



TETRATHECA JUNCEA
MONITORING REPORT
FOR THE
KARUAH EAST QUARRY SITE
(PROJECT APPROVAL 09-0175)

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ABBREVIATIONS

DA	<i>Development Application</i>
EPA Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GPS	<i>Global Positioning System</i>
OEH	<i>NSW Office of Environment and Heritage</i>
PA	<i>Project Approval</i>
PPR	<i>Preferred Project Plan</i>
RMS	<i>NSW Roads and Maritime Service</i>
TJMP	<i>Tetratheca juncea Management Plan</i>



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I INTRODUCTION

Firebird ecoSultants has been engaged by Karuah East Pty Ltd to monitor the success of the translocation of the *Tetratheca juncea* in accordance with the Translocation Plan for *Tetratheca juncea* at Kaurah East Quarry prepared by Firebird ecoSultants (July 2015) to satisfy the requirements of the Project Approval (PA 09_0175) granted on 17 June 2014 for the Karuah East Quarry Project (Karuah East).

The expansion area of the Karuah East Quarry Project required a translocation program to be implemented for the threatened flora species *Tetratheca juncea*. 243 clumps of *Tetratheca juncea* were originally found to be within the area of development. The approved quarry expansion includes a biodiversity offset conservation area adjacent to the existing quarry. This area was investigated during the approval process and found 6324 clumps of *Tetratheca juncea*. At the time of translocation (May 2016), a total of 367 individuals (clumps) of *Tetratheca juncea* were recorded and subsequently translocated. It is acknowledged that translocation is not a mitigation measure and is considered as a supplementary action due to low certainty of success. In this instance, translocation has been proposed as an additional measure to gain a better biodiversity outcome. Translocation of the individuals to be impacted from within the impact area to the offset site will assist in protecting the genetic diversity of the population. Translocation has been successfully undertaken for *Tetratheca juncea* previously at other sites with a moderate survival rate of 27% after 5 years (Lake Macquarie City Council, 2013).

Alex Picton (Firebird, ecologist) and Nicolas Alexander (Firebird, ecologist) aided in the removal of 367 *T.juncea* individuals during their excavation from the impact site on the 11 May 2016 till the 23rd May 2016. The 367 individuals were translocated into pre-prepared areas within the proposed offset site now referred to as the Translocation Site within this report. An area of 2,500m² to 3,000m² has been identified in Lot 14 as the Translocation Site. Refer to Figure 1-1 for the location of the Translocation Site. The Translocation Site was selected to ensure that an appropriate vegetation community and aspect would be provided. By replicating the source environment as much as possible, the chances of translocation success was as high as practically possible.

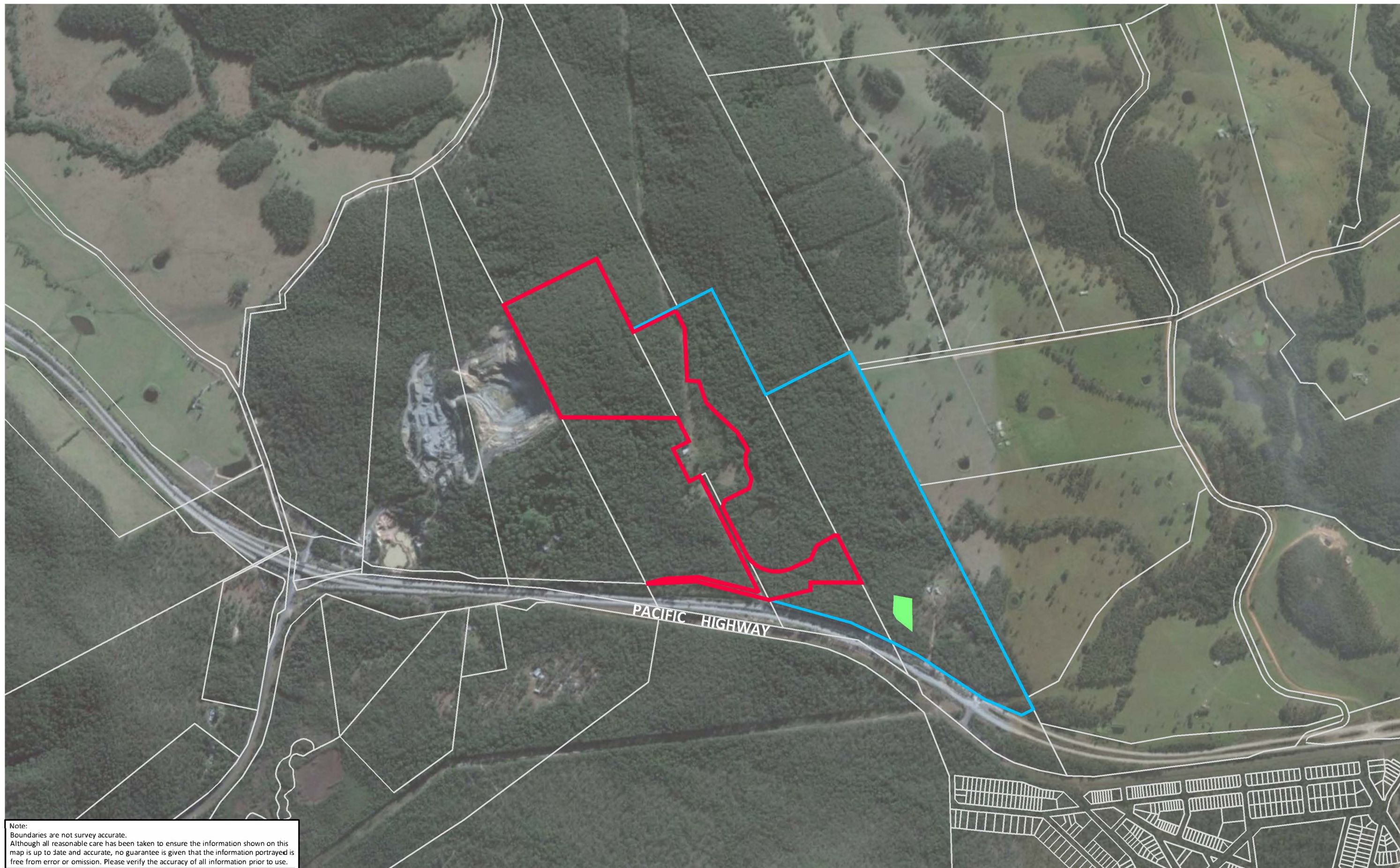
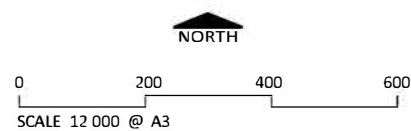


FIGURE 1-1: TRANSLOCATION AREA

CLIENT Karuah East Pty Ltd
SITE DETAILS Pacific Highway Karuah
DATE 19 July 2015

Legend

- ▬ Karuah East Hard Rock Quarry
- ▬ Offset Site (Owned)
- ▬ Translocation Area



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2 TRANSLOCATION PREPARATION

2.1 Marking Plants

Three hundred and sixtyseven clumps of *Tetralthea juncea* were removed from the impact site that were translocated as part of the development approval. The collection method entailed digging within the Translocation Site before collecting a translocation section from the impact area and placing the section into the hole within the Translocation Site. Site preparation included the removal of threatening processes that may impact upon the success of plant survival. These include weed control, protection from herbivory and management of fire risks. An irrigation system was installed to ensure moisture levels remain adequate for plant survival.

Removal of the plants were undertaken in patches that included numerous clumps. Each of these patches are referred to as a translocation section with Rows A1-A30 and B1-B14 the number of individuals were recorded for each row. Refer to Table 2-1 for results of number of individuals plants in each row.

Table 2-1 Number of *T. juncea* translocated

Row	Count of <i>Tetralthea juncea</i>
A1	6
A2	5
A3	5
A4	4
A5	6
A6	8
A7	4
A8	7
A9	5
A10	5
A11	8
A12	7
A13	4
A14	6
A15	6
A16	6
A17	10
A18	11
A19	10
A20	10
A21	8
A22	9

Row	Count of <i>Tetratheca juncea</i>
A23	8
A24	8
A25	12
A26	16
A27	13
A28	11
A29	10
A30	11
B1	11
B2	9
B3	11
B4	7
B5	6
B6	11
B7	9
B8	10
B9	9
B10	11
B11	10
B12	9
B13	12
B14	3
Total	367

The following methods were employed for the translocation program:

- An excavator was used to dig the plants out of the ground in large scoops. This ensured the plant would be removed with large root balls and soil from the source area.
- The excavator operator would carefully slide the plants with the clump of soil from the excavator's bucket onto the bucket of a front end loader.
- Once the front end loader was filled with approximately 6 excavator scoops, the driver would carefully transport the plants to the translocation area. The plants and soil from source area were carefully slid from the loader bucket by a labourer into the prepared holes.
- The area was watered immediately. The translocation sections received follow up watering to ensure establishment.

3 MONITORING RESULTS

Monitoring of the *T. juncea* individuals in accordance with the Translocation Plan for *T. juncea* (Firebird, 2015) has been undertaken by Firebird ecoSultants in October 2016, October 2017, September 2018, September 2019 and October 2020. Monitoring involved the following:

- Flower Counts
- Observe general plant health
- Identify all plants within each Section
- Photo points

A site visit was undertaken on 12 October 2020, at this time only six of the translocation rows were observed to have *T. juncea* that were in flower, otherwise the *T. juncea* within the translocation site were predominantly not in flower or have browned or died off completely. The translocation site is also extensively overgrown in some areas, particularly rows B1 to B7 which are covered in dense grass growing around 2 m in height. *T. juncea* are extremely difficult to find when not in flower, particularly in densely vegetated areas. Due to the extremely low number of *T. juncea* that were observed to be in flower at this time (seven individuals total), combined with the dense overgrown rows, it was decided that it was not viable to undertake the complete survey for 2020. Instead, rows that contained no flowering individuals were recorded as NFP (no flowering plants) because the number of *T. juncea* existing in these rows cannot be accurately counted. In the rows that did contain flowering plants, only the flowering plants and the number of flowers on each were counted.

The results displayed in Table 3-1 show that of the 367 individuals translocated, 118 have survived as of September 2019 and were showing signs of regrowth &/ or in flower. This presents an approximate survival rate of **38%**. As discussed above, accurate results for 2020 were not viable. Refer to Appendix A for Photos.



Table 3-1 Monitoring results of *T.juncea* plants recorded during the October 2020 survey

Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Monitoring Results September 2019	Monitoring Results September 2019	Flower Count
A1	6	6	5	2	1	NFP	Plant 1: 13 flowers.
A2	5	0	0	1	1	NFP	Plant 1: Green, no flower
A3	5	5	1	1	3	NFP	Plant 1: 0/BR, Plant 2: 0/BR, Plant 3: 3 flowers
A4	4	5	2	1	5	NFP	Plant 1: 12 flowers, Plant 2: 3 flowers, Plant 3: 1 flower, Plant 5: 2 flowers
A5	6	3	3	2	3	NFP	Plant 1: 0/BR, Plant 2: 1 flower, Plant 3: 0/BR
A6	8	8	4	5	3	NFP	Plant 1: 0/BR , Plant 2: 1 flower, Plant 3: 0/BR
A7	4	4	2	3	2	NFP	Plant 1: 7 flowers, Plant 2: 1 flower
A8	7	9	9	5	5	NFP	Plant 1: 4 flowers, Plant 2: 1 flower, Plant 3: 1 flower, Plant 4: 21 flowers, Plant 5: 3 flowers
A9	5	5	3	2	3	NFP	Plant 1: 4 flowers, Plant 2: 2 flowers, Plant 3: 0/BR



Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Monitoring Results September 2019	Monitoring Results September 2019	Flower Count
A10	5	3	1	1	1	NFP	
A11	8	7	1	2	2	NFP	
A12	7	8	4	1	3	NFP	
A13	4	4	1	2	2	NFP	
A14	6	6	0	2	1	NFP	
A15	6	6	5	5	3	NFP	
A16	6	4	4	4	3	NFP	
A17	10	4	10	2	3	NFP	
A18	11	11	8	4		NFP	



Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Monitoring Results September 2019	Monitoring Results September 2019	Flower Count
					3		
A19	10	8	5	4	4	NFP	
A20	10	9	5	2	3	NFP	
A21	8	8	2	3	3	NFP	
A22	9	8	7	5	6	1	Plant 1: 1 flower
A23	8	13	5	6	6	1	Plant 1: 12 flowers
A24	8	7	4	7	5	NFP	



Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Monitoring Results September 2019	Monitoring Results September 2019	Flower Count
A25	12	6	4	4	5	2	Plant 1: 3 flowers, Plant 2: 1 flower
A26	16	18	7	4	7	1	Plant 1: 4 flowers
A27	13	7	6	3	4	NFP	
A28	11	2	2	2	2	1	Plant 1: 3 flowers
A29	10	7	5	5	2	1	Plant 1: 1 flower
A30	11	10	6	3	4	NFP	
B1	11	12	4	4		NFP	



Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Monitoring Results September 2019	Monitoring Results September 2019	Flower Count
					6		
B2	9	8	4	3	4	NFP	
B3	11	9	6	3	6	NFP	
B4	7	5	5	3	4	NFP	
B5	6	6	5	3	3	NFP	
B6	11	7	4	1	4	NFP	
B7	9	8	7	3	3	NFP	
B8	10	7	4	5		NFP	



Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Monitoring Results September 2019	Monitoring Results September 2019	Flower Count
					3		
B9	9	6	5	2	2	NFP	
B10	11	11	5	2	2	NFP	
B11	10	10	6	3	0	NFP	
B12	9	10	5	3	2	NFP	
B13	12	10	5	3	3	NFP	
B14	3	9	1	4	2	NFP	
Total	367	319	187	135	140	7	

4 CONCLUSION

As discussed in previous section 3, a site visit was undertaken on 12 October 2020, at this time only six of the translocation rows were observed to have *T. juncea* that were in flower, otherwise the *T. juncea* within the translocation site were predominantly not in flower or have browned or died off completely. The translocation site is also extensively overgrown in some areas, particularly rows B1 to B7 which are covered in dense grass growing around 2 m in height. *T. juncea* are extremely difficult to find when not in flower, particularly in densely vegetated areas. Due to the extremely low number of *T. juncea* that were observed to be in flower at this time (seven individuals total), combined with the dense overgrown rows, it was decided that it was not viable to undertake the complete survey for 2020. Instead, rows that contained no flowering individuals were recorded as NFP (no flowering plants) because the number of *T. juncea* existing in these rows cannot be accurately counted. In the rows that did contain flowering plants, only the flowering plants and the number of flowers on each were counted. Refer to photos 1 to 5 in Appendix A for all individuals observed to be in flower as of 12 October 2020. Refer to photos 6 to 8 in Appendix A which show the densely overgrown translocation rows.

The year 2020 was to be the final year of monitoring of the translocation project. We have been unable to obtain sufficient data for the 2020 monitoring survey due to the low number of individuals in flower at the time. It is possible that *T. juncea* may have begun flowering earlier in the year and subsequently stopped flowering earlier in the year which may explain the lack of flowering individuals observed in October 2020. However, it is more likely that the chosen translocation site is just not suitable habitat for *T. juncea*. The chosen site is considered to be too structurally open with little to no canopy cover, with the exception of rows A20 to A30 which have some tree canopy cover. It has been observed in previous years that *T. juncea* appear to be healthier and show a higher rate of survival in rows that have canopy cover or in rows that are considerably overgrown with grassy or shrubby vegetation. Rows A20 to A30 have a much higher number of surviving plants and have significantly more canopy cover than rows A1 to A19, which in contrast have significantly lower rates of survival and very little canopy cover. It is possible that *T. juncea* within rows A1 to A19 may be experiencing too much direct sunlight. As such, it is recommended that native trees and shrubs are planted adjacent to and within rows A1 to A19 to create more shade for the *T. juncea* within these rows, however the trees and shrubs should be representative of species that occur in areas where *T. juncea* grow naturally. It is also recommended that any future translocations are to be replanted in areas with canopy cover that is representative of typical habitat *T. juncea*.

Firebird ecoSultants also sought advice from Dr Colin Driscoll who is a biologist with extensive experience working with *T. juncea*, including translocation projects for this species in the surrounding local government areas. Dr Colin Driscoll agrees with Firebird ecoSultants that the chosen translocation site does not represent suitable habitat for *T. juncea*, he also stated that in his experience over the years he has found that *T. juncea* translocation projects tend not to be very successful.



Previous monitoring of the *T. juncea* translocation, as of September 2019, has shown a survival rate of less than 38% for the fourth year of monitoring. Kleinfelder (2021) have also observed a decline in the *T. juncea* numbers within the Biodiversity Offset for the past five years. It is noted that the yearly rainfall totals as recorded by the Bureau of Meteorology's official weather station at Nelson Bay has been below the long-term average in 2016, 2017, 2018 and 2019. This suggests that the natural decline in *T. juncea* population could potentially be related to the drier than normal conditions in past years, although the year 2020 has experienced more rainfall than previous years. The lack of rainfall may have been a contributing factor in the steadily declining survival rate; however, we believe that the primary factor is that the translocation site is simply not representative of the habitat that *T. juncea* typically occur in.

In conclusion, Firebird ecoSultants believe that the translocation project for *T. juncea* at the Kaurah East Quarry has had a low level of success, with the survival rate steadily reducing each year. We believe that the low rate of success is primarily attributed to the selection of the translocation site, which does not adequately represent the habitat in which *T. juncea* are typically found. *T. juncea* are typically found on southern facing slopes with sufficient canopy cover. The chosen translocation site is located near the top of a hill with little to no canopy cover which we believe has exposed the translocated *T. juncea* to too much direct sunlight. We also believe that there may have been other contributing factors to the low success rate, such as the lack of rainfall in past years and the increase in average temperature attributed to climate change.

For future translocation projects, we recommend that the translocation sites be more carefully selected to be more representative of the habitat in which *T. juncea* are typically found, including flora species and structure, canopy cover, soil composition, slope and topography.



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APPENDIX A PHOTOS

Photos 1 to 5: *T. juncea* in flower in October 2020

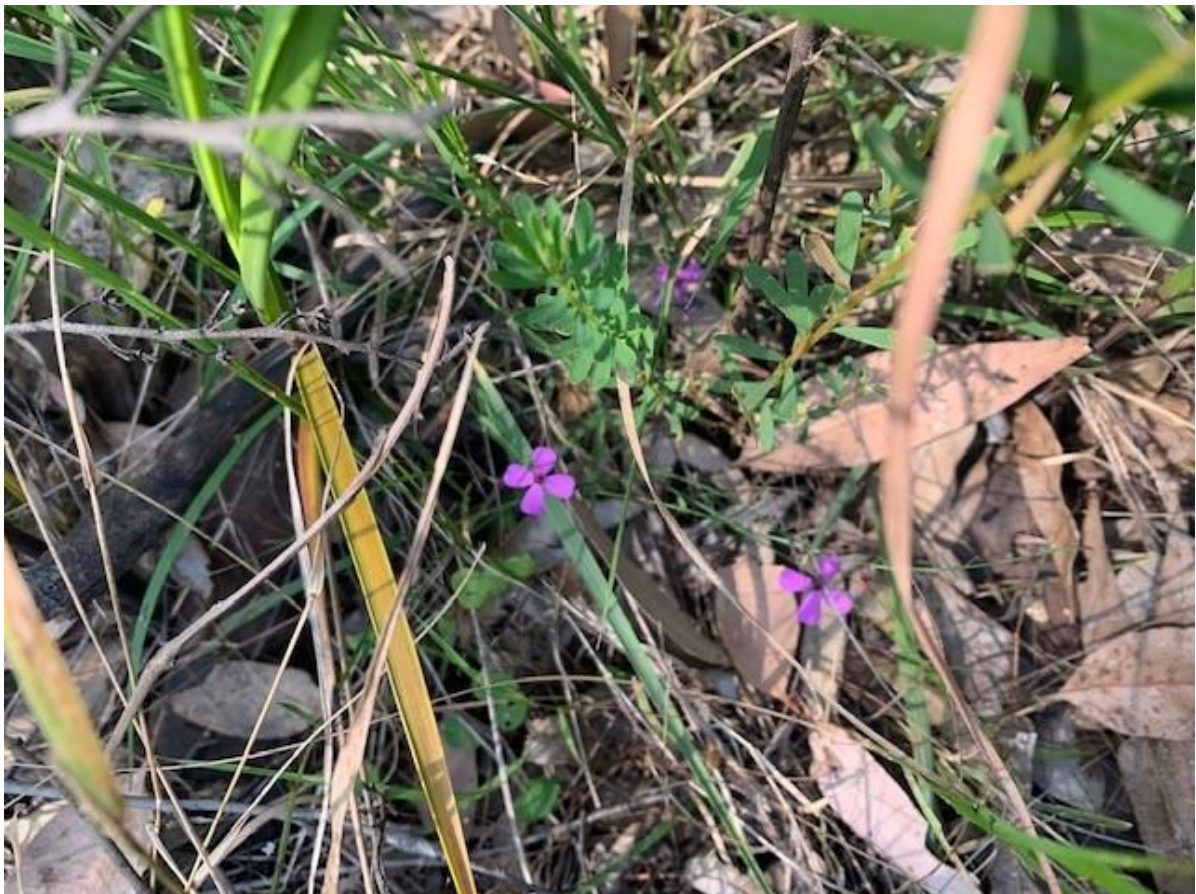






Photo 6 to 8: Considerable regrowth of native vegetation in translocation rows



