in order to remove anomalies that were the result of instrument malfunction or unrecognized changes in sampling conditions. In general, points were considered outliers and removed from the final data set if they:

- Differed by more than 10 NTU from both the preceding and following points, data is recorded every 15 minutes
- Were part of an anomalous cluster of points which differed by more than 10 NTU from the points preceding and following the cluster
- Have a value of zero
- Were recorded during a period of erratic readings

Exceptions to this outlier filter policy were made at RM 11.5 during times of high motorized boating activity when data spikes were consistently seen and turbidity rapidly increased and decreased relative to natural conditions.

Locations

The locations for the turbidity monitoring sites selected in the KWF 2008-2010 Turbidity Study are shown in Table 1 and in map view in Figure 1.

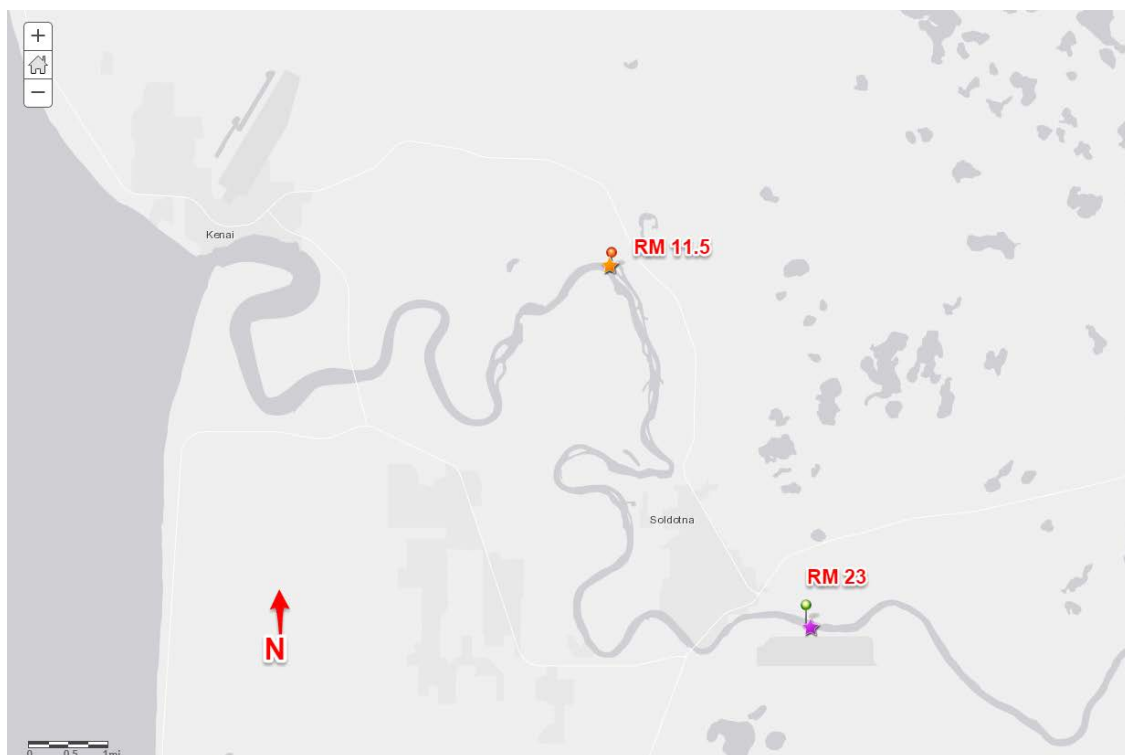






Figure 1. Map view for locations where the turbidity sondes were deployed for all three years of the KWF 2008-2010 Turbidity Study and for the ADEC/KWF 2018 Limited Turbidity Monitoring Study.

Table 1. Locations where the turbidity sondes were deployed for all three years of the KWF 2008-2010 Turbidity Study and for the ADEC/KWF 2018 Limited Turbidity Monitoring Study.

River Mile	Site Description	Coordinates NAD 83	Map Symbol (Figure 2)
23	River Left; upstream Kenai River Center	-151.0390, 60.4805	
23	After sonde moved on 7/23	-151.0374, 60.4805	
11.5	River Right off Island, upstream of Eagle Rock	-151.1120, 60.5460	
11.5	Approximate location of sonde after drifting out of position twice between 7/16 and 7/19/2018	-151.1292, 60.5420	

2018 KWF/ADEC Limited Turbidity Study

Purpose

ADEC sought to obtain a limited amount of data in order to perform a check on whether the river use changes that may have taken place since 2010 are still causing a turbidity impairment, as described in the ADEC's 2017 Kenai River Turbidity Listing Determination⁴. ADEC contracted with KWF, as part of an Alaska Clean Water Actions (ACWA) grant agreement, to perform turbidity monitoring on the lower Kenai River during a two-week interval in July.

Methodology

The same field methods used to prepare the equipment and deploy the sondes as were used in the 2008-2010 KWF Turbidity Study were employed in the ADEC/KWF Limited 2018 Turbidity Monitoring Study. The QAPP developed and approved by ADEC in the 2008-2010 KWF Turbidity Monitoring Study was updated for the ADEC/KWF 2018 Limited Turbidity Monitoring Study.

Data Quality Control

The data provided to ADEC for the ADEC/KWF Limited 2018 Turbidity Monitoring Study was not filtered or otherwise checked. All of the raw values were transmitted as recorded. When ADEC evaluated the turbidity data, the same data quality control procedures used in the 2008-2010 KWF Turbidity Study were undertaken. Outlier values were flagged, using the same procedures:

- Differed by more than 10 NTU from both the preceding and following points, data is recorded every 15 minutes
- Were part of an anomalous cluster of points which differed by more than 10 NTU from the points preceding and following the cluster
- Have a value of zero
- Were recorded during a period of erratic readings

Outlier values were not used to calculate the daily averages.

⁴ <http://dec.alaska.gov/water/wqsar/waterbody/docs/kenai-river-turbidity-listing-determination.pdf>

Locations

The locations where the sondes were deployed were the same locations as in the 2008-2010 KWF Turbidity Study and described in Table 1 and shown on Figure 2. Some adjustments to placement of the sondes occurred in the ADEC/KWF 2018 Limited Turbidity Monitoring Study that were not necessary in the 2008-2010 KWF Turbidity Monitoring Study. Specifically, two different events of note took place:

- On 7/19/2018, at about 9 AM, KWF discovered that the sondes had drifted from their original placement to downstream of the Eagle Rock boat launch site. The sondes were known to have been in their original, correct placement when they were checked previously on 7/16/2018. The reason for the sondes' drift was not captured on the game cameras positioned to collect boat count information at Eagle Rock. KWF personnel replaced the sondes in the correct position at 9:10 AM. This was the second instance of the sondes' displacement since they were first deployed on 7/16/2018. In both instances, the sondes were found in the position below the Eagle Rock boat launch site. Location shown on Figure 2.
- On 7/23/2018, KWF personnel moved the sonde located at RM 23 upstream approximately 100 yards, due to heavy boat traffic noticeable around the original sonde deployment location. Boat traffic was absent in the KWF 2008-2010 Turbidity Monitoring Study. Location shown on Figure 2.

For both instances of sonde movement, the resulting turbidity data was evaluated and standard QC evaluation of resultant data was performed.

Summary of Findings from 2018 Limited Kenai River Turbidity Monitoring

Data Evaluation

Data collected during 2018 monitoring was used to calculate the daily averages at the natural condition site (RM 23) and the suspected impaired site (RM 11.5). The average daily turbidity value was calculated utilizing both the original and duplicate instrument readings and averaged into 24 hour time periods. Average daily turbidity values ranged from 4.2 to 28.7 NTU. These values are lower than previously found in 2008-2010 study (4.0 to 80.7 NTU). A few quality control issues were identified, the most significant being instrument accuracy. Very low turbidity values have a higher degree of relative error due to instrument accuracy. Instrument accuracy is the range of potentially accurate readings. The 2009 Kenai River Turbidity Monitoring QAPP states the accuracy of the instrument as "Greater of 5 NTU or +/- 10%".

Average daily turbidity values at the suspected impaired site were then compared against Alaska Water Quality Standards. The drinking water and contact recreation uses have the same, most stringent turbidity criteria. The criterion is determined by adding 5 NTU to the concurrent natural conditions site, using RM 23 as the natural condition. The secondary recreation use criterion is developed by adding 10 NTU to natural condition (RM 23). See Table 2 for a comparison of average daily turbidity values at both sites and turbidity criteria. Neither the KWF 2008–2010 or KWF 2018 Limited Turbidity studies had sufficient exceedances of the aquatic life criteria (greater than 25 NTU

over natural condition) to impair the designated use for growth and propagation of fish, shellfish, other aquatic life and wildlife.

Table 2. 2018 average daily values at RM 23 (natural conditions site) and RM 11.5 (suspected impact site). Instrument accuracy is not accounted for in this table, all values below 25 NTU have an accuracy range of 5 NTU, values above 25 NTU have an accuracy range of +/- 10%.

Sample Date	Avg. Daily Turbidity (Nephelometric turbidity units, NTU)			
Location/Use	Natural Condition Site, RM 23	Applicable Turbidity Criteria at RM 11.5		Suspected Impaired Site, RM 11.5
		Drinking Water & Contact Recreation (RM 23 + 5 NTU)	Secondary Recreation (RM 23 + 10 NTU)	
7/16/2018	4.95	9.95	14.95	13.38
7/17/2018	4.58	9.58	14.58	11.23
7/18/2018	4.19	9.19	14.19	9.92
7/19/2018	4.41	9.41	14.41	11.30
7/20/2018	5.65	10.65	15.65	12.32
7/21/2018	7.90	12.90	17.90	13.64
7/22/2018	9.91	14.91	19.91	14.07
7/23/2018	12.70	17.70	22.70	13.66
7/24/2018	9.71	14.71	19.71	14.56
7/25/2018	11.88	16.88	21.88	15.81
7/26/2018	14.88	19.88	24.88	18.94
7/27/2018	15.28	20.28	25.28	21.00
7/28/2018	22.18	27.18	32.18	19.21*
7/29/2018	17.90	22.90	27.90	16.83*
7/30/2018	23.73	28.73	33.73	19.01*
7/31/2018	22.70	27.70	32.70	19.19*

For a determination of impairment to be made, the daily average turbidity at RM 11.5 must be higher than the turbidity criteria value more than 10% of the time. For a determination of attainment (meeting water quality goals), the daily average turbidity at RM 11.5 must be less than the turbidity criteria value more than 90% of the time. ADEC is unable to make either of these determinations due to low turbidity daily averages and resulting high relative error due to instrument accuracy. Twelve days have daily averages that either could be in attainment or could be an impairment when we evaluate against the turbidity criteria for drinking water, contact recreation uses. Eight days have daily averages that either could be in attainment or could be an impairment when evaluated against the turbidity criteria for secondary recreation uses. On four days (7/28–7/31) the values at the suspected impaired site are confirmed to be below the turbidity criteria for secondary recreation use including consideration of instrument accuracy. This is insufficient information to make an attainment determination.

The turbidity criteria and the daily averages for RM 11.5 are shown in Figure 2 and 3 with instrument accuracy depicted as error bars for both. The criteria include error bars since the criteria are based on daily averages at RM 23. Overlapping criteria and RM 11.5 daily average error bars indicate days when ADEC is unable to discern attainment or impairment.

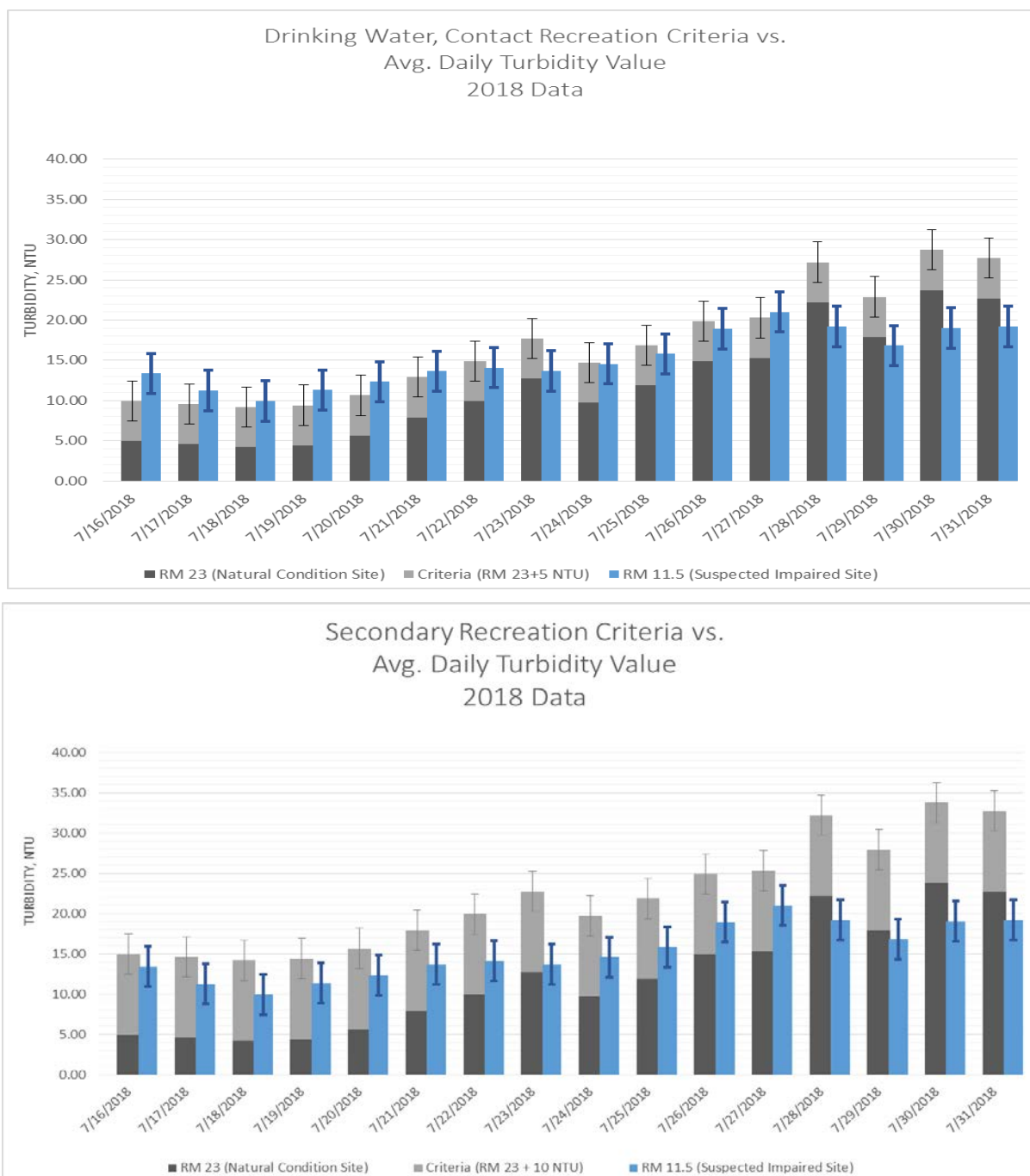


Figure 2 and 3. Time series plot of turbidity criteria and suspected impaired sites (RM 11.5) for July 16–31, 2018. Criteria values are determined using the natural condition site plus 5 or 10 NTU depending on the use. Drinking water and contact recreation are 5 NTU above natural conditions, secondary recreation is 10 NTU above natural conditions. Error bars indicate instrument accuracy. Overlapping error bars on the criteria and RM 11.5 daily average indicate days when ADEC is unable to determine whether criteria are exceeded (impairment) or not (attainment) due to instrument limitations.

Comparison of Assessment of 2008-2010 Kenai River Turbidity Monitoring and 2018 Limited Turbidity Monitoring

The duration of sampling is the most notable difference between the KWF's 2008-2010 Turbidity Monitoring Study and the 2018 Kenai River Limited Turbidity Monitoring Project. While both studies took place in July, the 2008-2010 KWF Turbidity Monitoring Study was conducted throughout the entire month of July for three years. The 2018 monitoring study only lasted sixteen days. The same number of data points per day were collected in both studies, using the same type of equipment, guided by the same QAPP procedures, and deployed in the same locations. Summaries of the data collected in 2008, 2009, 2010, and 2018 are in Appendix A.

Changes in boating behavior and fishery activity have also occurred between the 2008-2010 monitoring and 2018 monitoring. An additional boat launch was installed between studies, this new launch is further downstream from our suspected impaired site and may be reducing the impact of suspected boat wake caused turbidity at RM 11.5. Due to a closure of the Chinook salmon fishery in 2018, fewer boats were present during the limited turbidity monitoring study in 2018 than would have been expected in the original study in 2008-2010.

ADEC funded work to study changes in boating behavior. Information on the number of boats between Eagle Rock (RM 11) and the Pillars (RM 12.6), boat position relative to the bank of the river, boat hull shape, and approximate load of the boat was obtained. The data should be helpful in selecting effective best management practices to reduce turbidity. The data will also enable comparisons to be made to the historic data. A project report of both boating behavior and comparisons with the turbidity data will be completed in early 2019.

Conclusion

While not all objectives of the 2018 monitoring study were achieved, the 2018 study was useful in identifying changes in turbidity patterns and the need for a study redesign to re-evaluate attainment or impairment of turbidity in the lower Kenai River. The data from this study does suggest turbidity patterns on the lower Kenai River were different in 2018 than during the previous study in 2008-2010. This may be due to different fishery and boat use patterns on the lower Kenai River. Overall, the 2018 turbidity values were reduced from previous studies. At the low values observed ADEC cannot reliably make a determination of attainment or impairment given the high relative error after considering instrument accuracy.

Therefore, the final 2014/16 IR leaves the lower Kenai River in Category 3 (insufficient information) for turbidity until further information becomes available to reassess the current condition of the river. ADEC will work with local stakeholders to create a prioritized watershed plan to address potential water quality issues affecting the Kenai River.

Appendix A

The graphs below illustrate the turbidity criteria for drinking water and contact recreation compared against the suspected impacted site (RM 11.5). The drinking water and contact recreation criterion is developed by adding 5 NTU to the daily average of natural conditions site (RM 23).

