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ANNUAL SUMMARY REPORT

Project Title:	P8 Evaluate the performance of the Transport Network Reconstruction Program (TNRP) (Year 2 – 2015/16)
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AN INITIATIVE BY:
arrb GROUP
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P8 EVALUATE THE PERFORMANCE OF THE TRANSPORT NETWORK RECONSTRUCTION PROGRAM (TNRP)

SUMMARY

The Transport Network Reconstruction Program (TNRP) is the largest flood recovery work undertaken in the history of Queensland. The Department of Transport and Main Roads (TMR) engaged ARRB Group to undertake a research project to evaluate the performance of the TNRP flood repair works. The key objectives of this project are to identify best practices and lessons learnt during the flood recovery program. This annual summary report presents the findings from Year 2 of the multiple-year research project.

The key tasks that have been completed in Year 2 are as follows:

- updated TNRP treatments database based on the new ARMIS data
- continued to monitor the performance of pavement treatment projects
- conducted field trips in the Fitzroy District and the Far North District in Queensland
- organised field investigation in the Far North District to study the most probable cause of reported pavement failures
- scoping work for future years.

The focus of Year 2 was to confirm potential sites of interest flagged in Year 1. These were achieved by conducting field validation to confirm sections of TNRP roads that were failing or showing an early sign of deterioration. Based on the new condition data from 2015, results from condition surveys in subsequent years were compared using the ARMIS query tool developed in Year-1 of the project.

The most recent condition data was collected at the end of April 2015. The condition data was supplemented with the Traffic Speed Deflectometer (TSD) survey results collected between April and August 2015. The monitoring pavement sections identified by the different Regional Program Offices (RPOs) in Year 1 will continue to be monitored in Year 3 of the project. Based on the data available in 2015/16, there is only a small increase in newly reported TNRP sections.

Revised criteria for the pavement condition index (PCI) have been introduced. The revised criteria comprise two categories which cover both low and high traffic volumes, and this reflects the difference in serviceability expectations across the road network.

Two field visits to Rockhampton (Fitzroy District) and Cairns (Far North District) were undertaken by the project team this year. There was an emphasis on the investigation of the causes of pavement failures observed on TNRP works.

Although pavement distress was reported in some pavement sections found on the TNRP network, these sections represent a small percentage of the work undertaken as part of the TNRP program. The long-term performance of the entire network should continue to be monitored.

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1 INTRODUCTION

1.1 TNRP Flood Repairs

The Department of Transport and Main Roads (TMR) engaged ARRB Group to conduct a research project under the NACoE agreement to evaluate the performance of the TNRP flood repair works. The key objectives of the project are to identify best practices and lessons learnt, and to assess the early life performance of pavement works during the $6 billion flood restoration program.

1.2 Purpose of the Project

The goal of the project is to identify key findings from the largest flood restoration program ever undertaken in Queensland and Australia. This project documents the key lessons learnt in construction activities, innovative practices and techniques, and guidelines for future major pavement restoration programs.

During the project some districts indicated some poorly performing TNRP treatment sections. This triggered a change in the direction of the research project, with a focus on investigating the cause of some of the failures reported.

1.3 Tasks in Year 2

The project is a Year 2 of a multiple-year study which began in 2015. The primary focus of Year 1 was to undertake a detailed scoping study to identify areas to focus the research investigation. In Year 2, the tasks were undertaken as follows:

- updated TNRP treatments database based on the new ARMIS data
- continued to monitor the performance of pavement treatment projects
- conducted field trips in the Fitzroy District and the Far North District in Queensland
- organised field investigation in the Far North District to study the most probable cause of reported pavement failures
- scoping work for future years.

New pavement condition data became available in Year 2. The data was used to update the pavement condition assessment and to improve the current criteria used to define the pavement condition index (PCI).

Two field visits to Rockhampton (Fitzroy District) and Cairns (Far North District) were undertaken by the project team this year. There was an emphasis on the investigation of the cause of pavement failures observed on TNRP works.

1.4 Structure of the Report

Following the introduction, a summary of the condition data collected in 2015 is presented in Section 2. Any noticeable changes in pavement conditions and treatment types between Year 1 and Year 2 have been highlighted. Roads which had previously been identified by Regional Program Offices (RPO) as monitoring sites will continue to be monitored.

Section 3 presents the findings from the field visit near Rockhampton (Fitzroy District). The project team is fortunate to be guided by RPO staff who have been responsible for flood repair work since 2010. Their insight is valuable to the project team.

Section 4 presents a summary of the field trip in Cairns (Far North District). The purpose of the field visit was to validate selected sections of the road nominated by the district that show early-life

pavement failures. As part of the project, an additional field and laboratory investigation has been proposed. The proposed investigation program will commence in Year 3, with the objective to identify the most probable reasons for the pavement failures observed.

Section 5 presents a summary and conclusions of findings from the work undertaken in Year 2, which includes the scoping for future years' work.

2 TNRP PAVEMENT CONDITION MONITORING

2.1 Data Collection

In Year 1, it was found that the ARMIS database could be used to identify the types of TNRP pavement treatments, and it can also be used to monitor pavement conditions. This year's task was to update the database tool using the latest available ARMIS data. The ARMIS dataset used this year reflects the annual survey conducted in 2014/15 and the most recent condition data collected at the end of April 2015.

In addition to the ARMIS data, the Traffic Speed Deflectometer (TSD) data collected during the 2014 and 2015 annual Queensland network survey (between April and August), was also used. The TSD measures rutting, roughness, texture depth, surface imagery as well as deflections. The data has proven to be a valuable tool for monitoring conditions of individual sections of pavement treatments.

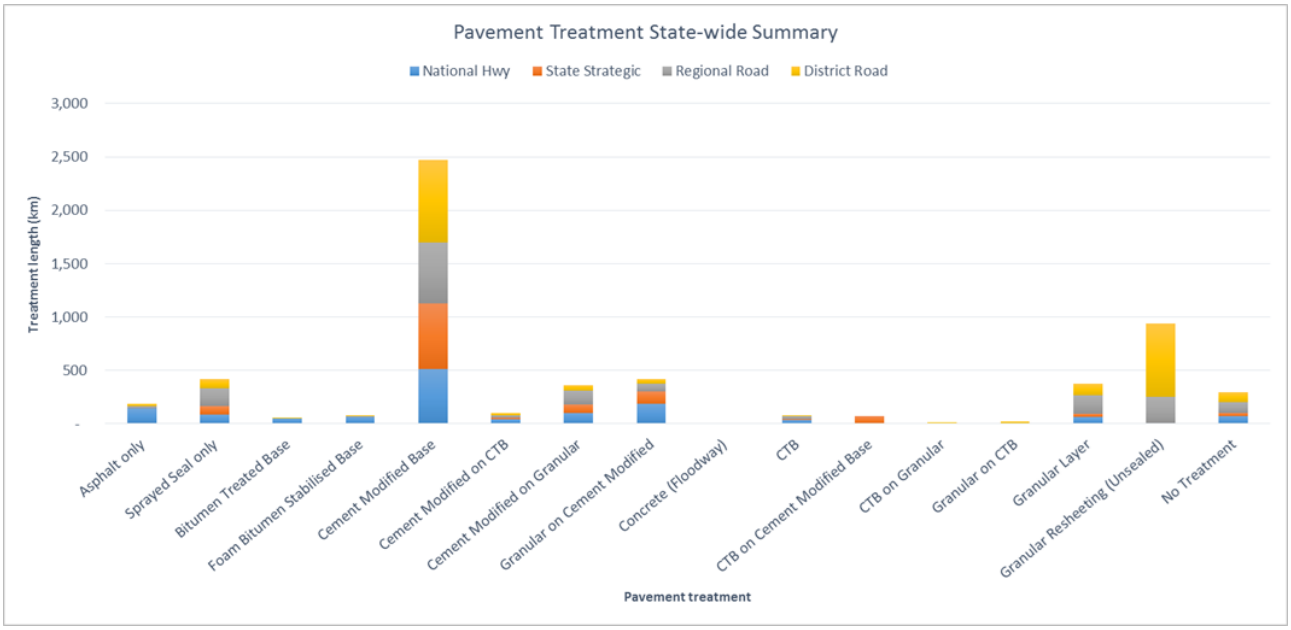
Approximately 10 800 km of TSD data was collected along roads in 2014, and TSD data for about 18 000 km of roads was collected in 2015. About 9 500 km of roads were common in both years.

2.2 Treatment Types Summary

A catalogue of pavement treatments completed as part of the TNRP project was produced including details of type, length, and location of treatments. Figure 2.1 and Figure 2.2 are summaries of the pavement treatments by lane-km for the entire state. The cement modified granular pavement is the most widely adopted pavement treatment in the TNRP works. Figure 2.3 shows the treatment locations and the majority of the TNRP treated areas that coincide with areas identified as having reactive soil subgrade.

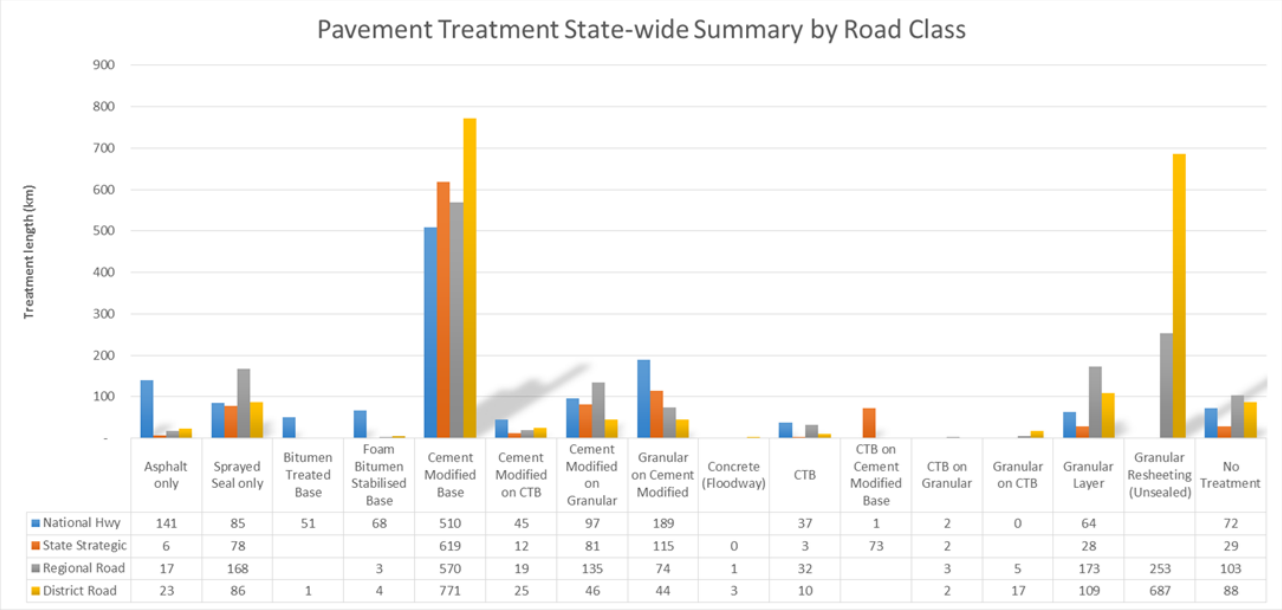
The summary includes the treatment recorded for the majority of the TNRP works, except for a small percentage of work from the flooding event in 2013. These sections will be included in the analysis when data becomes available in Year 3.

Figure 2.1: Summary of TNRP pavement treatment type



Note: Cement treated base (CTB).

Figure 2.2: Summary of TNRP pavement treatment type by road class



	Asphalt only	Sprayed Seal only	Bitumen Treated Base	Foam Bitumen Stabilised Base	Cement Modified Base	Cement Modified on CTB	Cement Modified on Granular	Granular on Cement Modified	Concrete (Floodway)	CTB	CTB on Cement Modified Base	CTB on Granular	Granular on CTB	Granular Layer	Granular Resheeting (Unsealed)	No Treatment
National Hwy	141	85	51	68	510	45	97	189		37	1	2	0	64		72
State Strategic	6	78			619	12	81	115	0	3	73	2		28		29
Regional Road	17	168		3	570	19	135	74	1	32		3	5	173	253	103
District Road	23	86	1	4	771	25	46	44	3	10		2	17	109	687	88

Figure 2.3: TNRP pavement treatment map

2.3 Performance Monitoring

A set of condition categories (e.g. good, fair, poor, bad), that determined the Pavement Condition Index (PCI), was established and used in Year 1 of the project to identify road sections that showed a sign of premature deterioration or pavement distress.

In Year 2, while the computation of the PCI remains unchanged, the criteria used to define the PCI values have been revised. There are separate criteria for roads carrying low and high traffic volumes as shown in Table 2.1. These changes were developed to recognise that there are different expectations (and standards), for roads carrying low and high volumes of traffic. The criteria that were used in Year 1 were similar to those for a low-level of traffic (AADT < 5000 vehicles/day). The revised criteria were then used to rank the pavement conditions on both the 2014 and 2015 data.

Table 2.1: Pavement condition criteria

	Pavement condition (AADT ≥ 5000 vehicles/day)			
	Good	**Fair**	**Poor**	**Bad**
Roughness (IRI)	0–2.3	2.3–3.8	3.8–6	> 6
Rutting (mm)	0–10	10–20	20–30	> 30
Crocodile cracking (%)	0–10	10–20	20–30	> 30
	Pavement condition (AADT < 5000 vehicles/day)			
	Good	**Fair**	**Poor**	**Bad**
Roughness (IRI)	0–3.8	3.8–5.5	5.5–8	> 8
Rutting (mm)	0–10	12–25	25–35	> 35
Crocodile cracking (%)	0–15	15–25	25–40	> 40

The TNRP network condition in 2014 and 2015 is detailed in Table 2.2 and Table 2.3 and illustrated in Figure 2.5 and Figure 2.6, respectively.

Table 2.2: 2014 TNRP network condition summary

Road class	**Condition**				**Total**
	Good	**Fair**	**Poor**	**Bad**	
District road	1500.2 km	109.1 km	29.2 km	47.1 km	**1685.6 km**
National highway	1962.7 km	124.2 km	20.2 km	53.6 km	**2160.7 km**
Regional road	1731.2 km	78.2 km	26.8 km	44.5 km	**1880.7 km**
State strategic road	1451.9 km	47.8 km	20.4 km	37.0 km	**1557.1 km**
Total	**6646.0 km**	**359.3 km**	**96.6 km**	**182.2 km**	**7284.1 km**

Table 2.3: 2015 TNRP network condition summary

Road class	Condition				Total
	Good	Fair	Poor	Bad	
District road	1506.8 km	111.3 km	23.0 km	45.3 km	1686.4 km
National highway	2061.1 km	104.4 km	6.0 km	4.4 km	2175.9 km
Regional road	1772.2 km	75.0 km	20.3 km	34.2 km	1901.7 km
State strategic road	1493.6 km	41.3 km	9.4 km	12.6 km	1556.9 km
Total	**6833.7 km**	**332.0 km**	**58.7 km**	**96.5 km**	**7320.9 km**

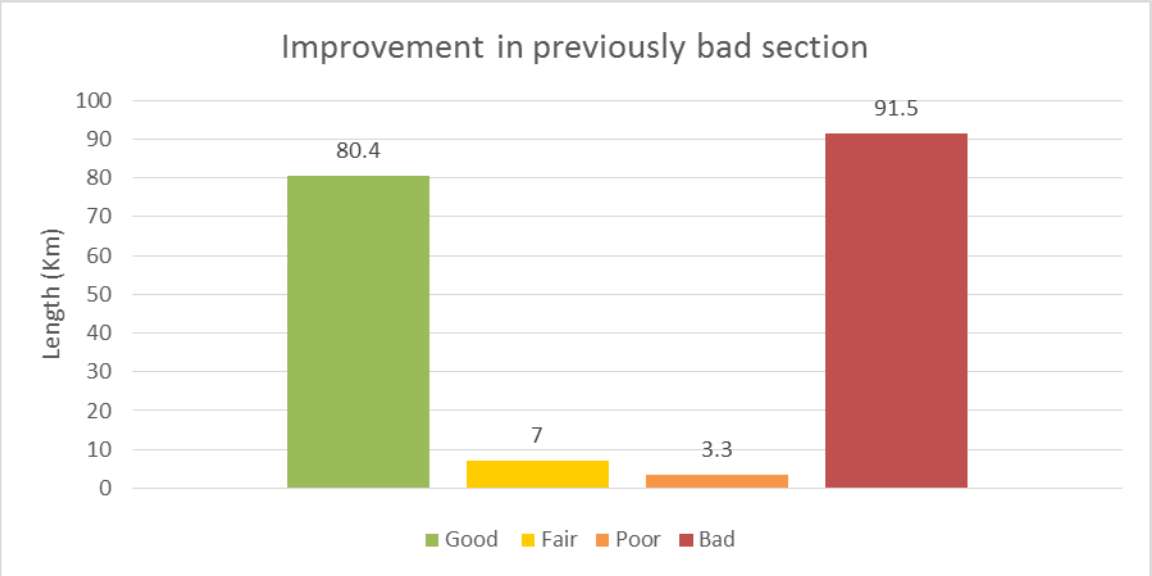
Similar to the findings in Year 1, the percentage of roads in poor or bad condition according to the 2015 condition survey is relatively small. This represents only 2% of the overall pavement treatment length. Roads which are showing early signs of failure (or those in fair condition) are also reported at around 5%.

It is noted that the length of roads in poor or bad condition is only half of those reported in the previous year. This is expected on a road in this condition, which often requires immediate repair under current maintenance strategy.

The change in sections categorised in the 2014 survey as bad to their current conditions in 2015 is illustrated in Figure 2.4. It shows that almost half of the sections have been improved with 80.4 km out of 182.2 km now in good condition.

Roads with an improved PCI from bad to good were cross-referenced with TMR maintenance records to confirm that the improvement can be attributed to recent maintenance treatments (e.g. pothole repair, surface correction, and major pavement repair).

Figure 2.4: Tracking the improvement in previously bad sections



Since a section classified as good according to functional condition attributes in PCI may not always be sound structurally, the TSD data was utilised to analyse the effectiveness of maintenance work. This was achieved by comparing the changes of the maximum TSD deflection collected in both the 2014 and 2015 surveys. The PCI condition in 2014 and 2015 is shown in Figure 2.5 and Figure 2.6, respectively.

Figure 2.5: 2014 pavement condition

Figure 2.6: 2015 pavement condition

The performance of TNRP sections between 2014 and 2015 was compared. Table 2.4 provides the total lengths of the pavement sections that are classified as fair and poor or bad. From a pavement deterioration standpoint, it is also important to quantify the lengths of road sections that have deteriorated to a worse category since the last survey.

About 97.6 km of the total 332 km of the TNRP network classified as fair in 2015 was in the good category in 2014. Furthermore, 10.5 km of the total 155.2 km of the network classified as poor or bad in 2015 had a better condition than in the previous year.

Table 2.4: Summary of deteriorated sections in 2015

Current condition (as at June 2015)	Length
Fair	332.0 km
Poor or bad	155.2 km

The 2015 condition results are presented in Table 2.5. The condition results were grouped by pavement treatment types. Roads that have a current condition classification of fair and poor or bad are shown in Figure 2.7. Figure 2.7 also shows the location of the pavement sections where the conditions have deteriorated between 2014 and 2015.

Table 2.5: 2015 condition by treatment type

Surface type	Pavement treatment type	Condition			
		Good	Fair	Poor	Bad
Asphalt	Asphalt only	197.6 km	21.2 km	2.6 km	4.6 km
	BTB or foamed bitumen	2.0 km	0.4 km	–	–
	Concrete	–	0.1 km	–	–
	CTB	39.6 km	3.9 km	0.2 km	0.3 km
	Granular	38.0 km	3.9 km	–	–
	Modified granular	85.4 km	9.8 km	3.0 km	3.3 km
Subtotal for asphalt		**362.6 km**	**39.3 km**	**5.8 km**	**8.2 km**
Sprayed seal	BTB or foamed bitumen	245.2 km	6.2 km	0.4 km	0.2 km
	Concrete	0.4 km	0.2 km	–	–
	CTB	312.3 km	14.6 km	1.6 km	4.6 km
	Granular	459.8 km	13.8 km	3.4 km	14.2 km
	Modified granular	4679.9 km	186.7 km	35.3 km	60.0 km
	Seal only	650.5 km	61.6 km	9.3 km	4.3 km
Subtotal for sprayed seal		**6348.1 km**	**283.1 km**	**50.0 km**	**83.3 km**

Note: Cement treated base (CTB); Bitumen treated base (BTB).

Figure 2.7: Changes in the PCI between 2014 and 2015

2.4 Monitoring Sites

The method adopted to monitor the conditions of the entire TNRP network was described in Section 2.3. This network-level approach provided a simplistic view of the pavement performance for Queensland. For a selected number of monitoring sites across the state, a project-level approach has been adopted. These monitoring sites were nominated to represent dominant TNRP treatments adopted in each region, and where detailed construction information on the pavement treatments was available.

Table 2.6 identifies the monitoring sites located in the Central West, Far North, and the South West Districts. For sites where a recent field visit has not been conducted, the project team had rely on other sources of condition data. Other than the ARMIS database, the project team had access to the TSD annual condition survey. It should be noted that not every monitoring site has a TSD survey completed in 2015. For instance, the monitoring sites along Bruce Highway Ingham – Innisfail (10N), Carnarvon Highway Roma – Injune (24A) and Mulligan Highway Lakeland – Cooktown (34C), did not have a TSD surveyed conducted in 2015.

Pavement condition data collated for some of the monitoring sites is shown in Appendix A.

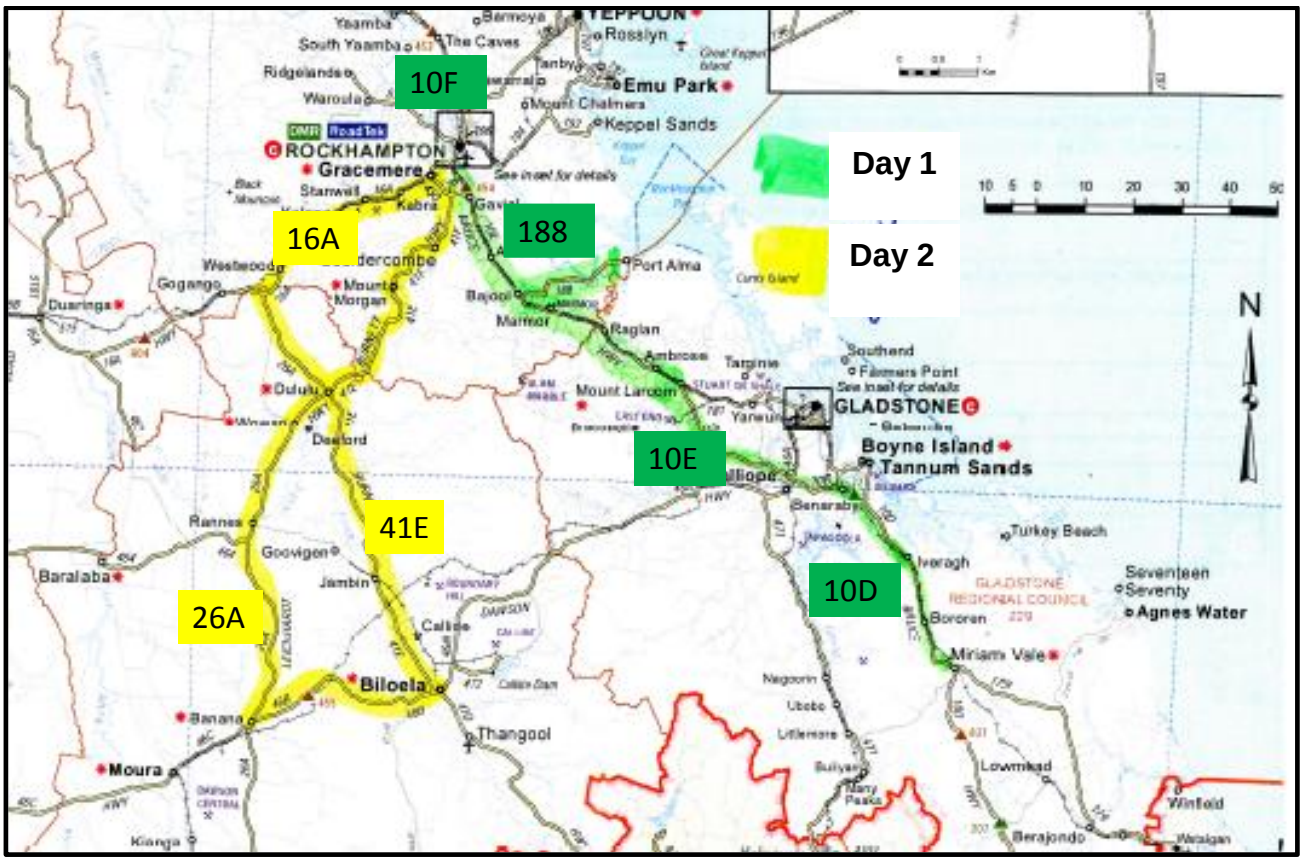
Table 2.6: Sites suggested by RPOs for future monitoring

RPO	Road	Job no.	Pavement treatments
Central West District	Landsborough Highway: (a) 208/13B (Augathella – Tambo) – LGA 208 (Blackall – Tambo Regional Council) (b) 205/13E (Barcaldine – Longreach) – LGA 205 (Barcaldine Regional Council) (c) 241/13E (Barcaldine – Longreach) – LGA 241 (Longreach Regional Council)	–	Different 150 mm overlay types over 200 mm cement stabilised subbase of WQ35 top-up material mixed with existing pavement (7-days UCS 1–1.5 MPa)
Far North District	Bruce Highway (Ingham – Innisfail) (10N) near El-Arish Range (LGA 216 – Cassowary Coast Regional Council)	216/10N/660	Foamed bitumen stabilisation
	Mulligan Highway (Lakeland – Cooktown) (34C) near Black Mountain (LGA 220)	–	Stabilisation of Type 3 gravels
South West District	Warrego Highway – Miles to Roma (18D)	259/18D/650	Bitumen treated base
	Warrego Highway – Miles to Roma (18D) West of Jackson	259/18D/650 259/18D/67H (reseal)	Cracked modified pavement – (Note: Ch. 57–61.1 km, Type E full width stabilising treatment with 10 mm AMC5 primerseal,14 mm S0.7S seal 250 mm 3% cement: slag (35:65) was cracking post-construction. The design life is 20 years.
	Carnarvon Highway (Roma – Injune) 24A, near St George	–	Marginal material

3 FIELD INSPECTIONS NEAR ROCKHAMPTON, FITZROY DISTRICT

The project team inspected roads near Rockhampton on 17–18 March 2016. A map of the sections of roads visited by the project team is shown in Figure 3.1. On Day 1, Bruce Highway (10D, 10E, 10F) and Bajool – Port Alama Road (188) were visited. On Day 2, the visit was concentrated in the south-west area of Rockhampton along Capricorn Highway Rockhampton – Duaringa (16A), Leichhardt Highway Westwood – Taroom (26A), Burnett Highway Biloela – Mount Morgan (41E), and Dawson Highway Bioela – Banana (46B). The roads along 26A, 46B and 41E south of the town of Dululu were expected to be an over-reactive soil subgrade region.

Figure 3.1: Roads visited near Rockhampton between 17–18 April 2016



The project team inspected the performance of pavement repairs carried out under different periods of the TNRP program, namely the 7H/7L and 13A flooding events. The majority of the inspected pavements were in good condition. Due to funding constraints, it is noted that part-width pavement treatment had increased in popularity in recent the flooding event.

Of particular interest are some sections along the Bruce Highway where premature crocodile cracking was found on cement modified or stabilised pavements. Some photographs taken at these sites are shown in Figure 3.2 and Figure 3.3. Without detailed field coring and material information on the stabilised pavements, a preliminary conclusion is that over-dosage of stabilising agent can be one of the most likely reasons for the premature distress.

Seals flushing at the surface were observed at different pavement treatment sections. Other NACoE research projects are addressing the performance of seals.

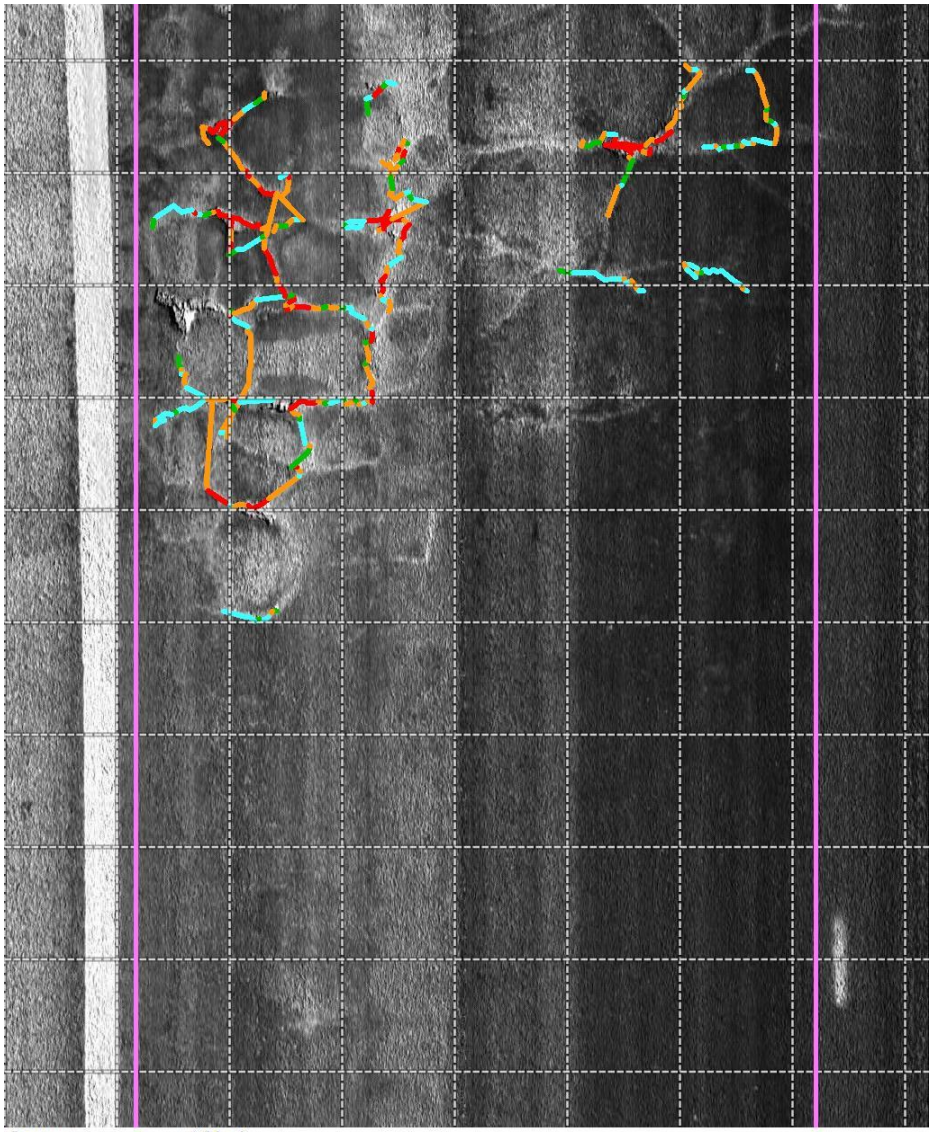
Figure 3.2: Pavement defects observed along Bruce Highway (10D)

Figure 3.3: Pavement defects observed along Bruce Highway (10E)

In Year 1 of the study, a few pavement sections had a low PCI value. One of the sections flagged was located near Rockhampton along the Capricorn Highway (Rockhampton – Duaringa), 16A, between chainage 16.6 km and 18.8 km. This condition was confirmed by the TSD automatic crack detection survey collected on 12 June 2015. An example of the surface condition is shown in Figure 3.4.

The original plan was to visit this section to gain a better understanding of the causes of the pavement distress. However, the section has since been repaired, therefore further investigation of the original work cannot be conducted.

Figure 3.4: Automatic crack detection image collected along the Capricorn Highway (16A)



Survey:	16A_1
Camera:	ACD
Frame No:	3567
Chainage:	16.621 km
SubChainage:	3.724 km
Vehicle location:	Lat: -23.4825168 Lon: 150.3661927 Alt: 40.1
Road name:	N.ABUT/MIDDLE CK
From:	4 16A-4
To:	5 16A-5

4 FIELD INSPECTIONS NEAR CAIRNS, FAR NORTH DISTRICT

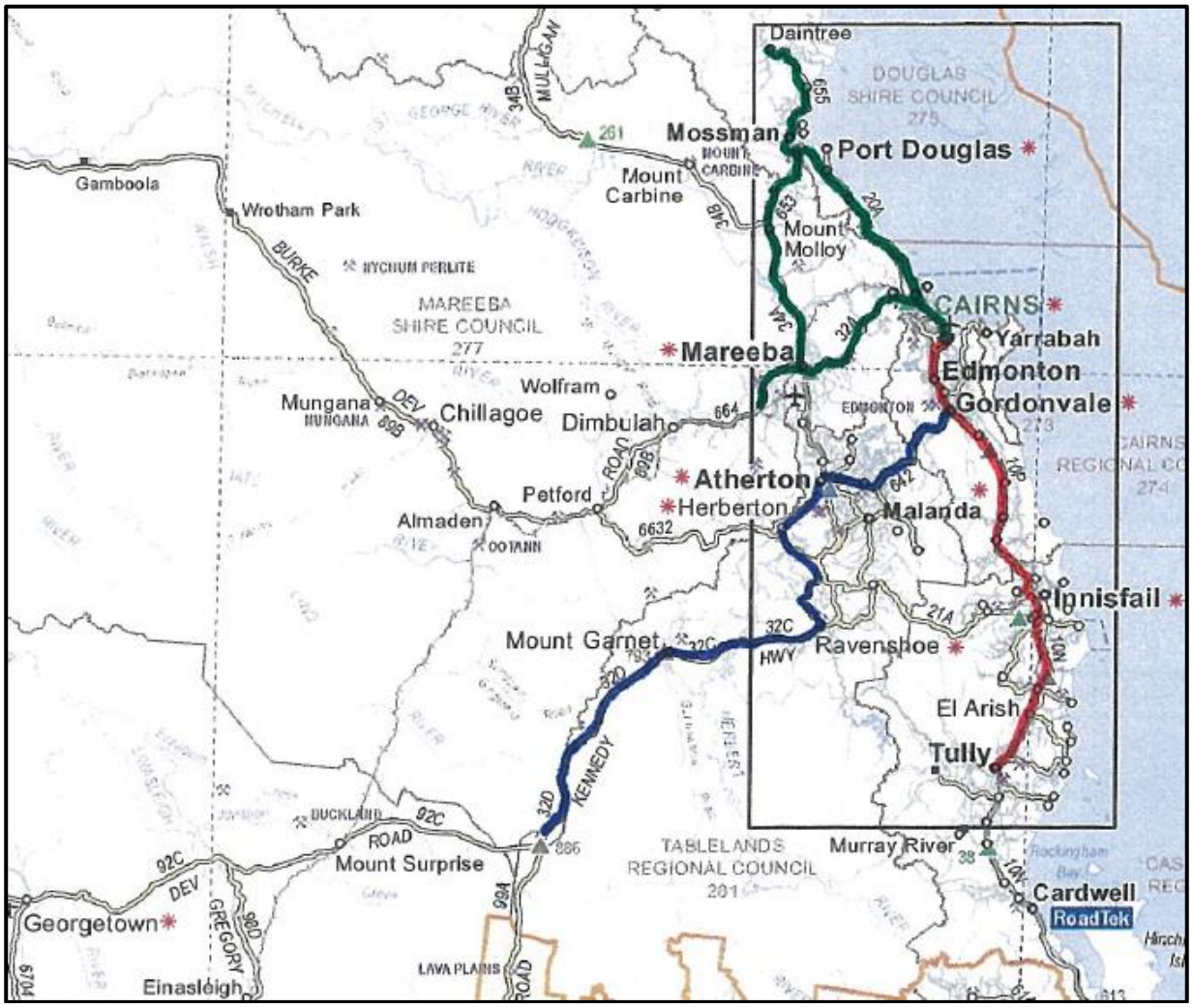
The project team carried out site inspections in the Far North District between 13 and 15 April 2016. A list of pavement defects was provided to the project team and it is noted that not every project is part of the TNRP. The list of defects is shown in Table 4.1 and the location of the road sections visited during the inspection is shown in Figure 4.1.

Table 4.1: TNRP projects with pavement defects identified by Fitzroy District near Cairns

Road no.	Road name	Job no.	Year	Chainage (km)	Pavement type	Description of defects
10N	Bruce Highway (Ingham-Innisfail)	216/10N/66Z	2011	96.6-105.52	Cement stabilised	Rutting, potholes, block cracking and pavement failures. Flushed seal
10N	Bruce Highway (Ingham-Innisfail)	216/10N/809	2014	112.76-113.65	Foamed bitumen stabilisation	Wheel-path flushing
21A	Palmerston Highway	216/21A/652	2013	29.98-33.92	Plant-mixed CMB	Major pavement failures
642	Gillies Range Road	264/642/665	2014	53.88-55.02	CMB	Severe flushing in wheel-paths. Stripping at Kelly Street intersection.
663	Herberton-Atherton Road	264/663/67H	2013	6.84-7.76	Cement stabilised overlay	Seal flushing and early potholing
665	Longlands Gap Road	264/665/65	2014	11.7-13.89	Cement subbase and granular overlay	Shoulder batter failures and pavement failures
6605	Tumoulin Road	240/6605/650	2014	4.04-6	CMB over culvert	Pavement failures
6404	East Evelyn Road	264/6404/67H	2012	1.97-3.4	Cement stabilised overlay	Early potholing and shoving
641	Millaa Millaa-Malanda Road	264/641/650	2011	1.58-2.97	Cement stabilised subbase and foamed bitumen base	Major flushing
664	Mereeba-Dimbulah Road	264/664/652.1	2014	3.99-4.66	CMB	Wheel-path rutting, surface deformation
664	Mereeba-Dimbulah Road	264/664/651	2013	33.8-34.1	CMB	Algoma Road intersection and surface deformation
34A	Mulligan Highway (Mareeba-Mt Molloy)	264/34A/652	2013	29.76-29.8	CMB over culvert	Surface deformation
34B	Mulligan Highway (Mt Molloy-Lakeland)	264/34B/654	2013	15.44-16.12	Plant-mixed CMB	Surface deformation
655	Mossman-Daintree Road	214/655/701	2012	32.71-32.91	Asphalt corrector and reseal	Major flushing. Thin layer of gravel found between seal and underlying seal

Note: Cement modified base (CMB).

Figure 4.1: Map of Road sections visited near Cairns between 13 and 15 April 2016



Among all the sections listed in Table 4.1, the majority of the pavements identified are either in good condition or the distress is localised and therefore not representative of the entire length of the pavement treatment. The project team has identified only four pavement sections as suitable for further detailed investigation as listed below:

- Bruce Highway (Ingham – Innisfail) 10N, Ch. 96.6–105.5 km
- Bruce Highway (Ingham – Innisfail) 10N, Ch. 112.8–113.6 km
- Palmerston Highway 21A, Ch. 29.9–33.9 km
- Mossman – Daintree Road 655, Ch. 32.7–32.9 km.

Coring and pavement material sampling is being organised and is expected to commence in Year 3 of the project.

It was noted that the section of Bruce Highway (Ingham – Cairns) 10N near El Arish Range, was one of the monitoring sites identified in Year 1 of the project. Flushing along the wheel paths has been reported within the foamed bitumen stabilised section. Figure 4.2 and Figure 4.3 are photographs taken along the Bruce Highway section (10N) at the time of the site visit. Defects along the wheel paths are visible. Field cores will be taken to visually assess the reason for the flushed seal along the wheel paths. Where needed, further laboratory testing on the sampled material will be conducted.

Figure 4.2: Pavement defects along Bruce Highway (Ingham – Innisfail), 10N, Ch. 96.6–105.517 km

Figure 4.3: Pavement defects along Bruce Highway (Ingham – Innisfail), 10N, Ch. 112.76–113.65 km

The section along the Palmerston Highway (21A) is located in a hilly region of the district. The road is located on steep gradient, and a significant volume of heavy vehicles utilises this section of the road. Some of the major pavement distress along the section is shown in Figure 4.4 and Figure 4.5, including potholes and severe rutting on the pavement surface. It is noted that some surface maintenance and patching work has been undertaken.

District staff suggested that the cause of premature failure may be caused by water seepage from the cutting areas. From the inspection, it appears that the plant-mixed cement modified base (CMB) treatment varies in width with some patches extending the full width of the traffic lane, while some are part-width treatments. Trenching and cores are planned in the Year 3 investigation to better understand the reasons for the premature failure observed.

Figure 4.4: Pavement defects observed along Palmerston Highway, 21A, Ch. 29.98–33.92 km

Figure 4.5: Pavement defects observed along Palmerston Highway, 21A, Ch. 29.98–33.92 km

The section along the Mossman – Daintree Road (655) has major flushing of the surface. District staff suggested that the council maintenance team may have left a loose gravel layer between subsequent resealing during recent maintenance activities. Cores will be taken at the wheel paths and between wheel paths in Year 3 to assess the reasons for the distress.

5 SUMMARY AND CONCLUSIONS

The focus of the study was to confirm potential sites of interest flagged in Year 1. These were achieved by conducting field validation of sections of TNRP roads that were failing or showing early signs of deterioration. The ARMIS query tool developed in Year 1 was updated with new condition data. A comparison of the survey results collected in 2014 and 2015 was undertaken.

The most recent ARMIS condition data obtained for the Year 2 work was collected at the end of April 2015. This has been supplemented with the TSD surveys collected in 2015. The monitoring sites identified in Year 1 will continue to be monitored in Year 3 of the project. Based on the data available, there is only a small increase in newly reported TNRP sections.

Revised criteria for the PCI have been introduced. The revised criteria were developed for both the low and high traffic volumes, reflecting the difference in serviceability expectations across the road network. The percentage of roads in poor or bad condition is relatively small, and this is consistent with the findings from Year 1. The length of roads in poor or bad condition is only half of that reported in the previous year. This trend is expected because roads in poor or bad condition would likely have been repaired as part of the maintenance works.

The pavement treatment classifications are similar to those reported in Year 1. It is noted that the cement modified base pavement treatment is the most popular treatment across the TNRP network.

Based on available project resources, the project team was only able to inspect selected pavements near Rockhampton (Fitzroy District) and Cairns (Far North District). The field observation confirms the trends illustrated from the ARMIS database. During the project, there has been a change of focus to investigate and identify the reasons for premature distress. Some cases of the distress observed near Rockhampton and Cairns have been reported. The project team is in the process of organising field and laboratory investigations, and these are expected to start in Year 3 of this project. The findings of the detailed investigation will be reported in Year 3 of this project.

Although some distresses were observed, those represent a minor percentage of the work undertaken as part of the TNRP program. The long-term performance of the entire network should continue to be monitored and will form part of the work in future years of the NACoE P8 project.

APPENDIX A CONDITION DATA OF SELECTED TNRP MONITORING SITES

A.1 Landsborough Highway (Augathella – Tambo), 13B

Figure A 1: Visual condition of the monitoring site along Landsborough Highway, 13B

Chainage 84 km

Chainage 86 km

Chainage 87 km

Chainage 88 km

Chainage 90 km

Chainage 92 km

A.2 Landsborough Highway (Barcaldine – Longreach), 13E

Figure A 2: Pavement condition measurements along Landsborough Highway, 13E

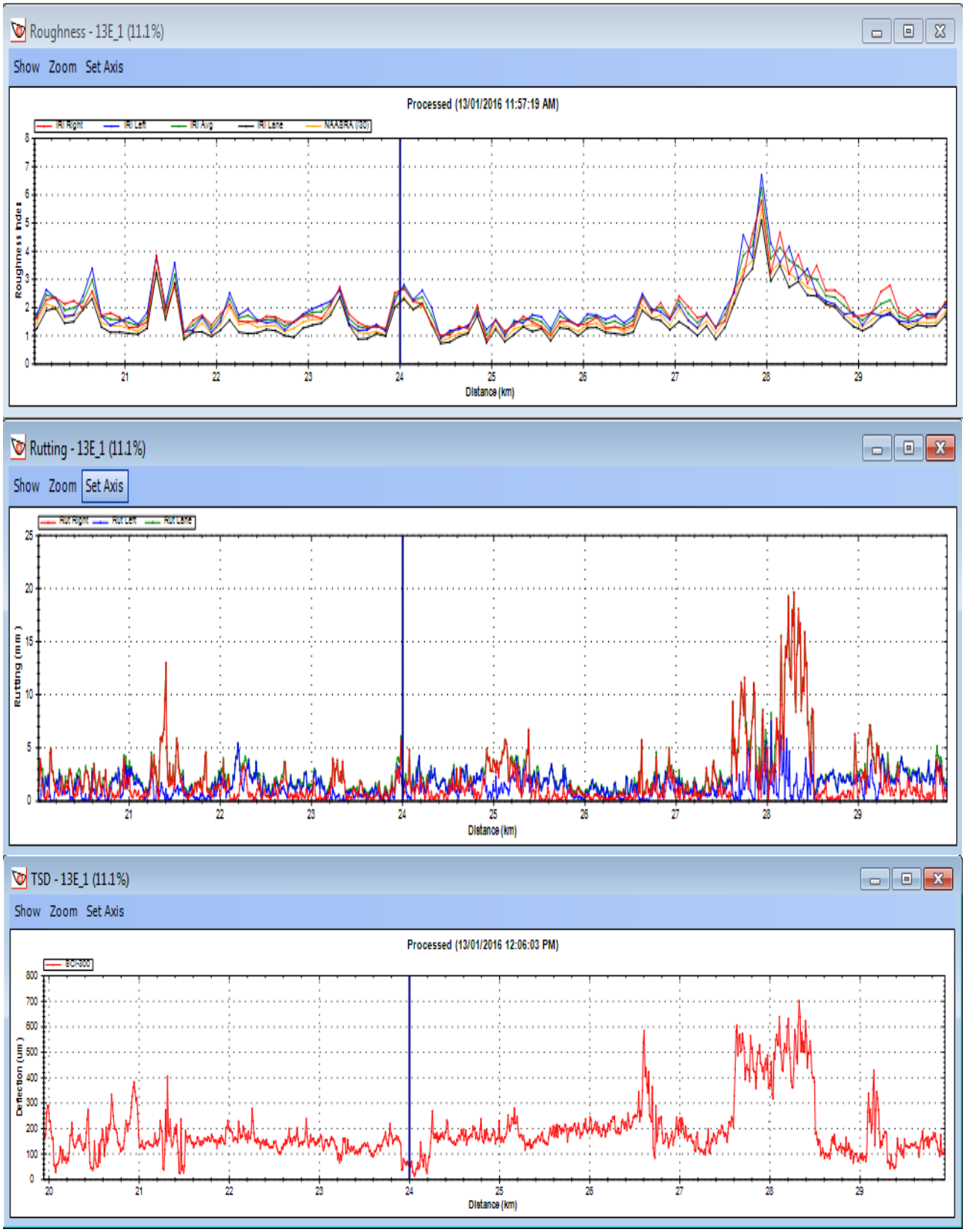


Figure A 3: Visual condition of the monitoring site along Landsborough Highway, 13E

Chainage 24.0 km

Chainage 25.0 km

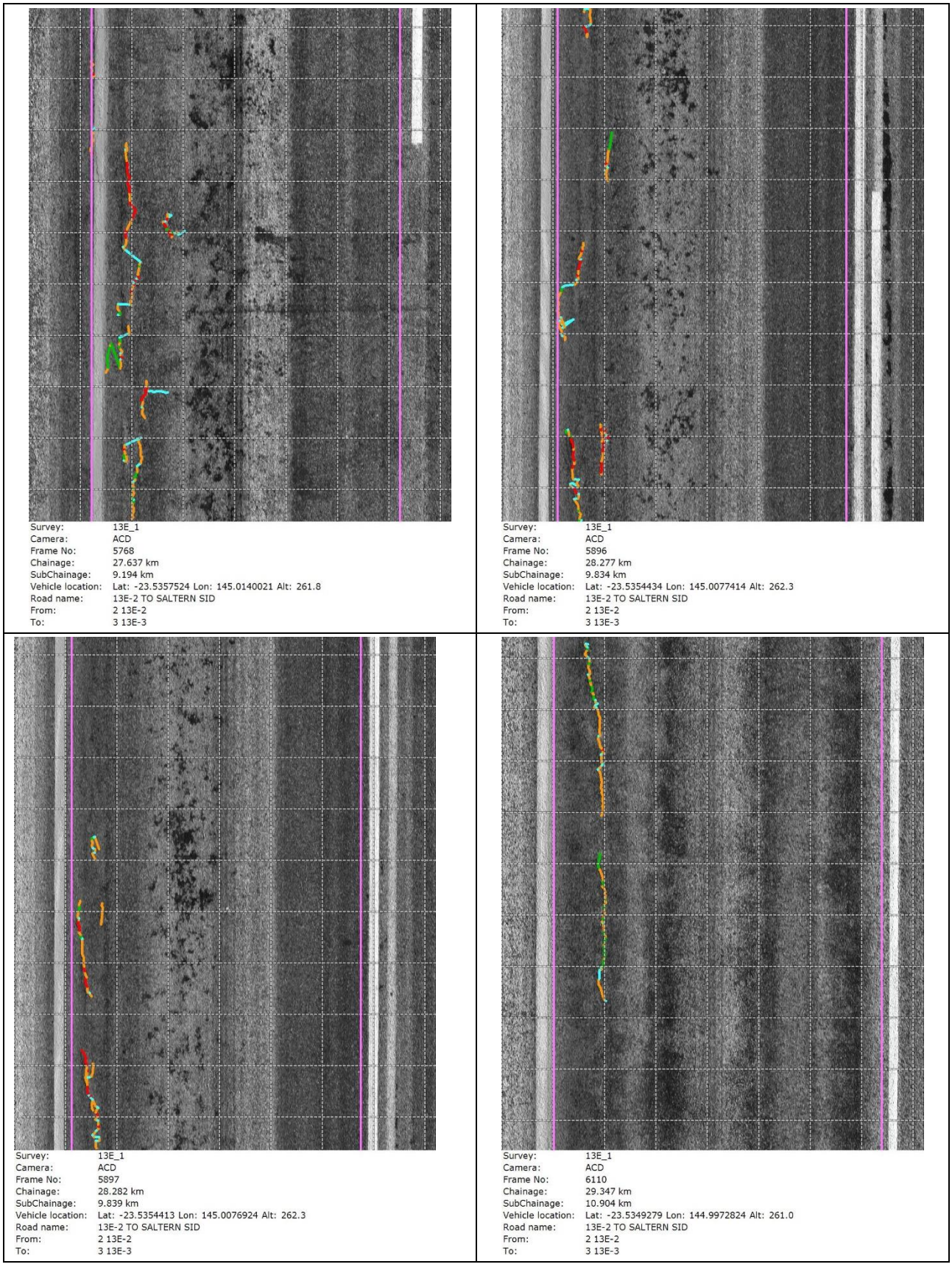
Chainage 26.0 km

Chainage 26.6 km

Chainage 27.0 km

Chainage 27.8 km

Figure A 4: Surface scans and defects identified by the automatic crack detection along the Landsborough Highway, 13E



A.3 Warrego Highway (Miles – Roma), 18D

Figure A 5: Pavement condition measurements along Warrego Highway, 18D

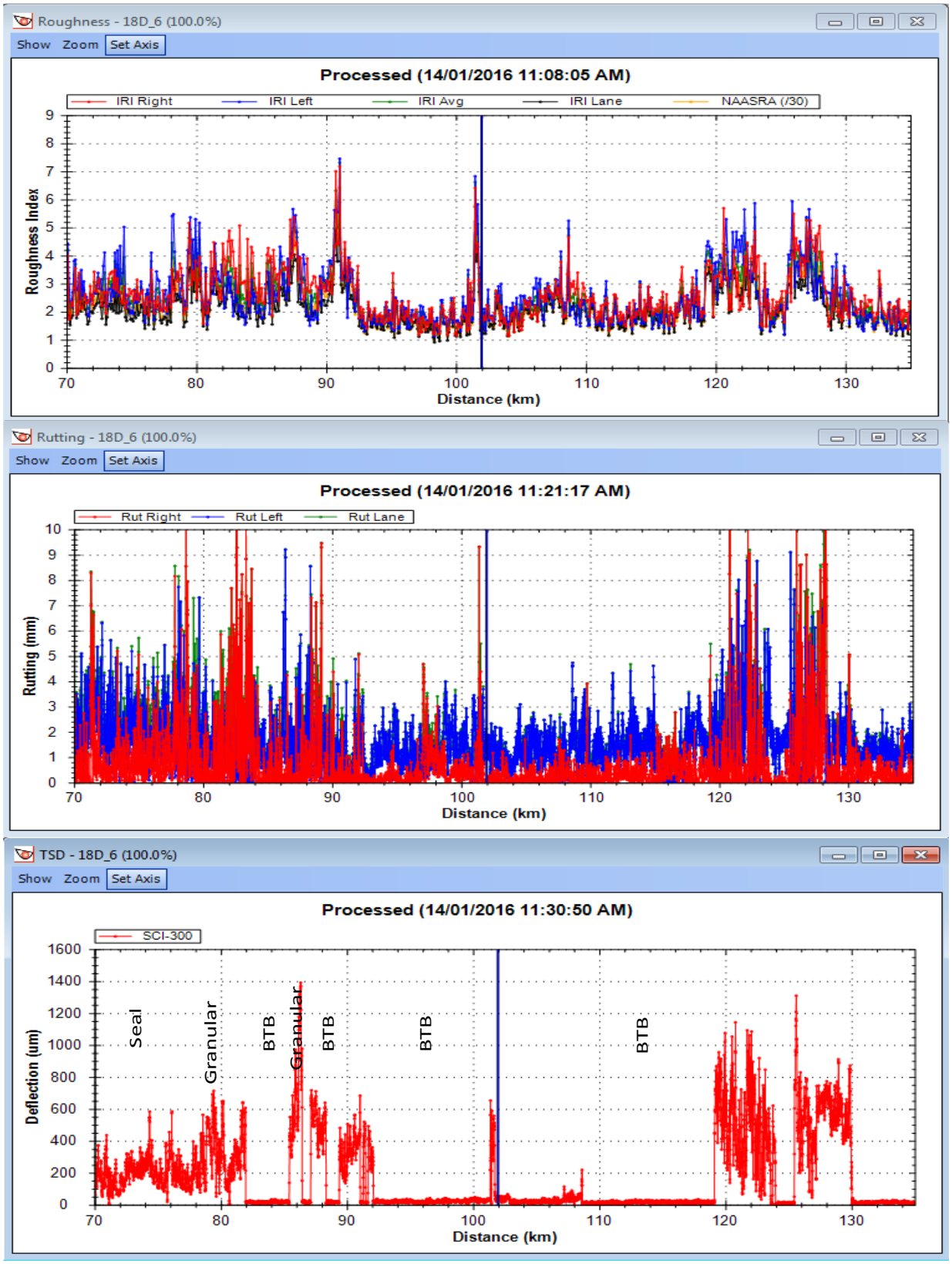


Figure A 6: Visual condition of the monitoring site along Warrego Highway, 18D

Chainage 70.0 km

Chainage 80.0 km

Chainage 88.0 km

Chainage 95.0 km

Chainage 100.0 km

Chainage 115.0 km