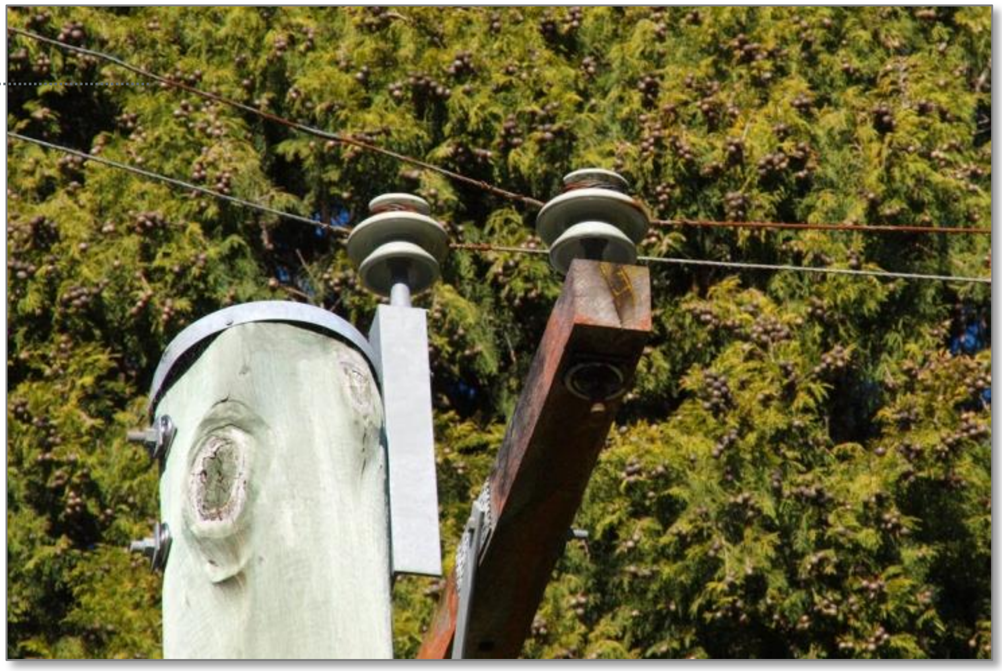

HV DISTRIBUTION STEEL MAINS REPLACEMENT PROGRAM

Project DS011.18 2017/18 business case

Prepared by Asset Strategy and Planning

January 2017

REVIEW AND APPROVAL SCHEDULE

Responsibility	Position	Name	Signature	Date
Author	Renewal Planning Engineer	Mark Alexander		31/01/17
Reviewed	Senior Renewal Project Development Engineer	Jonathan Cook		31/01/17
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Approved	Acting Manager Asset Strategy and Planning	Manoraj Jayasekara		31/01/2017

CONTENTS

1.0 EXECUTIVE SUMMARY

The purpose of this business case is to seek approval for the next stage of the program of replacement of steel mains in Endeavour Energy's distribution network commencing in 2017/18.

Endeavour Energy has approximately 11,300km of overhead lines at 11, 12.7 and 22kV throughout its distribution network. Of these, approximately 1,500km utilise galvanised steel conductors.

These types of conductors have generally been used in the past in lines with long spans in rural areas and have the potential to fail as they age and are subject to corrosion and/or vibration and fatigue.

In rural areas, a live conductor falling off a pin insulator can hang above ground presenting a significant hazard for personnel and livestock. A conductor which sits on a wooden cross-arm or falls to the ground has the potential to initiate a bushfire as well as causing a hazard for the public and impacting supply reliability. Furthermore, damaged conductors can fail during live-line work posing a significant hazard for the Company's live-line workers.

Concern over the risks presented by steel mains, reinforced by the recommendations of the Victorian "Powerline Bushfire Safety Taskforce Final Report" of September 2011, which called for the progressive replacement of steel conductors with a suitable alternative to reduce bushfire risk, led to the elevation of the priority of these works with a strategy approved by the Board in November 2010. Subsequently, a specific project was established and funding for completing the program of replacement of steel mains in bushfire areas through-out Endeavour Energy's network over a nominal 10-year period was endorsed.

The scoping study carried out in the initial stages of the program indicated that a large proportion of the steel mains in the network appeared to be in reasonable condition at present although at risk of failure due to impact from nearby trees. However, there are a number of caveats to this result – firstly that steel conductor often fails due to stress fractures, which are caused by excessive stringing tension when the line was originally installed and subsequent vibration. This damage is not visible to an inspection and therefore there is generally no warning of impending failure. This appeared to be the cause of the failure of a steel conductor during live-line work at Rylstone during October 2011.

Furthermore, galvanised steel conductors remain in apparently good condition until the galvanising is consumed and then the underlying steel corrodes. In some situations the corrosion of the steel conductor proceeds rapidly with a corresponding increasing risk of failure. Given that the majority of the steel mains in the network were installed in a relatively short period during the rural electrification schemes of the 1950's through to the 1970's, there is concern that there will be a rapid decrease in the condition of a large volume of mains with a subsequent increase in risk of failures in the near future.

These two issues have informed the development of a two-pronged approach to the management of steel mains which includes:

- Targeting high–risk sections of mains for replacement in the short-term;
- Conducting a strategic replacement program to replace all aged steel mains in high bushfire risk areas over a longer period of time.

Furthermore, steel mains are generally installed in rural areas which are remote from field service centres and often have poor access. Accordingly, it is efficient to mobilise to replace whole sections of the feeder at a time rather than just addressing the often small parts within the line which present a particularly high risk and then returning to work on other sections of the line at a later date.

280km of generally the highest risk sections are expected to have been replaced by the end of 2016/17 leaving some 870km of steel mains in service in high-risk bushfire areas and therefore in the replacement program DS011.

Based on previous replacement works undertaken within the DS011 program, which includes a range of terrain, line types including three phase, single phase and SWER and varying quantities of pole replacements and delivery models, the average rate of replacement is $95,000/km.

Furthermore, the actual projects undertaken to date indicate that the average cost of surveying and design is $5,000/km.

After consideration of the prioritisation of the replacement works based on the results of the scoping study, the regions' experience and fault records it is proposed that the next phase of the program include the replacement of 60 km of mains in 2017/18.

The proposed scope also includes design works for the next stage of the works, further condition assessment study and allocation for the reactive replacement for 3km's of mains identified through PSBI's.

The project costs total $6.65 million in nominal terms which falls within the "short-term" funding allocation within the PIP (v8.1) of $6.66 million over the period of 2017/18.

No contingency amount is proposed as there are sufficient sub-projects within the overall project to provide diversity and allow under and over expenditures between sub-projects to balance out.

Capital overheads are calculated to be $2.15 million giving a total project cost of $8.80 million.

Accordingly, this business case seeks:

- Approval for an expenditure of $8.80 million to fund the next stage of the program of replacement of high-risk steel mains at specific locations throughout Endeavour Energy's network commencing in 2017/18.

The program amount comprises base costs of $6.65 million, $0 contingency and overheads of $2.15 million.

2.0 INTRODUCTION

2.1 PURPOSE

The purpose of this business case is to seek approval for the next stage of the program of replacement of steel mains in Endeavour Energy's distribution network commencing in 2017/18.

Approval is sought for the replacement of 59.5 kilometres of mains with an allowance for design works for the next stage of the works, further condition assessment study and allocation for the reactive replacement for 3km's of mains identified through PSBI's at a total estimated program cost of $8.80 million including $6.65 million for base costs and $2.15 million for overheads.

2.2 BACKGROUND

Endeavour Energy's high voltage distribution network contains approximately 11,300km of overhead lines including 11kV and 22kV three phase and single phase (2 conductor) lines and 12.7kV single wire earth return (SWER) lines. Most of these lines utilise aluminium conductors but approximately 1,500km[1] utilise galvanised steel conductors or steel reinforced aluminium conductor (ACSR). Unlike modern ACSR conductors, which consist of aluminium conductors wrapped around galvanised steel reinforcing wires which are in turn protected from moisture by a grease packing, the older ACSR used galvanised steel wires wrapped together with the aluminium conductors. Thus the steel wires are exposed to the atmosphere and are susceptible to corrosion effects.

These types of "steel" conductors have been used for many years by most supply authorities in Australia where long spans in rural areas are required. The majority of the steel mains were installed during the 1950's - 1970's as part of the NSW Rural Electrification schemes. The conductors generally perform well when installed at the correct tension and in predominantly dry environments. However, in wet environments or where the stringing tension is too high (and/or vibration dampers have not been fitted), failures can occur over time due to corrosion and/or vibration and fatigue.

A further risk is that the tie wires which secure the steel conductors to the pin insulators used on top of the cross-arms also corrode and can fail allowing the conductor to fall onto the cross-arm with the potential to start a fire or to fall off the cross arm and hang at a low level above ground. This type of failure is particularly hazardous as the conductor will remain energised, presenting a risk of electrocution to personnel and livestock until the failure is observed and reported. These types of failures have occurred in Endeavour Energy's network in the past and resulted in death of cattle.

Furthermore, moisture is trapped between the conductor and the pin insulator and tie wires causing frequent failure of the steel conductors and or tie wires at that location. Unfortunately, degradation in this area is not readily visible from the ground and so little warning of impending failures is usually received from the routine ground line and overhead line inspection process.

In rural areas, live conductors which fall to the ground have the potential to initiate bushfires. Other risks include causing a hazard to the public and impacting supply reliability. Furthermore, damaged conductors and tie wires can fail during live-line work posing a significant hazard to the company's live-line workers. As a result of a failure of a steel conductor during live-line work at Rylstone in 2011 [1], live-line work is currently not permitted on lines with steel conductors.

Steel conductors were predominantly installed in Endeavour Energy's network up until the late 1960's with lesser volumes installed during the 1970's - 1980's and therefore many of these conductors are now 50 or more years in age and failing due to corrosion and fatigue.

Concern over the increasing rate of failure of steel mains with the subsequent risks noted above and increasing demand on maintenance and repair resources, led to the initiation of a refurbishment program to replace steel conductors under SARP program DS00402 in 2003.

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[1] The volume is constantly changing as steel mains are replaced and sections of lines with "unknown" conductor types are resolved.

However, implementation of the program since that time has been largely reactive due to the limited availability of internal resources in the regions and the remote and inaccessible locations of many of the lines.

After the bushfires in Victoria in 2009, concern over the risks presented by steel mains, reinforced by the recommendations of the Victorian "Powerline Bushfire Safety Taskforce Final Report" of September 2011 [2], which called for the progressive replacement of steel conductors with a suitable alternative to reduce bushfire risk, led to the elevation of the priority of these works with a strategy approved by the Board in November 2010 [3].

Subsequently, a statement of asset need was issued by Network Engineering in June 2012 [4] to accelerate the steel conductor replacement program and a new SARP program DS011 was developed to elevate the priority of the these works and ensure adequate funding was available.

The proposed program included a strategic approach which recognised that there was a large volume of steel mains in the network which was already past its nominal life of 40 years and therefore may deteriorate rapidly and require replacement in a relatively short timeframe in the near future. In response to this risk, a program of strategic replacement was developed aimed at replacement of approximately 600km of steel mains over a ten-year period from 2013/14. The works were to target high risk mains first and then work steadily through the network replacing all steel mains with the potential to fail and initiate a bushfire or impact the safety of the personnel. The total estimated cost of this program was $107 million (in nominal terms). This program was endorsed by the Board and funding for the first stage of the works was approved in June 2013.

At the same time, a ground level visual based inspection and scoping study was being carried out by Program Director/Capital Programs to provide a more comprehensive view of the volume and condition of steel mains in the distribution network and the risks that it presents.

The scoping study indicated that a large proportion of the steel mains in the network appeared to be in reasonable condition at present although at risk of failure due to impact from nearby trees. However, there are a number of caveats to this result – firstly that steel conductor often fails due to stress fractures, which are caused by excessive stringing tension when the line was originally installed and subsequent vibration. This damage is not visible to an inspection and therefore there is generally no warning of impending failure.

Furthermore, galvanised steel conductors remain in apparently good condition until the galvanising is consumed and then the underlying steel corrodes. In some situations the corrosion of the steel conductor proceeds rapidly with a corresponding increasing risk of failure. Given that the majority of the steel mains in the network were installed in a relatively short period during the rural electrification schemes of the 1950's through to the 1970's, there is concern that there will be a rapid decrease in the condition of a large volume of mains with a subsequent increase in risk of failures in the near future.

280km of generally the highest risk sections are expected to have been replaced by the end of 2016/17 leaving some 870km of steel mains in service in high-risk bushfire areas and therefore in the replacement program DS011.

The 2014/15 business case proposed an expanded strategic replacement program to extend for 17 years until 2029/30 at a nominal rate of 60km per year. That proposal was subsequently endorsed and therefore forms the basis of the ongoing replacement program of which this business case is part of.

This business case is proposing approval for the funding for the next stage of replacement works to be undertaken in 2017/18.

3.0 PROJECT NEED

3.1 CONDITION ASSESSMENT

An initial scoping study carried out during 2013/14 involved a ground based visual inspection of every section of high voltage distribution mains that was recorded in the Ellipse database as being of steel or small diameter ACSR construction and was located in non-urban areas. This inspection was conducted at the base of the pole or at distance through binoculars where access was limited. Each instance of steel mains was verified for its type and location and assessed for its risk in accordance with the *Steel Wire Replacement Strategy [5]*.

Also included was an assessment of the consequence of failure, such as being located in a designated bushfire prone area.

Since the completion of the scoping study, the assessment of steel mains has been enhanced by the revision of supporting standards and release of technical bulletin updates: MMI 0001 section 5.10.7 [8], TB-0189 [9] and TB-0194 [10] for the reporting of failures and locations of lines in particularly poor condition or at high risk of failure.

A further risk assessment *Steel Mains Failure Risk and Replacement Cost Modelling* was published June 2016 [11]. This report focused on the possible impact of bushfire which could be caused by mains down incidents and is based on the CSIRO Phoenix/Tolhurst fire risk model (Tolhurst 2014).

To select the highest priority sections for replacement during the next stage of the program, 300km of the highest risk mains were assessed for their condition by examining high resolution photos of the line taken during the 2016 pre-summer bushfire aerial inspections.

This scoping study has identified the 59.5km of mains which presents a high bushfire impact risk and was in the poorest condition for replacement in 2017/18.

Figure 1 below shows an example of 7/0.064 steel conductor in service at 11kV at Leura. The outer phases are more effected by corrosion than the inner phase and all are showing more corrosion at the pin insulator.

FIGURE 1 - CORRODED 7/0.064 SC/GZ CONDUCTOR IN SERVICE AT LEURA

Figure 2 shows a piece of 3/0.104 SC/GZ conductor which was removed from Lowther Siding in the Good Forest area in March 2015. This conductor shows widespread corrosion and some loss of section and would be considered to be at high risk of failure, both due to the corrosion damage it has suffered and also due to its very small diameter. Figure 3 shows a 7/0.064 SC/GZ conductor which failed on top of its pin insulator at Mount Irvine in 2012.

FIGURE 2 - CORRODED 3/0.104 SC/GC CONDUCTOR

FIGURE 3 - FAILED 7/0.064 SC/GZ CONDUCTOR

3.2 REPLACEMENT PRIORITISATION

The 2013/14 scoping study has been able to provide higher priority sites to date. Progress within the steel mains replacement program has seen 280km of the 1,150km steel mains SC/GZ and small ASCR replaced (with the inclusion of expected works scheduled for completion within 2016/17).

An increased understanding of the conditions and risks has since been applied to assist in evaluating steel mains to identify the next sections for replacement.

The sections of steel mains are prioritised for replacement based on:

- Impact of bushfire provided by the *Steel Mains Failure Risk and Replacement Cost Modelling* and the likelihood of failure;
- Known problem lines in remote areas; and
- The condition as assessed by desktop inspection of aerial images of the pole top.

Based on the bushfire risk modelling 300km with the greatest bushfire impact-risk in the event of a failure has been identified and reviewed to confirm the highest priority sections for inclusion into 2017/18 program. The condition of these sections have since been validated through a review of aerial images of the pole tops provided with the most recent PSBI LiDAR surveys and prioritised for replacement in accordance with TB-0194 [9] from category rating 5 (highest) to 1 (lowest) as shown in Figure 4 below. This has allowed the program to be broken into manageable packages of works on a priority basis.

FIGURE 4 – VISUAL COMPARISON OF CONDUCTOR CORROSION CATEGORIES

The desktop condition review of the 300km of steel mains reviewed indicated that there were nil category 5 conductors in the field requiring immediate attention. Further, 42.5 km was assessed as category 4 requiring replacement in the short term.

Table 1 shows the categorised risk profile of 300km of the steel mains assessed as having to create the greatest bushfire impact-risk in the event of a failure.

TABLE 1 - RISK PROFILE OF THE HIGHEST RANKED 300KM OF STEEL MAINS

Assessed risk level		Length in each region (km)			Total lengths (km)	Total lengths (%)
Corrosion category rating	Description	Northern	Central	Southern		
1	No Corrosion, 100% galvanised	29.5	70.0	13.1	112.6	38%
2	Light surface corrosion	17.1	20.6	2.4	40.1	13%
3	Medium Surface corrosion	68.3	34.4	0.2	102.9	35%
4	Heavy Surface corrosion	25.8	13.4	3.3	42.5	14%
5	Heavy Surface corrosion with history of failure	0	0	0	0	0%
Totals		140.7	138.4	19.0	298.6	100%

3.3 REPLACEMENT CONDUCTOR

The *Steel Wire Replacement Strategy* prepared by Asset Standards and Design provides a guide to the replacement approach for sections of steel mains [5].

A further assessment by Asset Standards and Design in 2014 resolved that 3/4/2.5 mm “Raisin” ACSR conductor has adequate load rating, fault rating and voltage drop characteristics for the majority of situations where steel mains are being replaced and has similar sag properties to the mains being replaced. Therefore, Raisin ACSR which has a copper equivalence of 0.015 square inches is proposed as the default replacement conductor. Refer to Appendix A for further detail.

Sections of steel mains which are in the backbone parts of feeders should be referred to Asset Strategy and Planning for an assessment of the capacity required of the replacement conductor.

3.4 SCOPE OF WORKS OF EACH PROJECT

The scope of the works for each section of line typically includes:

1) Inspection of the section for replacement;
2) Forward to Asset Strategy and Planning for assessing network needs if required;
3) Survey the section of line including new profiling to current standards of clearance;
4) Desktop design;
5) Check design on site, confirming measurements, pole heights and condition; access constraints, vegetation constraints;
6) Carry out Environmental Impact Assessment;
7) Finalise design taking into account the environmental assessment;
8) Forward design to Network Mains for dispensation if design standards cannot be met at reasonable cost;
9) The construction works.

3.5 UNKNOWN AND UNIDENTIFIED STEEL CONDUCTORS

The 2014/15 scoping study revealed that within Ellipse there are currently approximately 200km of 11 and 22kV mains whose type is recorded as “unknown”. Typically this conductor is in rural areas and so it is expected that a proportion of this may be steel mains in bush-fire prone areas. It is proposed that any additional sections of steel mains discovered through PSBI as high priority has the ability to be incorporated into the program as they are found, based on their condition and level of risk they present.

3.6 ISSUES THAT AFFECT THE COST OF THE WORKS

These issues influence the cost of the replacement works and should be considered in detail during the design stage of each project within the program.

3.6.1 GROUND CLEARANCE

In some instance the original conductor was strung at lower than current standard ground clearances. Typically clearances across paddocks may be 5.9m. Lifting this to current standard of 7.5m as specified by standard MDI0031 [6] often requires replacement of a significant proportion of poles with taller poles or the inclusion of additional poles. Dispensation to string to 6.7m (in accordance with AS/NZS 7000 [7]) in non-trafficable areas can reduce costs significantly in some locations and may be pursued if the standard clearances cannot be achieved at reasonable cost.

3.6.2 STANDARD OPERATING TEMPERATURE

The current standards require stringing for a maximum conductor operating temperature of 75^{o}C. In some situations, due to light loading, this operating temperature will never be reached and costs can be reduced significantly by seeking dispensation for a lower maximum operating temperature of typically 50^{o}C.

3.6.3 STRINGING TENSION

The original steel conductors were in some instances strung at high tensions, which coupled with the lack of vibration dampers, leads to premature fatigue and failure of the conductors. Replacing conductors at the correct tensions often requires taller poles or more numerous poles to achieve the required ground clearance.

3.7 TIMING OF DESIGN WORKS

Each year an allowance for ongoing design works is proposed to be included to ensure that designs are completed ready for construction at the start of the following year in anticipation of the program continuing as proposed.

This will also allow for more accurate estimates of the cost of the upcoming works to be made and streamline the commencement of the delivery phase in each subsequent year.

3.8 NETWORK AUGMENTATION

As noted above, where there are options for straightforward steel for steel replacement but there are advantages for voltage regulation or back-up supply capacity to augment the mains to a larger conductor at additional cost, then that project should be addressed as a Distribution Works Program (DWP) project and assessed for priority with other DWP projects.

Likewise, augmentations from SWER to multi-phase construction should be assessed as DWP projects.

However, where an upgrade to aluminium conductor is the practicable approach in accordance with the conductor replacement criteria noted in Section 3.3 above, the project should remain in this program.

4.0 PROJECT DETAILS

4.1 REPLACEMENT UNIT RATES

The rate of replacement to date varies from $77,000 per kilometre for the most straightforward replacement of SWER or single phase spur lines with little or no pole replacement requirements and reasonable terrain and access to $139,000/km for three-phase backbone line replacements where a large volume of poles are required to be replaced and access is poor. Based on the locality of each of the individual priority sites selected for replacement, the unit rate of $95,000/km will be used as the guide for budgeting purposes going forward.

This rate does not include the design costs. A review of a sample of sections designed indicates that a nominal rate of $5,000/km of line to be replaced is reasonable estimate of average design costs.

4.2 NEXT STAGE OF WORKS 2017/18

The next stage of the program proposed for completion with 2017/18 includes:

1. Design and replacement of 59.5km of Steel mains;
2. Scoping Study for the remaining 570km of steel mains;
3. A further 60km of design works proposed for construction in 2018/19; and
4. An allowance for 3km of high priority unknown and unidentified sections of steel mains discovered through PSBI.

After consideration of the prioritisation of the replacement works based on the outcome of the scoping study results detailed in Table 1, it is proposed that the next phase of the program include the replacement of 59.5 km of steel mains which includes the 42.5 km's of the highest priority sections of mains with corrosion ratings of category 4 and 17 km's of category 3 sites local to the category 4's to help drive delivery efficiencies. This total is spread over North, Central and Southern regions with the majority of the works in the Northern Region.

A summary of the proposed works and their costs, based on the average unit rates noted above, is shown in Table 2 below. Costs are in real 2017/18 terms. Refer Appendix B for details of the work proposed.

TABLE 2 - SUMMARY OF PROPOSED CONSTRUCTION WORKS IN EACH REGION

Year	Region	Category 3 length (km)	Category 4 length (km)	Length (km)	Cost ($)
2017/18	Northern	8.2	25.8	34.0	3,230,000
	Central	8.6	13.4	22.0	2,090,000
	Southern	0.2	3.3	3.5	332,500
Totals		17.0	42.5	59.5	5,652,500

With the recent enhancements made by the revision of supporting standards, risk assessment *Steel Mains Failure Risk and Replacement Cost Modelling* and LiDAR/aerial pole top images, it is estimated that $100,000 will be required to complete the desktop review of the condition of the remaining 570kms of HV distribution steel mains in bush fire-prone areas across the three regions as shown in Table 3 below. Scoping study requirements are outlined in Appendix C and D.

TABLE 3 - PROPOSED FUNDING FOR SCOPING STUDY IN 2017/18

Labour resource	Labour rate per hour ($)	Scoping study 570km's ($)	GIS update submission ($)	Total ($)
Scope reviewer #1	99.54	40,000	10,000	50,000
Scope reviewer #2	99.54	40,000	10,000	50,000
Totals	199.08	80,000	20,000	100,000

In addition to the 59.5km of design works identified for the replacement as outlined in Appendix B, an allowance for 60km of further design works is proposed to be included to ensure that designs are completed ready for construction at the start of the following year in anticipation of the program continuing. These sites will be selected by AS&P from Appendix E post-completion of the desk-top scoping study. Table 4 below shows a summary of the sections which require design in each regional area and an estimate of their costs.

TABLE 4 - PROPOSED FUNDING FOR DESIGN WORKS IN EACH REGION

Region	For construction in 2017/18	For proposed construction in 2018/19	Length (km)	Estimated cost ($)
North	34.0		34.0	170,000
Central	22.0		22.0	110,000
South	3.5		3.5	17,500
Unspecified		60	60.0	300,000
Totals	59.5	60	119.5	597,500

It is also proposed that an allowance is available for approximately 3km of high priority unknown and unidentified sections of steel mains discovered through the PSBI. These would be incorporated into the program as they are found based on their condition and level of risk they present. These changes would be required to be managed through the process outlined in MMI 0001 section 5.10.7 [10] and submitted for AS&P endorsement through the change control process. Proposed funding for these unspecified PSBI sites are shown in Table 5 below.

TABLE 5 - PROPOSED FUNDING FOR UNSPECIFIED PSBI SITES

Region	Total length (km)	Estimated cost ($)
Unspecified	3.0	300,000
Totals	3.0	300,000

4.3 COST ESTIMATES

At a nominal unit rate of $95,000/km the estimated costs for the 59.5km of mains proposed to be replaced under this business case is $5.65 million. The allowance for design works of $598,000, scoping study $100,000 and allocation of funds of $300,000 for high priority PBSI sites gives a total of direct costs for the program of $6.65 million in real 2017/18 terms.

Capital overheads in this case are estimated to be $2.15 million giving a total program cost, in nominal terms of $8.80 million.

Table 6 below shows the nominal break-up of the costs for the program in real terms including the PIP allocation and overheads.

TABLE 6 - PROGRAM ESTIMATED COST SUMMARY

ITEM	Rate ($/km)	Quantity (km)	2017/18 ($M)
PIPv8.1			**6.662**
Construction works	95,000	59.5	5.653
Scoping study		570.0	0.100
Design works	5,000	119.5	0.598
Reactive allocation PSBI Sites	100,000	3.0	0.300
Subtotal program costs			6.651
Subtotal program costs			**6.651**
Overheads (32.25%)			2.145
Total Program Costs			**8.796**

4.4 CONTINGENCY PROVISION FOR ADDITIONAL REPLACEMENTS

This stage of the steel mains replacement program contains a total of 46 packets of work, although many of these packets adjoin each other and will be designed and constructed as single projects. In practice, there are cost over-runs and underspends spread across the projects in the program. It is expected that these will balance out within the program and therefore it is proposed that no contingency amount should be applied to this approval.

Furthermore, any unforseen costs which increase the cost of delivery in general will be compensated for by a reduction in the volume of work completed and be managed via the change control process.

Likewise, any additional high-risk mains discovered during PSBI may be included into the program at an appropriate point. These changes will be required to be managed within the proposed funding outlined in Table 5 for unspecified sites and included into DS011 through the change control process.

4.5 FUNDING PROVISIONS

As noted in Table 6 above, the PIP (v8.1) includes adequate funding in 2017/18 for the proposed works. Table 7 below shows the PIP summary for the program DS011.

TABLE 7 - PIP SUMMARY

PIP element	PIP rating
Project ID	DS011s
Principal driver	Renewal
Risk level	High
Priority ranking	4,200
Percentage	43.24%

4.6 DATA RECORDING REQUIREMENTS

In order to facilitate the planning of the later stages of the program it is essential that details of the works carried out and the costs of those works for each is recorded in G:\SHARE\Renewal NIO-CWA\DS011 - steel distribution mains\2017-18:

- The details of scope of each project including:
    - Type of mains replaced (SWER, single-phase, three-phase);
    - The original conductor;
    - Lengths of mains replaced;
    - Number of poles replaced.
- Photographs of the original conductor on top of pin insulators and other areas where condition is poor and risk of localised failure is considered to be high.

5.0 RECOMMENDATIONS

It is recommended that:

- An expenditure of $8.80 million be approved to fund the next stage of the program of replacement of high-risk steel mains at specific locations throughout Endeavour Energy's network during 2017/18.

The program amount includes base costs of $6.65 million, $0 contingency and overheads of $2.15 million.

6.0 APPENDICES

APPENDIX A - Steel Mains Replacement Conductor, Network Mains Manager, September 2014

APPENDIX B - Details of Proposed 2017/18 Replacement

APPENDIX C - Steel Mains Scoping Study Specification

APPENDIX D - Steel Mains Condition Assessment Guide for Completion of Desktop Study

APPENDIX E - List of Remaining 570km of Steel Mains.xlsx

7.0 REFERENCES

1. Reliability Incident investigation Report, Rylstone Steel Conductor Failure, 7 October 2011, Network Performance and Compliance.
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3. Integral Energy Australia Board Paper – November 2010, Strengthening causal controls to mitigate network bushfire risk
4. Statement of Asset Need – Overhead Steel Conductor Replacement, Network Engineering, 5 June 2012
5. Steel Wire Replacement Strategy, Network Engineering, Endeavour Energy, March 2013
6. MDI0031 Overhead distribution: Design standards manual. Am3, Endeavour Energy, 14 September 2011
7. AS/NZS 7000:2010 Overhead line design - Detailed procedures

8. MMI 0001 section 5.10.7: Pole and Line Inspection and treatment Procedures. Endeavour Energy, 8 November 2016
9. TB-0189: Further Actions for Overhead Conductors Found in Poor Condition. Endeavour Energy, 15 May 2015
10. TB-0194: Assessment Criteria for Overhead Steel Conductors. Endeavour Energy, 2 July 2015
11. Steel Mains Failure Risk and Replacement Cost Modelling. Endeavour Energy, 9 June 2016

APPENDIX A - STEEL MAINS REPLACEMENT CONDUCTOR

From: David Mate
Sent: Friday, 19 September 2014 3:44 PM
To: Bruce Scoble; Paul Matlawski; Jason Lu; James Lound; Craig Brown; Frank Zammit; Sanja Milosavljevic
Cc: Stewart Daniel; Jude Perera; Peter Scholte; Kelly Hammonds; Lee Wiggins
Subject: Steel Mains Replacement Conductor

Hi All,

In relation to the steel mains replacement program the following approach is proposed.

In order to reduce the need for additional poles and to generally construct with standard height distribution poles, a conductor with a mechanical performance similar to the existing steel conductor is the preferred option.

This issue has been investigated by Network Mains and in order to meet the minimum load requirements specified by Network Planning, it is recommended that an ACSR conductor (Raisin) with a 3/4/2.50 stranding be adopted as the standard replacement conductor for steel mains replacement projects going forward.

Raisin conductor has similar mechanical / pole loading requirements and a slightly higher sag characteristic than the previously proposed 7/2.0 steel conductor however it is expected that the required ground clearance should be achievable with standard height distribution poles. The design temperature for ground clearance checks is 75°C with a maximum design tension of 25% CBL. If the terrain is such that a lower tension can be utilised and still obtain ground clearance then this should be adopted.

Where ground clearance cannot be obtained utilising the above limits, the particular project is to be referred to the Network Mains for investigation. Options including the use of 15.5 m poles and the reduction in maximum operating temperature will be considered for steel wire replacement projects.

Considering the electrical and mechanical characteristics of the proposed 3/4/2.50 (Raisin) conductor meets all of the current load requirements from Network Planning and has similar mechanical / sag characteristics to the existing and proposed steel conductors, at this stage a further investigation into introducing a standard steel conductor will not continue unless the use of Raisin results in a large number of design issues which it is not expected to do so.

If there are any comments / concerns please send them through so that they can be addressed to allow these projects to continue.

Regards,
David

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Network Mains Manager

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APPENDIX B - DETAILS OF PROPOSED 2017/18 REPLACEMENT

Section Included for Delivery in B	Feeder	Conductor	Steel Mains Section		Region	Depot	Location	TB-0194 Category Rating (1 to	Route Length (Re-checked)	Comment
			Pole From	Pole To						
BC1718-13	BWH2	B7 - 3/4/0.0661 ACSR/GZ (Wagtail) (OH) 11	PL3XP174	PL3XP177	Central	Moss Vale	Spring Hill Rd, Woodlands	4	540	Corrosion evident at terminations and along conductors.
BC1718-13	BWH2	B7 - 3/4/0.0661 ACSR/GZ (Wagtail) (OH) 11	PL3XR038	PL3XP106	Central	Moss Vale	Wombeyan Caves Rd, High Range	3	790	Some corrosion evident at old connection points
BC1718-13	BWH2	B7 - 3/4/0.0661 ACSR/GZ (Wagtail) (OH) 11	PL3XP106	PL3XP101	Central	Moss Vale	Wombeyan Caves Rd, High Range	3	840	Some light corrosion evident along conductors.
BC1718-13	BWH2	B7 - 3/4/0.0661 ACSR/GZ (Wagtail) (OH) 11	PL3XP003	PL3XP005	Central	Moss Vale	Wombeyan Caves Rd, High Range	3	1720	Light corrosion evident along conductors on multiple poles.
BC1718-13	BWH2	B7 - 3/4/0.0661 ACSR/GZ (Wagtail) (OH) 11	PL3XP009	PL779116	Central	Moss Vale	Wombeyan Caves Rd, High Range	3	805	Light corrosion evident along conductors on multiple poles.
BC1718-13	BWH2	B7 - 3/4/0.0661 ACSR/GZ (Wagtail) (OH) 11	PL3XP101	PL3XP099	Central	Moss Vale	Wombeyan Caves Rd, High Range	3	620	Corrosion evident along conductors.
BC1718-13	BWH2	A6 - 3/4/1.75 ACSR/GZ Hi Strength Quince (OH) 11	PL764098	PL3XP260	Central	Moss Vale	Wombeyan Caves Rd, Woodlands	3	900	Corrosion evident on conductors
BC1718-13	BWH2	A6 - 3/4/1.75 ACSR/GZ Hi Strength Quince (OH) 11	PL872635	PL200348	Central	Moss Vale	Wombeyan Caves Rd, Woodlands	3	310	Corrosion evident along conductors at multiple poles
BC1718-13	BWH2	A6 - 3/4/1.75 ACSR/GZ Hi Strength Quince (OH) 11	PL880088	PL764098	Central	Moss Vale	Wombeyan Caves Rd, Woodlands	3	245	Corrosion evident along conductors.
BC1718-11	MVF2	B3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL3XK568	PL3XK579	Central	Moss Vale	Meryla Rd, Manchester Square	3	1500	Corrosion evident at insulators and terminations
BC1718-11	MVF2	A7 - 3/4/0.0661 ACSR/GZ (Wagtail) (OH) 11	PL274026	PL3K1851	Central	Moss Vale	Meryla Rd, Manchester Square	4	420	Corrosion evident at insulators.
BC1718-11	MVF2	A6 - 3/4/1.75 ACSR/GZ Hi Strength Quince (OH) 11	PL3XK610	PL3XK509	Central	Moss Vale	Meryla Rd, Manchester Square	4	265	Corrosion evident at insulators
BC1718-11	MVF2	A7 - 3/4/0.0661 ACSR/GZ (Wagtail) (OH) 11	PL3K1863	PL3K1860	Central	Moss Vale	Meryla Rd, Manchester Square	4	650	Corrosion evident at insulators and along conductors.
BC1718-7	RW1218	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL3VP099	PL888515	Central	Moss Vale	Canyonleigh Rd, Canyonleigh	4	1015	Corrosion evident at insulators and along conductors on multiple poles.
BC1718-5	RW1218	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL3VC124	PL3VD054	Central	Moss Vale	Inverary Rd, Canyonleigh	4	3179	Corrosion evident at insulators on multiple poles
BC1718-6	RW1218	B3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL887390	PL400069	Central	Moss Vale	Kareela Ave, Wingello	4	675	Corrosion evident at insulators and along conductors on multiple poles.
BC1718-6	RW1218	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL3VJ216	PL3VJ224	Central	Moss Vale	Kareela Ave, Wingello	4	600	Corrosion and pitting evident at insulators and along conductors on multiple poles.
BC1718-6	RW1218	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL3VJ224	PL3VJ226	Central	Moss Vale	Kareela Ave, Wingello	4	420	Corrosion and pitting evident at insulators and along conductors on multiple poles.
BC1718-4	RW1218	B3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL883679	PL3VJ026	Central	Moss Vale	Murrimba Rd, Wingello	4	1980	Corrosion evident at insulators on multiple poles
BC1718-4	RW1218	B3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL3VA014	PL3VA020	Central	Moss Vale	Murrimba Rd, Wingello	4	1050	Corrosion evident at insulators and along conductors.
BC1718-4	RW1218	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL400068	PL3VJ014	Central	Moss Vale	Murrimba Rd, Wingello	4	1390	Corrosion evident at insulators and along conductors.
BC1718-4	RW1218	B3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL3VA032	PL874587	Central	Moss Vale	Murrimba Rd, Wingello	3	675	Some corrosion evident along conductors.
BC1718-4	RW1218	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL3VJ026	PL400068	Central	Moss Vale	Murrimba Rd, Wingello	4	765	Corrosion evident at insulators, terminations and along conductors.
BC1718-4	RW1218	B3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL3VA014	PL883679	Central	Moss Vale	Murrimba Rd, Wingello	4	490	Corrosion evident at insulators and along conductors on multiple poles.
BC1718-10	87220	F2 - 3/0.080 SC/GZ (OH) 12.7	PL824662	PL755151	North	Kandos	Bylong Rd, Breakfast Creek	3	2300	Corrosion evident at insulator ties on multiple poles.
BC1718-10	87220	F2 - 3/0.080 SC/GZ (OH) 12.7	PL460790	PL460748	North	Kandos	Pinnacle Swamp Rd, Rylstone	4	3985	Corrosion evident at insulators on multiple poles.
BC1718-10	87220	F2 - 3/0.080 SC/GZ (OH) 12.7	PL467690	PL460769	North	Kandos	Pinnacle Swamp Rd, Rylstone	3	1625	Corrosion evident at insulator ties on multiple poles.
BC1718-10	87220	F2 - 3/0.080 SC/GZ (OH) 12.7	PL460809	PL460762	North	Kandos	Tongbong Rd, Rylstone	4	2070	Corrosion evident at insulator ties on multiple poles.
BC1718-15	CX1232	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL927871	PL311013	North	Windsor	Putty Rd, Colo	4	285	Corrosion and pitting evident along conductors.
BC1718-12	D814	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL411592	PL411632	North	Windsor	Upper MacDonald Rd, St Albans	4	365	Corrosion and pitting evident at insulators and along conductors on multiple poles.
BC1718-12	D814	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL411561	PL411592	North	Windsor	Upper MacDonald Rd, St Albans	4	495	Corrosion and pitting evident at insulators and along conductors on multiple poles.
BC1718-12	D814	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	PL411561	PL411580	North	Windsor	Upper MacDonald Rd, St Albans	4	235	Corrosion and pitting evident at insulators and along conductors on multiple poles.
BC1718-14	L588	A2 - 3/0.080 SC/GZ (OH) 11	PL273050	PL406642	North	Bowenfels	Hartley Vale Rd, Hartley Vale	3	1565	Some corrosion and pitting evident at insulators
BC1718-14	L588	A2 - 3/0.080 SC/GZ (OH) 11	PL736489	PL406637	North	Bowenfels	Hartley Vale Rd, Hartley Vale	4	900	Corrosion and pitting evident along conductors.
BC1718-8	T838	B2 - 3/0.080 SC/GZ (OH) 11	PL462141	PL462146	North	Bowenfels	Williwa Creek Rd, Portland	4	1850	Corrosion evident along conductors, Limited Images.
BC1718-9	X217	F2 - 3/0.080 SC/GZ (OH) 12.7	PL461087	PL461018	North	Kandos	Ilford Rd, Sofala	4	4790	Corrosion and pitting evident along conductors.
BC1718-9	X217	F2 - 3/0.080 SC/GZ (OH) 12.7	PL410890	PL410968	North	Kandos	Ilford-Sofala Rd, Sofala	3	2160	Evidence of corrosion at connection points and along conductor.
BC1718-9	X217	F2 - 3/0.080 SC/GZ (OH) 12.7	PL807472	PL820274	North	Kandos	Razorback Rd, Running Stream	4	2685	Corrosion evident at insulators and along conductors on multiple poles.
BC1718-3	X482	F2 - 3/0.080 SC/GZ (OH) 12.7	PL469439	PL466192	North	Kandos	Dunns Swamp Rd, Rylstone	4	8124	Dunns Swamp Area - NR Recommendation Signs of corrosion around insulators, failing conductor ties.
BC1718-3	X482	H4 - 3/2.75 SC/GZ (3/0.104) (OH) 22	PL884539	PL467073	North	Kandos	Dunns Swamp Rd, Rylstone	3	250	Dunns Swamp Area - NR Recommendation Signs of corrosion around pin insulators
BC1718-3	X482	H4 - 3/2.75 SC/GZ (3/0.104) (OH) 22	PL468594	PL752385	North	Kandos	Dunns Swamp Rd, Rylstone	3	250	Dunns Swamp Area - NR Recommendation Signs of corrosion & pitting.
BC1718-3	X482	H2 - 3/0.080 SC/GZ (OH) 22	PL722501	PL469438	North	Kandos	Dunns Swamp Rd, Rylstone	3	50	Dunns Swamp Area - NR Recommendation Signs of corrosion.
BC1718-16	GG1232	A2 - 3/0.080 SC/GZ (OH) 11	4PA168	4PA169	South	Shellharbour	Rose Valley, Shellharbour	3	170	Recommended by SR
BC1718-1	GG1295	A5 - 7/0.080 SC/GZ 7/14 Guage (OH) 11	4PK075	784749	South	Shellharbour	Willow Vale Road, Gerringong	4	1400	Recommended by SR - Conductor showing visable signs of rusting along its full length
BC1718-2	NA1225	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	1XC007	782670	South	Nowra	Longreach Road, Longreach	4	1925	Recommended by SR - Conductor showing visable signs of rusting along its full length
								TOTAL	59.5km	

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APPENDIX C - STEEL MAINS SCOPING STUDY SPECIFICATION

1.0 PURPOSE

To communicate the requirements outlining a targeted steel mains condition assessment for selecting sections of mains for upcoming steel mains replacement program.

2.0 STEEL MAINS SCOPE EVALUATION

In continuation of the current delivery strategy to replace high risk distribution steel mains across the network by 2029/30, priority scope is required to be identified for delivery in future DS011 programs.

An increased understanding of the conditions and risks has since been applied to assist in evaluating steel mains to identify the next sections for replacement.

The sections of steel mains are prioritised for replacement based on:

- Impact of bushfire provided by the *Steel Mains Failure Risk and Replacement Cost Modelling* and the likelihood of failure;
- Known problems line in remote areas; and
- Aerial images of the pole top to efficiently identify conductors in poor condition.

Based on these learning's, 570km's has been identified for further review to confirm the highest priority sections for inclusion into future DS011 programs. The condition of these lines are to be validated through aerial images of the pole tops now provided with the most recent LiDAR surveys in accordance with TB-0194.

3.0 SCOPE OF WORKS

The proposed steel mains condition assessment process steps are shown in the Table 8 below.

The condition assessment should not include the scheduling or completion of any:

- Designs; and
- Construction (replacement).

TABLE 8 – STEEL MAINS CONDITION ASSESSMENT PROCESS

<table>
<tr><th>Task Actioned by</th><th>Process Steps</th><th>Description</th></tr>
<tr><td>AS&P</td><td>i)</td><td>List of Scope

AS&P have selected the targeted list of HV distribution steel mains sections for review in accordance with the methodology outlined.</td></tr>
<tr><td rowspan="4">Network Services</td><td>ii)</td><td>Desktop Review

The list of steel mains sections will be provided to Network Services to complete a desktop review. Aerial photos provided with the most recent LiDAR surveys are to be used to assist in determining:
- The section of conductor is steel mains;
- Apply appropriate corrosion category rating (1 to 5) to the total section length in accordance with TB 0194 after reviewing either end of its total continuous length and at an appropriate number of poles locations within its total continuous length to be able to provide an accurate reflection of its condition;
- When inspecting the aerial photos, particular attention needs to be made to visible signs of pitting on the conductor, any broken strands and where conductors are bound to the tops of the pin insulator or around the preformed termination dead-end;
- In addition; each section under review will need to be compared to the current delivery list to confirm that the section of conductor has not already been included within 2017/18 DS011 Business case or replaced as a PSBI defect.
- Re-confirm and record the total continuous length of each steel mains site using GIS/Google measuring tool; and
- Also provide a brief supporting commentary on each section length of steel mains as required and embed a link to the copy of the aerial photo's used for review into the Excel workbook template.
- AS&P will review the program and results periodically.</td></tr>
<tr><td>iii)</td><td>Sites "Not Steel Mains"
Sites identified as not steel mains or already scheduled for replacement, prior to 2017/18, through PSBI or 2017/18 business case do not need a condition evaluation as part of this process. These sites are to be label either as "Not Steel" or "Already Scheduled" in the attached Excel workbook template. However these sections will require a copy of the link to its supporting aerial LiDAR photo embedded into the Excel workbook template.

Any sections identified as "Not Steel" will need to be forwarded to the GIS team to update the applicable GIS system. (Note: applicable GIS update notification to be completed by 30th June 2018).</td></tr>
<tr><td>iv)</td><td>Site Evaluation

Site evaluations are not expected as part of this scope of works.</td></tr>
<tr><td colspan="2">v) Final Recommendations

The supporting information to be provided with final recommendations is detailed in the table below (and included in the attached Excel workbook template).
<table>
<tr><th colspan="2">Steel Mains Section</th><th rowspan="2">Region</th><th rowspan="2">Location (Road, Suburb)</th><th rowspan="2">TB-0194 Category Rating (1 to 5)</th><th rowspan="2">Route Length (Meters)</th><th rowspan="2">Comment</th><th rowspan="2">Embedded Photo's Link</th></tr>
<tr><th>Pole From</th><th>Pole To</th></tr>
<tr><td>PL1234</td><td>PL5678</td><td>Cen</td><td>Letsbe Ave, Moss Vale</td><td>N/a</td><td>1250</td><td>Not Steel</td><td>Link ABC</td></tr>
<tr><td>PL1434</td><td>PL5275</td><td>Sth</td><td>Albion Rd, Nowra</td><td>4</td><td>200</td><td>Signs of Pitting</td><td>Link CDE</td></tr>
<tr><td>PL5434</td><td>PL5338</td><td>Nth</td><td>Regents Rd, Bringelly</td><td>5</td><td>215</td><td>Corrosion PL5434</td><td>Link FGH</td></tr>
<tr><td>PL1354</td><td>PL5328</td><td>Nth</td><td>Alberts Rd, Carlingford</td><td>2</td><td>1000</td><td>No obvious signs</td><td>Link IJK</td></tr>
</table>
The completed list of recommendations is to be provided to AS&P by 30th November 2017</td></tr>
</table>

APPENDIX D - STEEL MAINS CONDITION ASSESSMENT GUIDE FOR COMPLETION OF DESKTOP STUDY

Table of Contents

Endeavour Energy

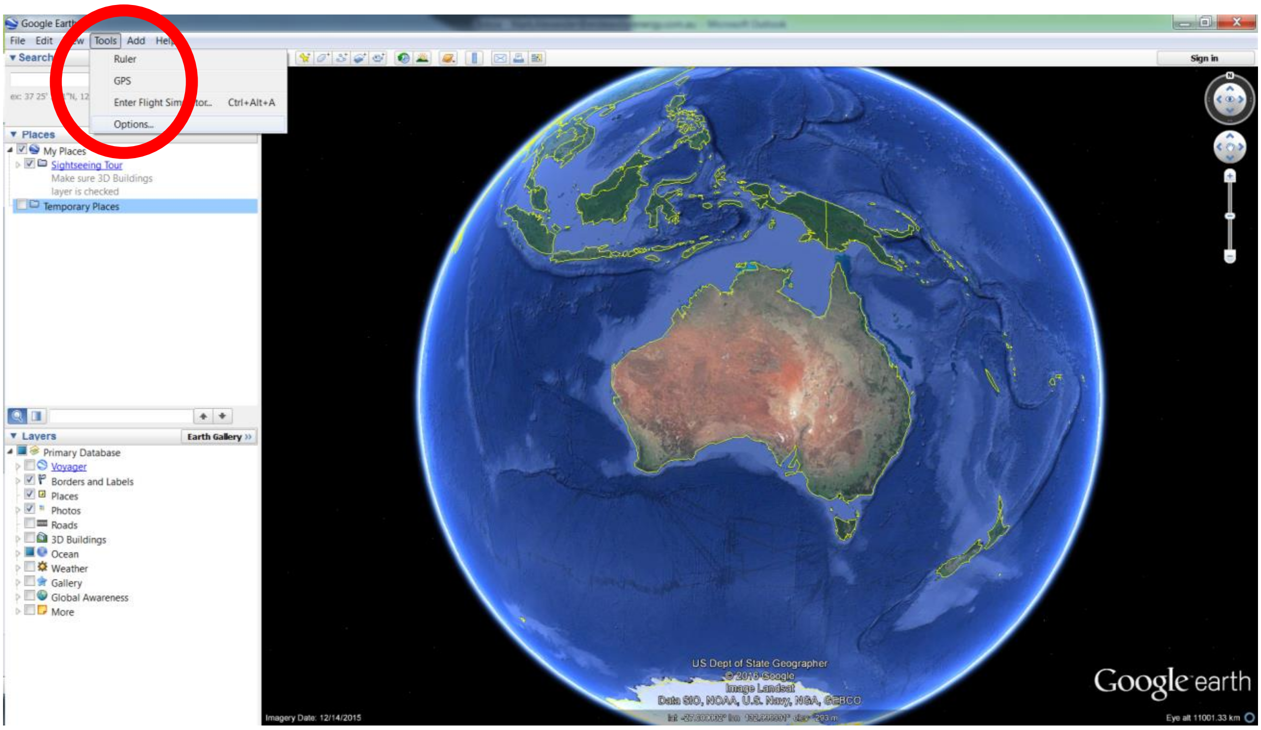
This guide will assist in using Google Earth and Endeavour Energy KML overlay functions to complete a desk top condition assessment for steel mains pole sites. The steps must be executed in the order shown.

1.0 CONFIGURING GOOGLE EARTH TO DECIMAL DEGREES

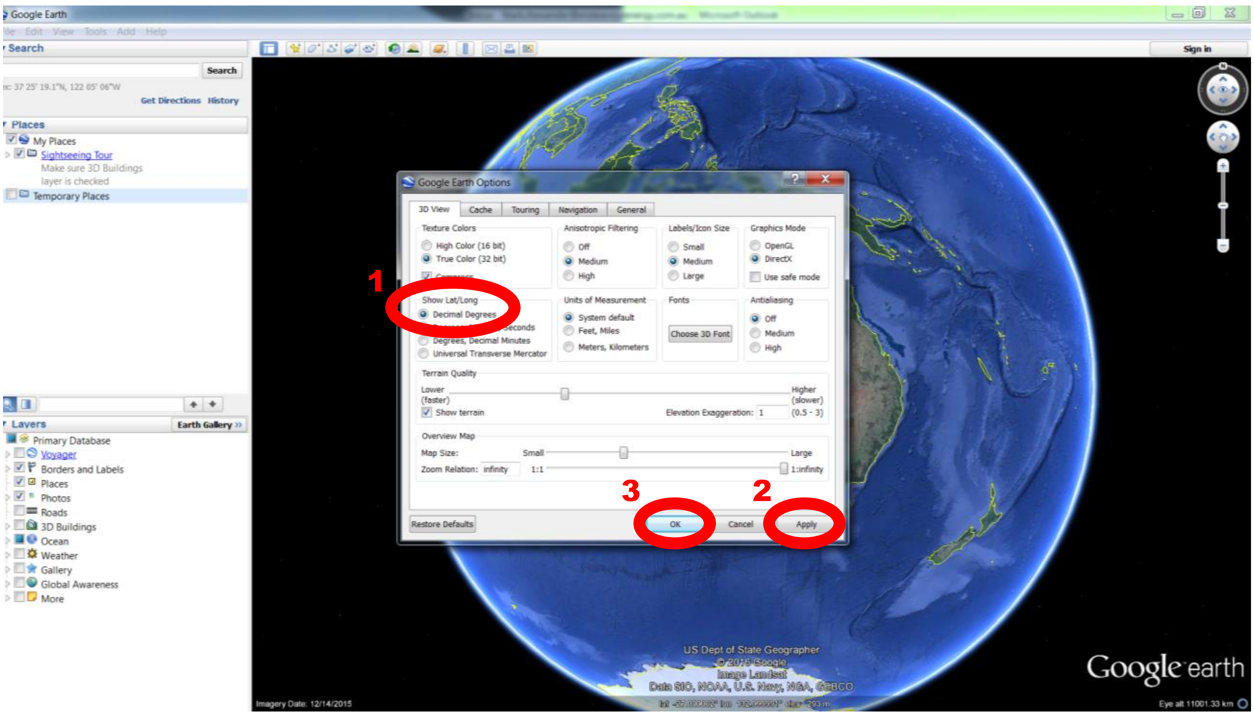
Google Earth by default operates under Degrees, Minutes, Seconds co-ordinate selection. Your settings will need to be adjusted to align to the Decimal Degrees latitude and longitude co-odinates provided with the scoping study.

To adjust the Google Earth settings:

1. Open Google Earth
2. Select "Tools" then "Options"



3. This will open the Google Earth Options tab. Select "Decimal Degrees", Select "Apply" and then Select "OK"



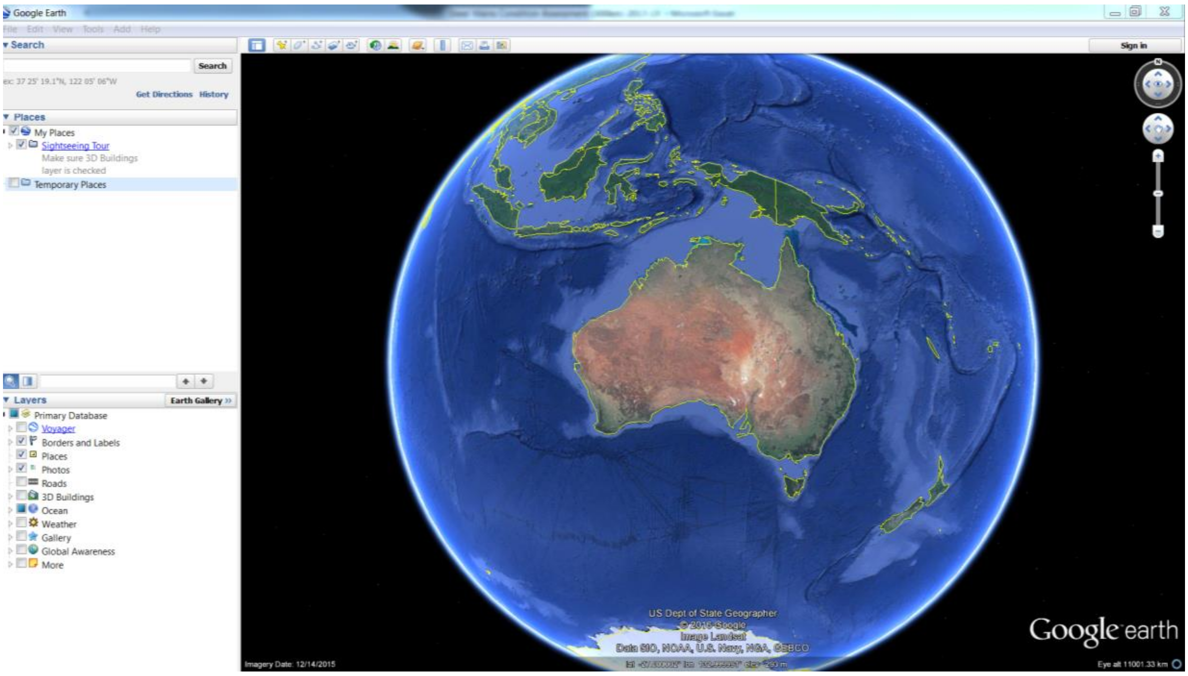
The settings should now be configured to align with Degree Minutes co-ordinates provided within the scope review list.

2.0 SELECTING THE PSBI IMAGE KML DEPOT FILE

Pole top images have been collected across bush fire prone sites through PSBI inspections. A copy of the pole top images collected from these inspections have been loaded into KML files per depot boundary. Opening a KML Depot file overlay's Endeavour Energy's data and images into their respective pole locations within Google Earth.

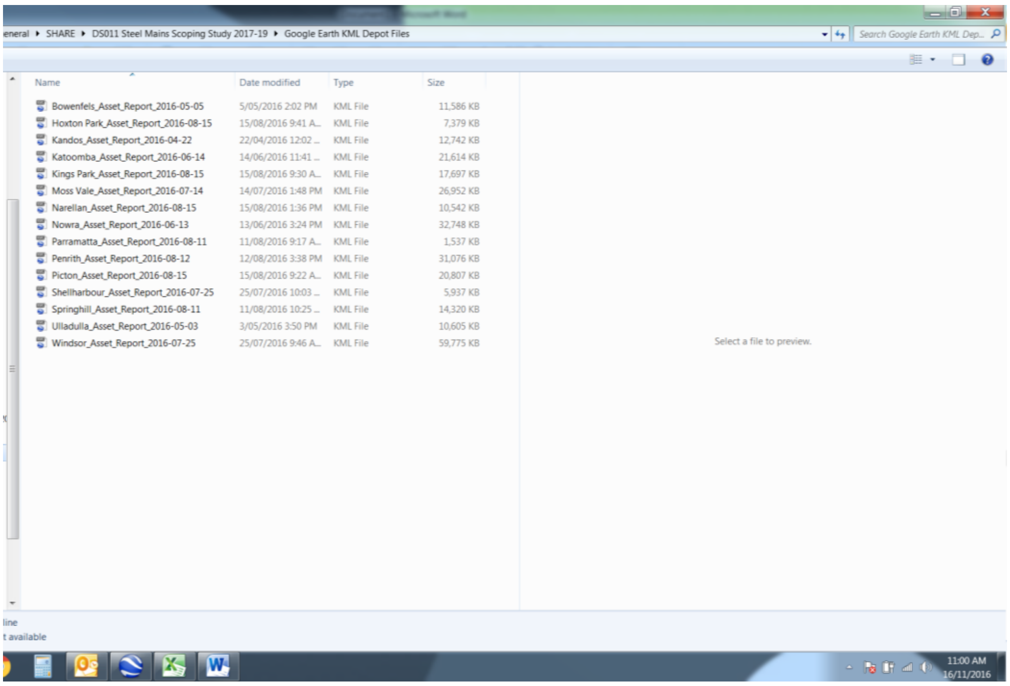
These next steps will assist you in loading the correct KML depot file with this supporting information.

1. Open Google Earth (if not already open)

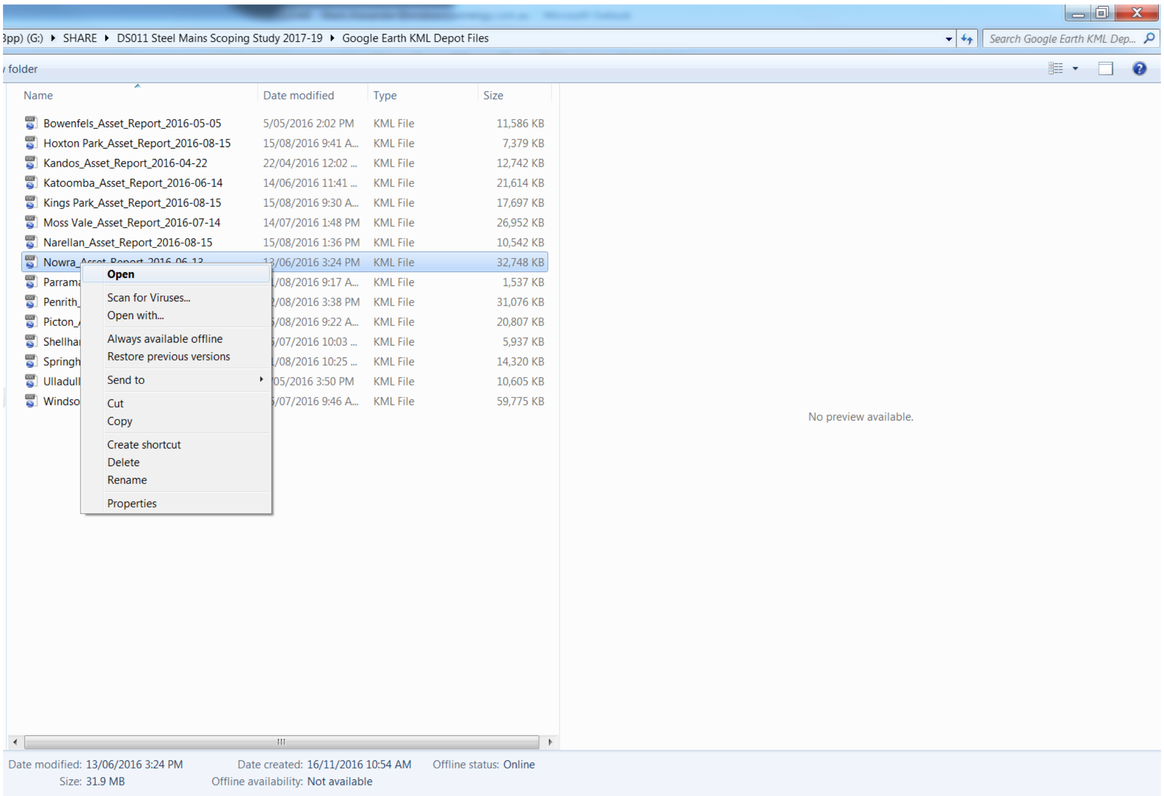


2. Open a separate Windows Explorer folder from the desktop bar on the bottom of your screen.

Follow the file path to *G:\SHARE\DS011 Steel Mains Scoping Study 2017-19\Google Earth KML Depot Files.* This will take you to where the most recent KML Depot files are stored.

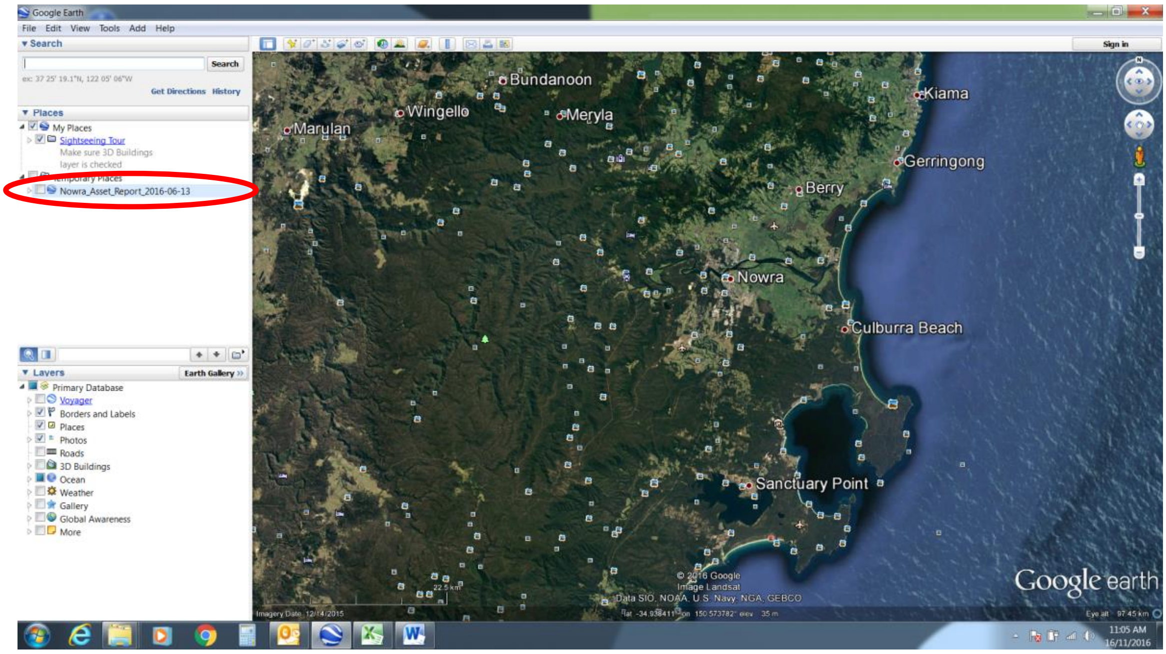


3. Right click the appropriate KML Depot file that you be completing the scope review. Select “Open” from the drop down menu. In this case Nowra KML file has been used as the example.



4. Once you have selected “Open”, Google Earth will automatically start uploading the KML Depot File data and zoom into the specific depot area.

5. Note that when the KML depot file is opened a new layer appears under ‘Places’ drop down on the left hand side of the screen.
   The check-box for the layer by default is not checked. This will need to be manually selected (ticked) to show the data onto Google Earth.



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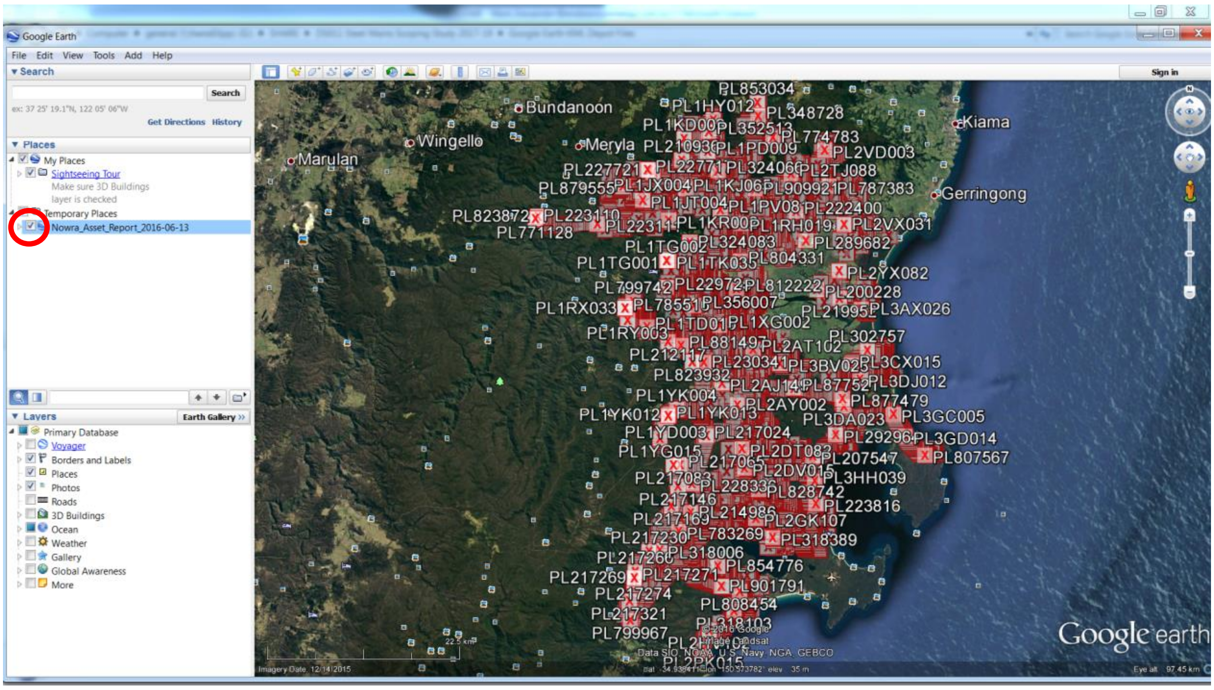
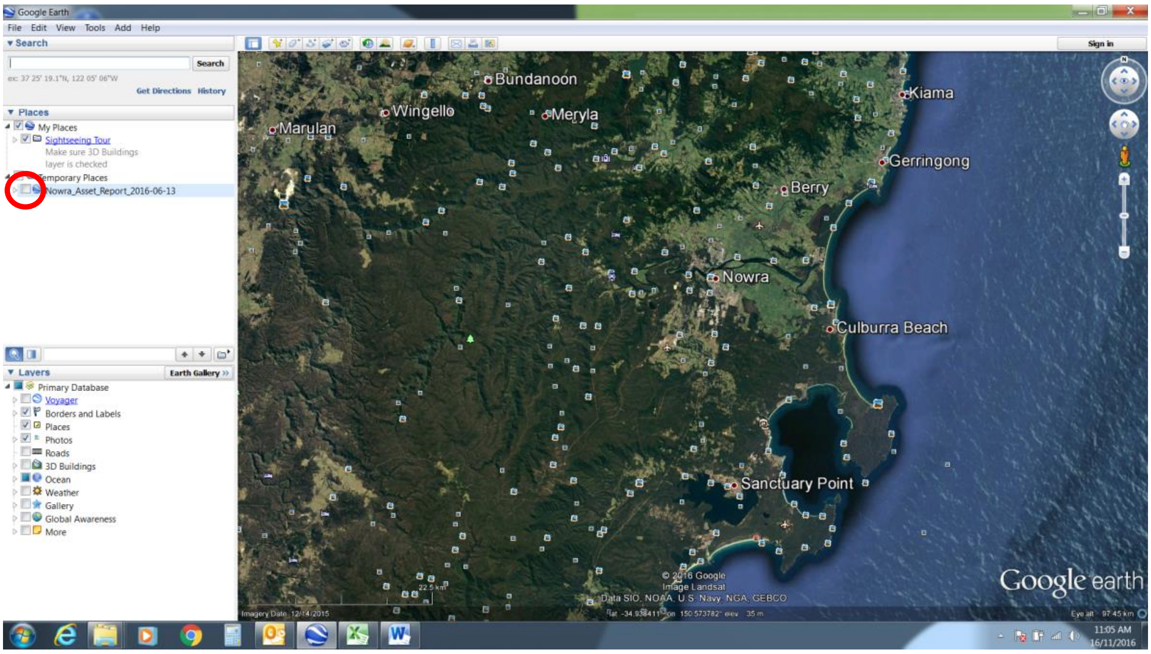
6. Once the checkbox is selected, the screen will start to populate with the PSBI information collected for that specific depot area.



7. Additional KML Depot files can be opened at the same time and will overlay into Google Earth. However this is not recommended as the KML files are quite large and depending on your CPU capabilities may slow Google Earth down.

8. Each time you have finished reviewing a depot area and move onto a new KML depot area. Uncheck the appropriate layer check-box. And this will remove the data from the screen.



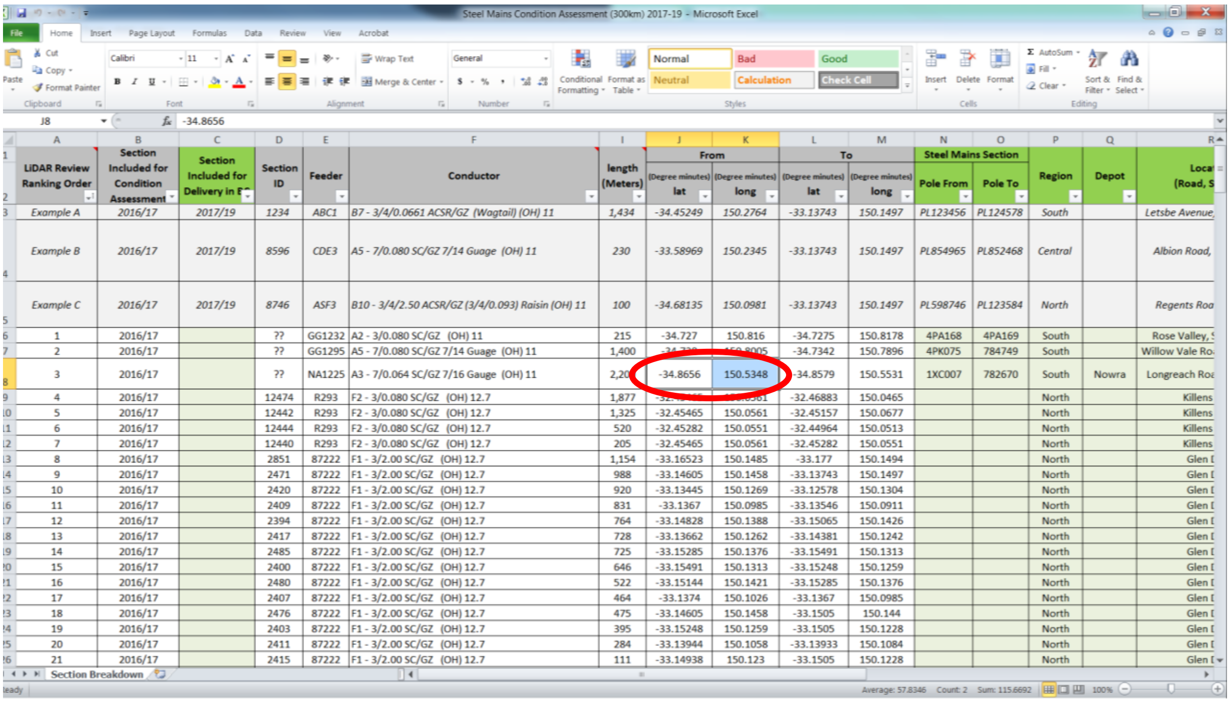
9. If you wish to review the specific KML depot data again later, you do not need to re-open its file location from Windows Explorer Folder. Simply, uncheck any other KML depot files you have been working on from the ‘Places’ drop down to the left of the Google Earth screen and re-check the depot layer you wish to review.

3.0 LOCATING A POLE SITE IN GOOGLE EARTH

3.1 USING THE LONGITUDE AND LATITUDE CO-ORDINATES

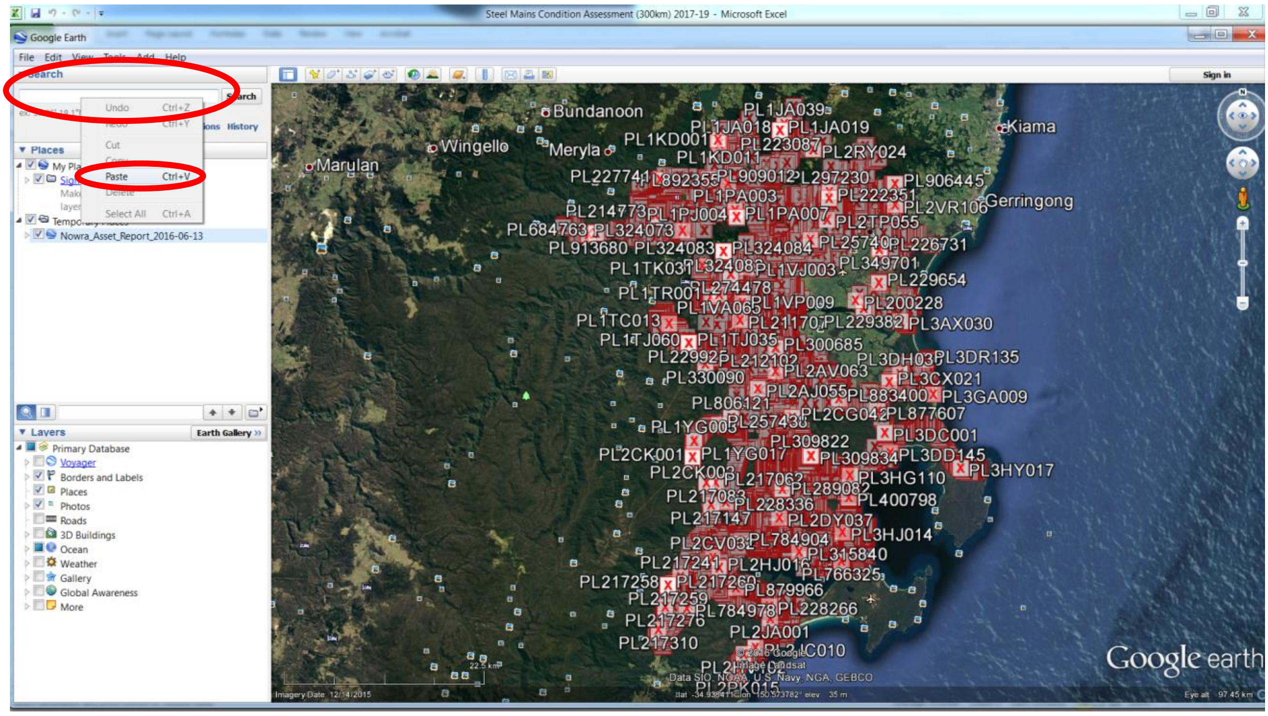
1. Open the *Steel Mains Condition Assessment (570km).xlsx* file

2. Select a corresponding set of “Lat” and and “Long” cells and copy (Ctrl+C)



LiDAR Review Ranking Order	Section Included for Condition Assessment	Section Included for Delivery in B…	Section ID	Feeder	Conductor	length (Meters)	From (Degree minutes) lat	From (Degree minutes) long	To (Degree minutes) lat	To (Degree minutes) long	Steel Mains Section Pole From	Steel Mains Section Pole To	Region	Depot	Locat (Road, S
Example A	*2016/17*	*2017/19*	*1234*	*ABC1*	*B7 - 3/4/0.0661 ACSR/GZ (Wagtail) (OH) 11*	*1,434*	*-34.45249*	*150.2764*	*-33.13743*	*150.1497*	*PL123456*	*PL124578*	*South*		*Letsbe Avenue,*
Example B	*2016/17*	*2017/19*	*8596*	*CDE3*	*A5 - 7/0.080 SC/GZ 7/14 Guage (OH) 11*	*230*	*-33.58969*	*150.2345*	*-33.13743*	*150.1497*	*PL854965*	*PL852468*	*Central*		*Albion Road,*
Example C	*2016/17*	*2017/19*	*8746*	*ASF3*	*B10 - 3/4/2.50 ACSR/GZ (3/4/0.093) Raisin (OH) 11*	*100*	*-34.68135*	*150.0981*	*-33.13743*	*150.1497*	*PL598746*	*PL123584*	*North*		*Regents Roa*
1	2016/17		??	GG1232	A2 - 3/0.080 SC/GZ (OH) 11	215	-34.727	150.816	-34.7275	150.8178	4PA168	4PA169	South		Rose Valley, S
2	2016/17		??	GG1295	A5 - 7/0.080 SC/GZ 7/14 Guage (OH) 11	1,400	[illegible]	[illegible]	-34.7342	150.7896	4PK075	784749	South		Willow Vale Ro
3	2016/17		??	NA1225	A3 - 7/0.064 SC/GZ 7/16 Gauge (OH) 11	2,20	-34.8656	150.5348	-34.8579	150.5531	1XC007	782670	South	Nowra	Longreach Roa
4	2016/17		12474	R293	F2 - 3/0.080 SC/GZ (OH) 12.7	1,877	[illegible]	[illegible]	-32.46883	150.0465			North		Killens
5	2016/17		12442	R293	F2 - 3/0.080 SC/GZ (OH) 12.7	1,325	-32.45465	150.0561	-32.45157	150.0677			North		Killens
6	2016/17		12444	R293	F2 - 3/0.080 SC/GZ (OH) 12.7	520	-32.45282	150.0551	-32.44964	150.0513			North		Killens
7	2016/17		12440	R293	F2 - 3/0.080 SC/GZ (OH) 12.7	205	-32.45465	150.0561	-32.45282	150.0551			North		Killens
8	2016/17		2851	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	1,154	-33.16523	150.1485	-33.177	150.1494			North		Glen [
9	2016/17		2471	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	988	-33.14605	150.1458	-33.13743	150.1497			North		Glen [
10	2016/17		2420	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	920	-33.13445	150.1269	-33.12578	150.1304			North		Glen [
11	2016/17		2409	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	831	-33.1367	150.0985	-33.13546	150.0911			North		Glen [
12	2016/17		2394	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	764	-33.14828	150.1388	-33.15065	150.1426			North		Glen [
13	2016/17		2417	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	728	-33.13662	150.1262	-33.14381	150.1242			North		Glen [
14	2016/17		2485	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	725	-33.15285	150.1376	-33.15491	150.1313			North		Glen [
15	2016/17		2400	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	646	-33.15491	150.1313	-33.15248	150.1259			North		Glen [
16	2016/17		2480	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	522	-33.15144	150.1421	-33.15285	150.1376			North		Glen [
17	2016/17		2407	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	464	-33.1374	150.1026	-33.1367	150.0985			North		Glen [
18	2016/17		2476	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	475	-33.14605	150.1458	-33.1505	150.144			North		Glen [
19	2016/17		2403	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	395	-33.15248	150.1259	-33.1505	150.1228			North		Glen [
20	2016/17		2411	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	284	-33.13944	150.1058	-33.13933	150.1084			North		Glen [
21	2016/17		2415	87222	F1 - 3/2.00 SC/GZ (OH) 12.7	111	-33.14938	150.123	-33.1505	150.1228			North		Glen [

3. Paste (Ctrl+V) directly into the Google Earth search box as detailed in the screen shot below;



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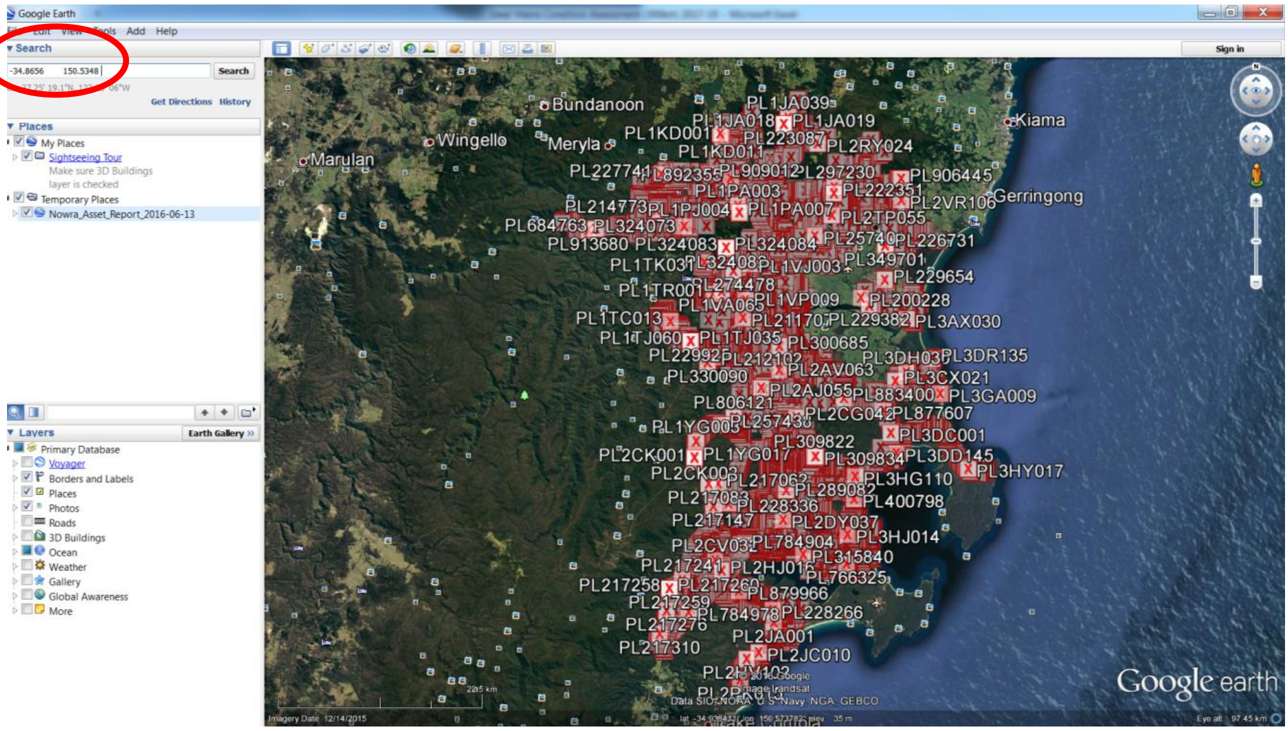
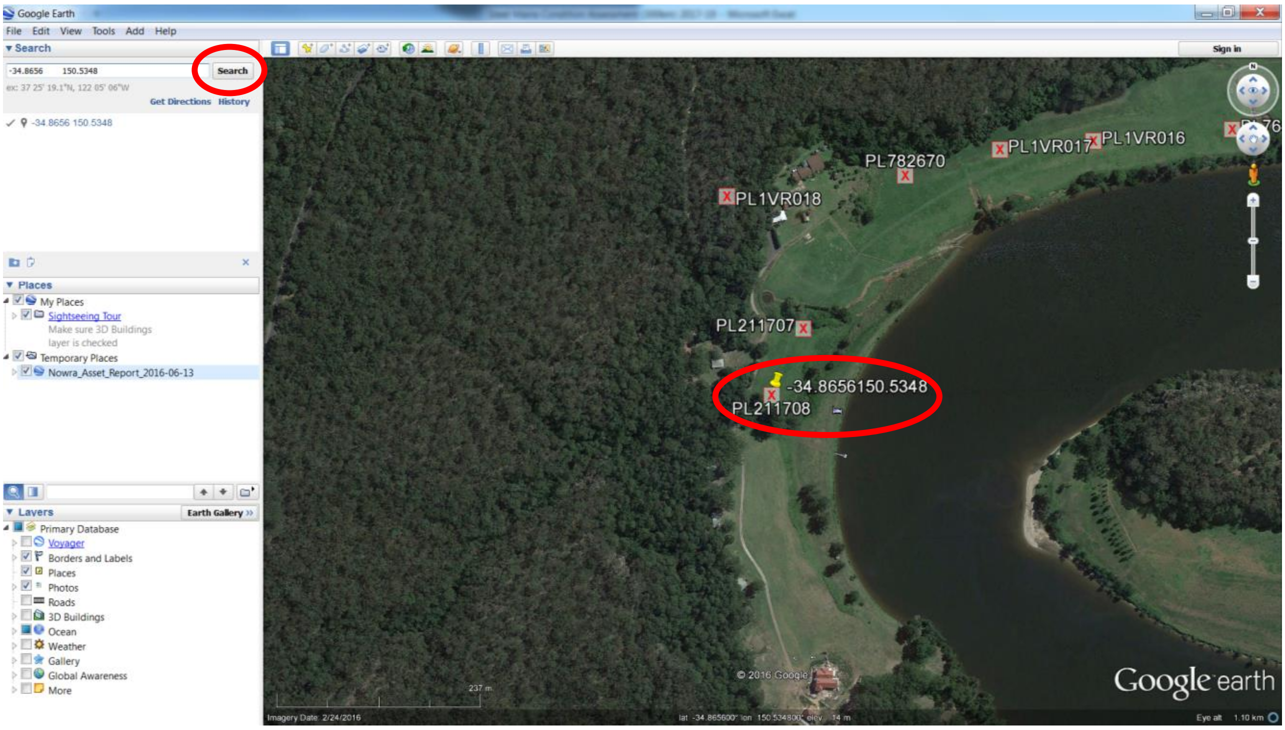
Note:No editing of the co-ordinates or spacing is required.



4. Click “Search” and Google earth will identify the pole location with a pin icon along with the co-ordinates of the location.

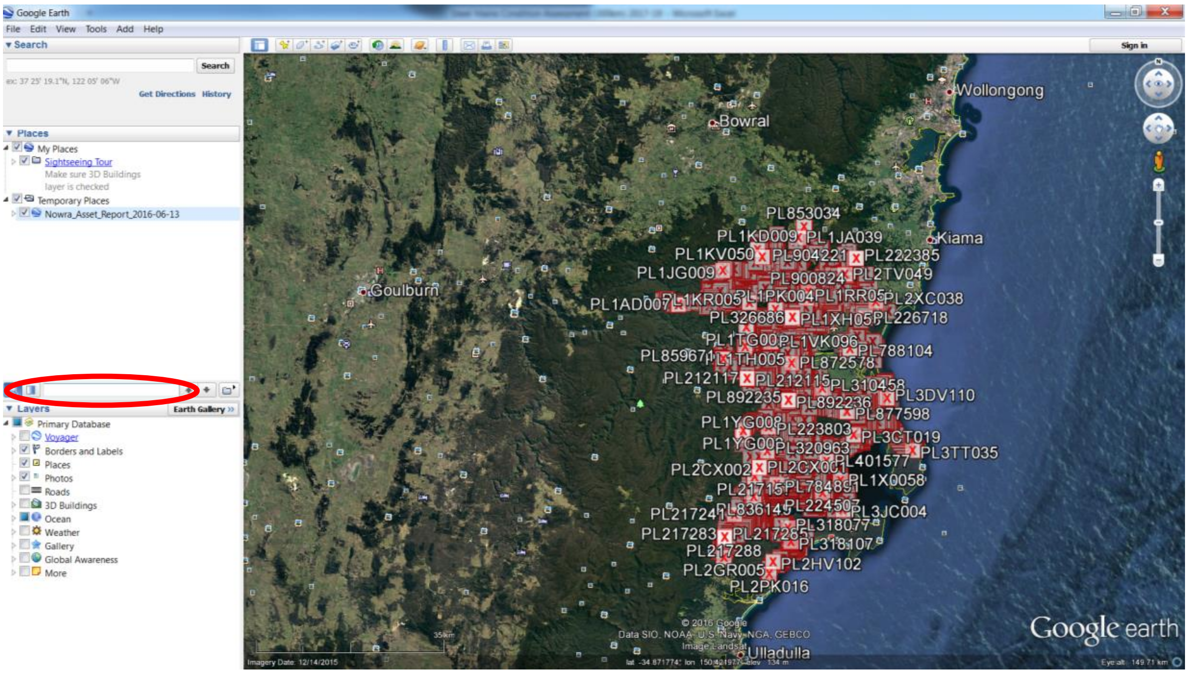


3.2 USING THE POLE NUMBER

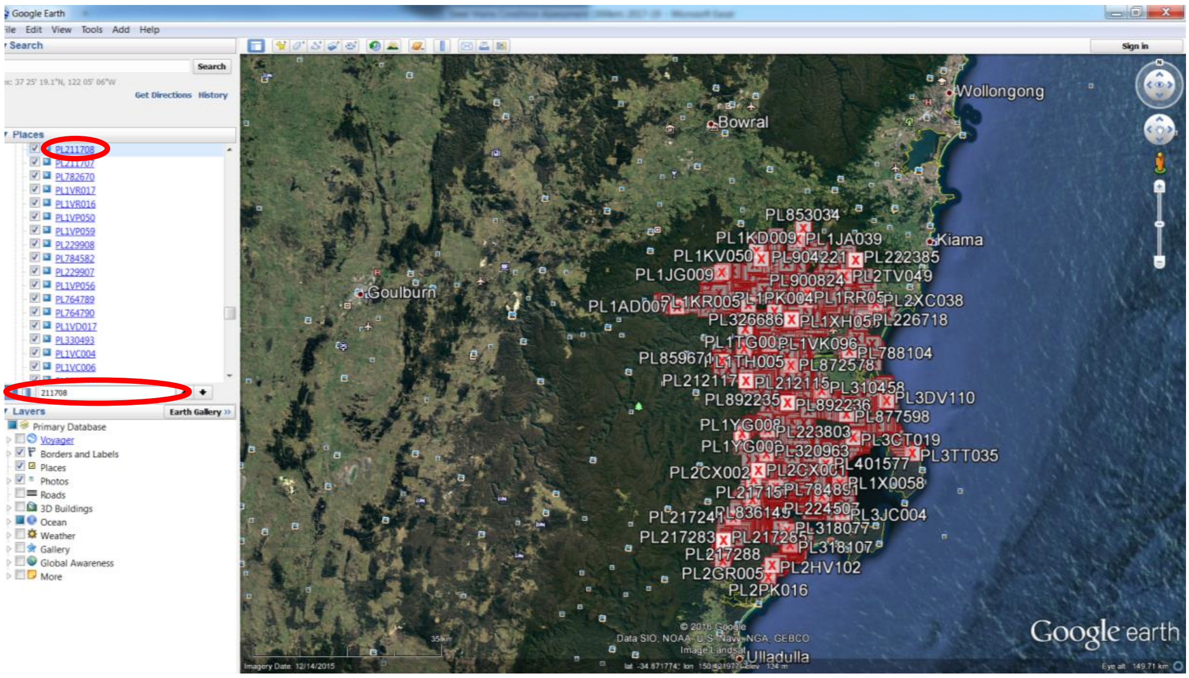
The KML Depot files also contain additional information such as pole numbers. These pole numbers can be used in a search function to assist in finding the data required for the condition assessment.

These next steps will assist you in locating sites in Google Earth using pole numbers instead of latitude and longitude coordinates.

1. Enter the pole number into the “Places” search bar. This search bar is found midway down the screen on the left hand side. A list of similar pole numbers will be generated as the number is typed into the search bar.



2. Once the list has been generated. Single click the blue hyperlinked pole number from the exact match. (Note: not the ticked check-box)



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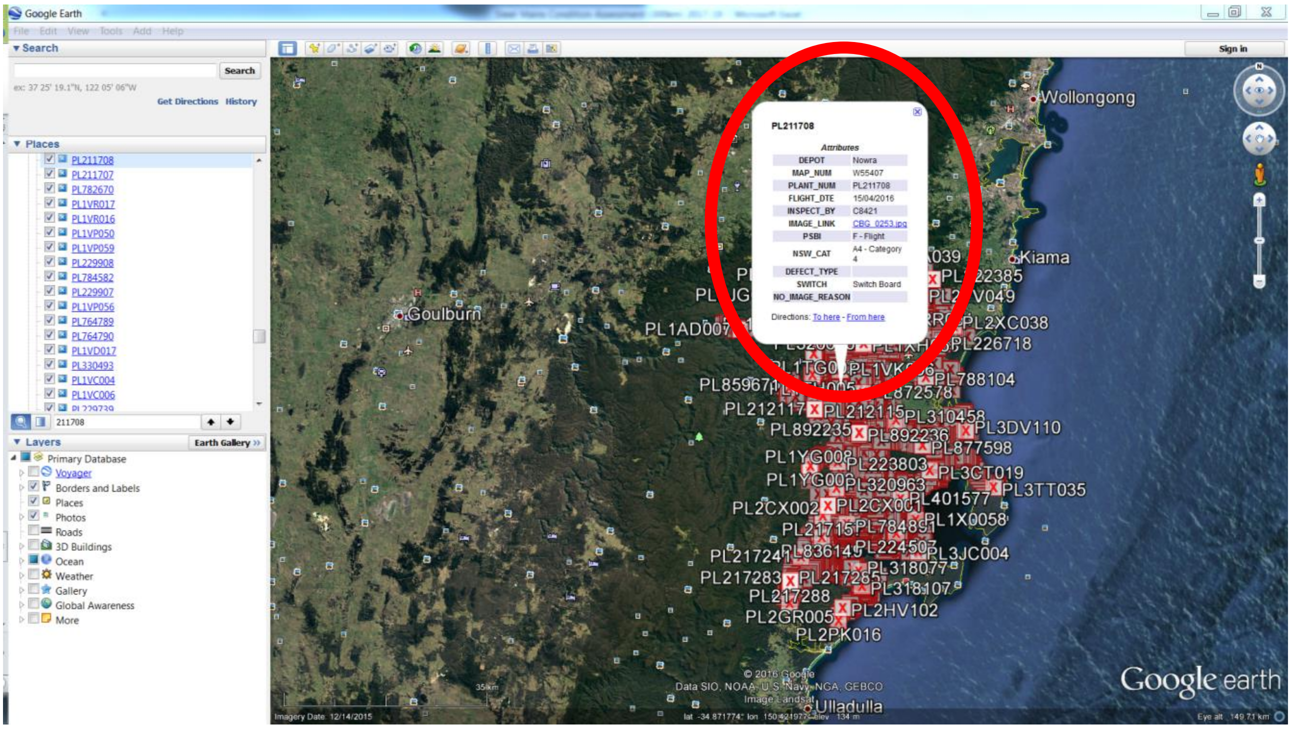
3. This will open the dialogue box linked to that pole site.



4. Note: When searching for a site using pole numbers Google Earth does not automatically expand the screen and zoom into the site location. This will need to be done manually using the dialouge box as a directing guide.

4.0 OPENING PSBI IMAGES IN GOOGLE EARTH

Whether using the pole number or longitude latitude co-ordinates to locate a pole site, the process to opening the PSBI image remains the same.

1. Once you have completed Sections 1.0, 2.0 & 3.0, each pole site with PSBI data will include either a Red X or a Pin icon.

2. Single click either the X or pin icon. This will open a dialogue box specific to that pole site.
(Note: this dialogue box will automatically open if you use the pole number to search for the pole site)

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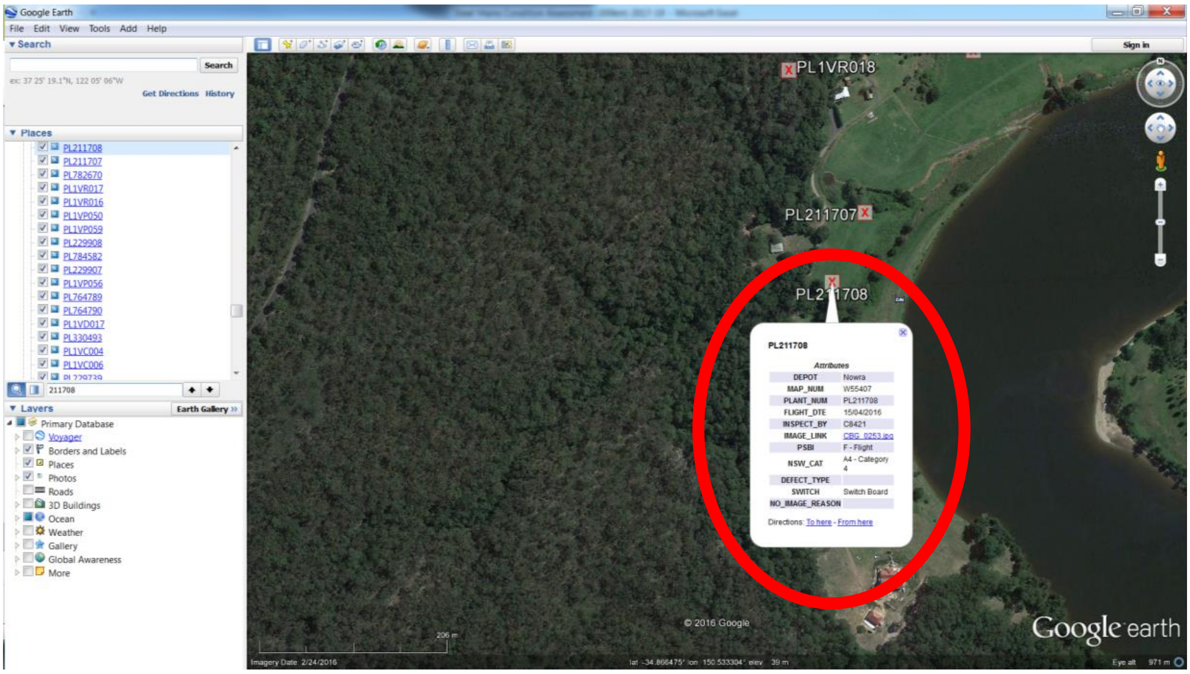
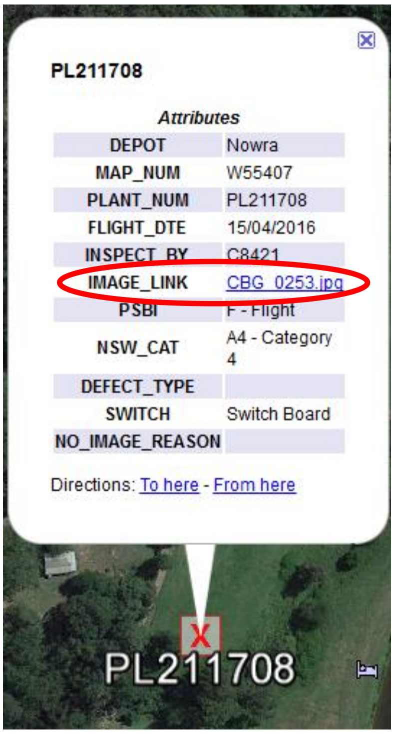
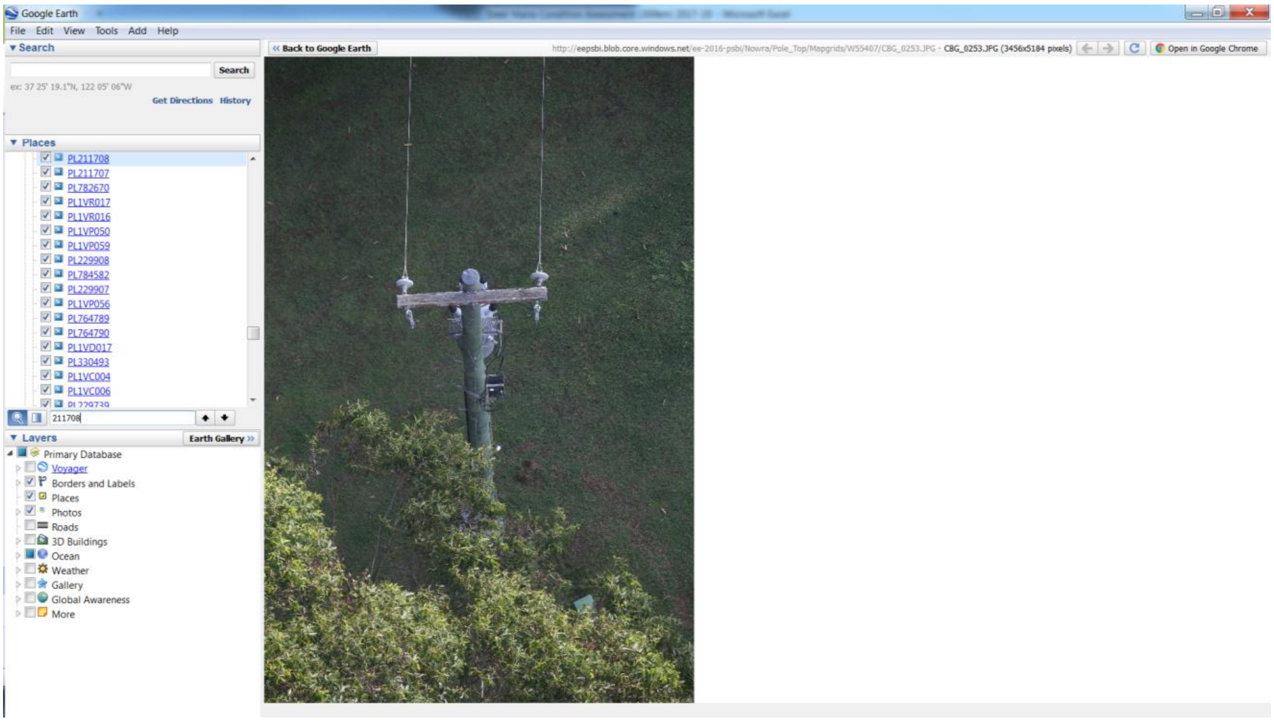


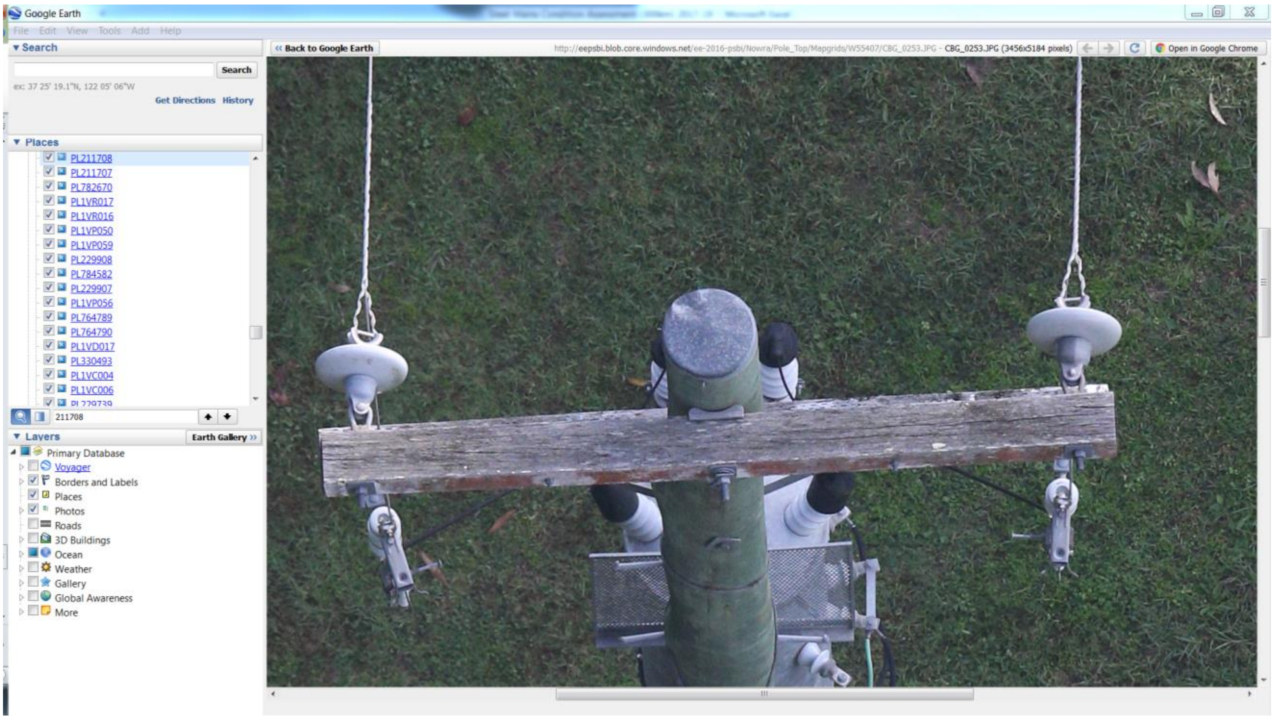
3. Once the dialogue box appears, click the “IMAGE_LINK” jpg hyperlink.



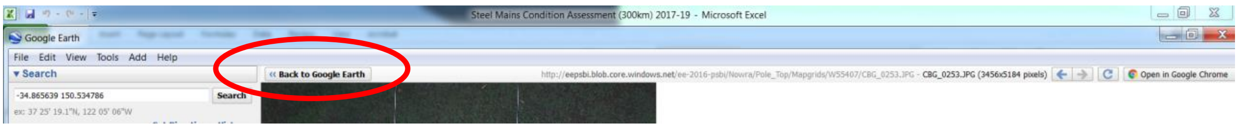
4. This will open the PSBI image stored against the pole location into the Google Earth window.



5. Click the cursor on the part of the pole top image you wish to review. This will magnify that point of the image to assist in closer inspection of the conductor or fittings.



Once you have finished reviewing the image, simply select the “Back to Google Earth” button. located on the top of the Google Earth screen.



Once back to the Google Earth, you can either continue to follow the steel mains line and select images of other related localised poles or retype a Lat/Long search for the next section of line taken from *Steel mains Condition Assessment (570km).xlsx* file and move onto the next section of steel mains line for review.

5.0 USING PSBI IMAGES FOR CONDITION ASSESSMENT

Aerial photos provided with the most recent PSBI surveys are to be used to assist in determining:

- The section of conductor is steel mains;
- Apply appropriate corrosion category rating (1 to 5) to the total section length in accordance with TB 0194 after reviewing either end of its total continuous length and at an appropriate number of poles locations within its total continuous length to be able to provide an accurate reflection of its condition;
- When inspecting the aerial photos, particular attention needs to be made to visible signs of pitting on the conductor, any broken strands and where conductors are bound to the tops of the pin insulator or around the preformed termination dead-end;

Some examples of condition assessment and category application are included below:

Note: Image quality can vary depending on the conditions that the photo was taken in.

5.1 CATEGORY 1, 2 or 3

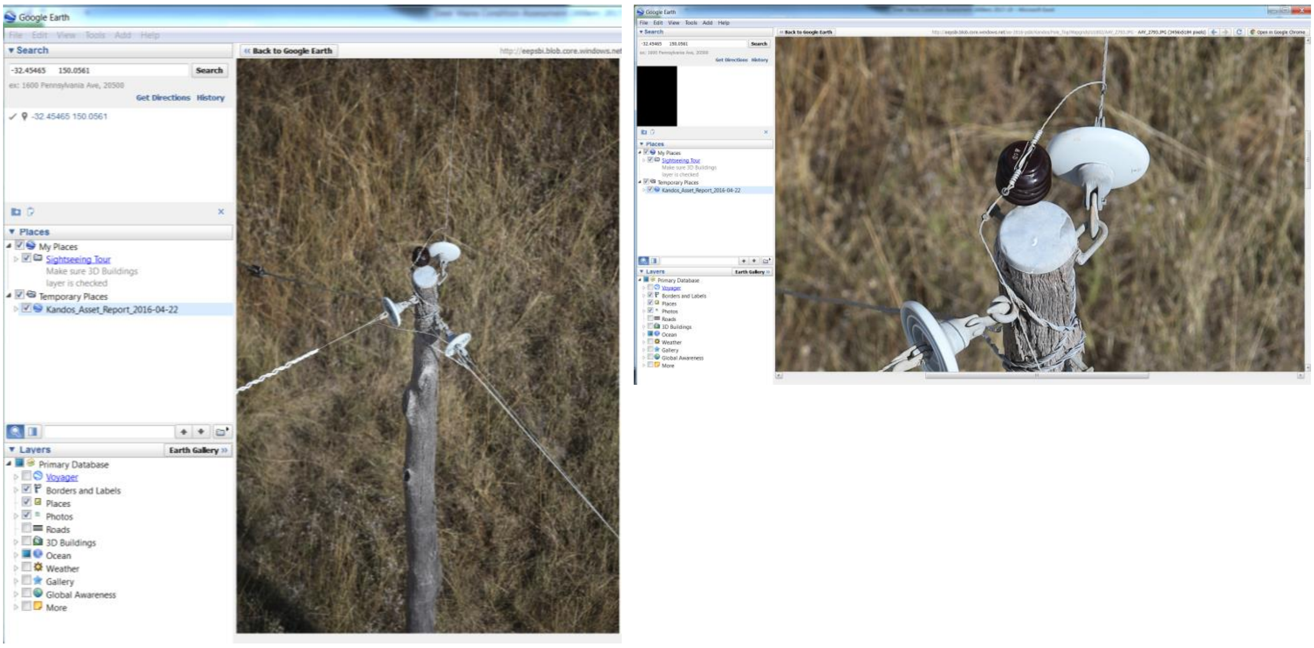
A category 1 or 2 site would show no corrosion, 100% galvanised or light surface corrosion with negliable pitting. Category 1 or 2 sites would not be prioritised or scheduled for short or medium term replacement.

Assessement for a category 3 site would show medium surface corrosion with mild pitting and would be expected to be scheduled for replacement within the next five years.

Although showing some signs of discolouration, no obvious signs of darker corrosion spots or extensive deterioration along its length.

Closer inspection of FIGURE 2 below, in places where mositure builds up in and around the dead-ends and heading out along the conductor, indicates limited evidence for any significant corrosion at this site.

FIGURE 2- CATEGORY 2 RATING



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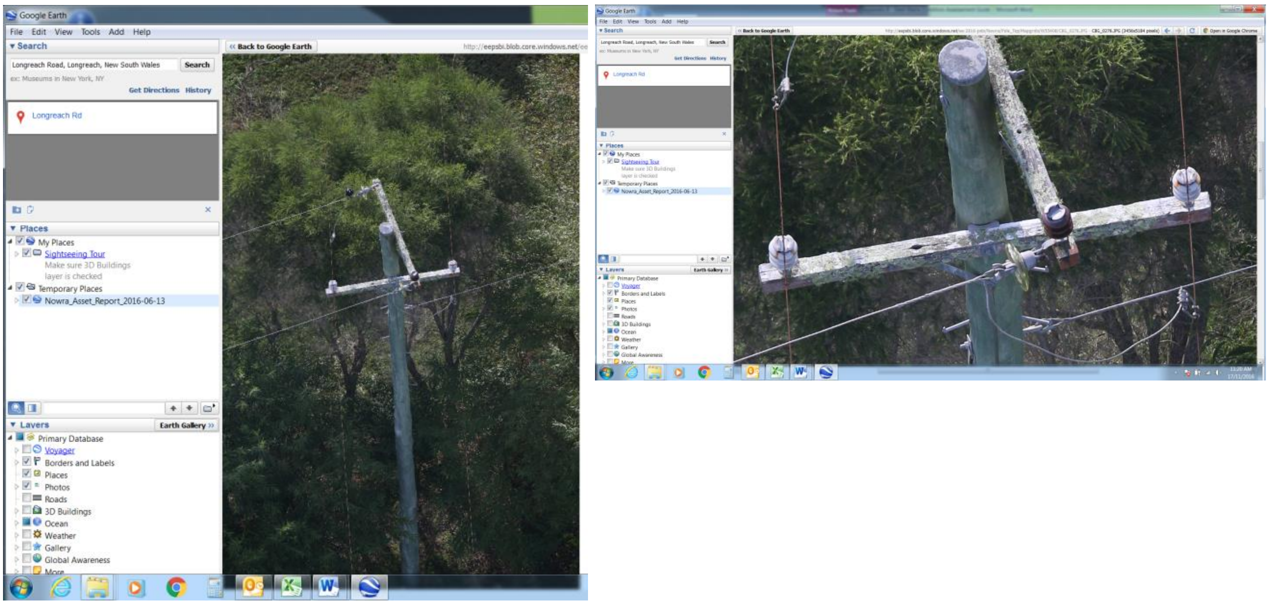
5.2 CATEGORY 4 or 5

A Category 4 or 5 site would show heavy surface corrosion with mild to heavy pitting, annealing or thinning of the conductor, broken, frayed or split conductors under tension. These sites are to be prioritised for replacment.

Visual inspection of FIGURE 3 below shows obvious signs of darker areas in and around the insulators and out along the length of the conductor that indicates higher levels of corrosion reflected in a higher priority category ranking.

FIGURE 3 - CATEGORY 4 OR 5 RATING

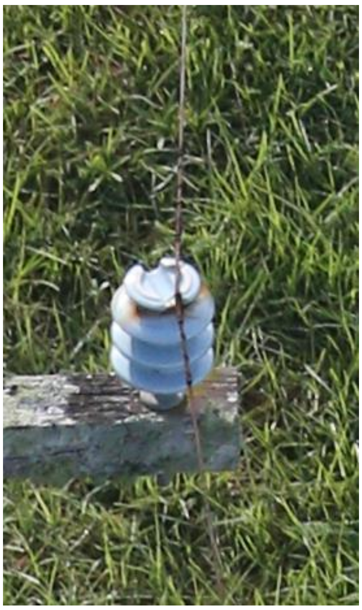


5.3 DEFECT IDENITIFCATION REQUIRING URGENT ATTENTION

In the event that a significant defect is identified during the image review process that may potentially result in a failure of the conductor or present a safety risk, the site must be flagged back to AS&P prior to the completion of the scoping study.

Significant defects could include missing tie-wires or obvious broken strands. The example in FIGURE 4 below shows the steel mains conductor at risk of coming free from the pin insulator. This site would need to be flagged back to AS&P as requiring urgent attention.

FIGURE 4 – EXAMPLE OF A HIGH PRIORITY DEFECT



APPENDIX E – REFER TO SEPARATE SPREADSHEET *LIST OF REMAINING 570KM OF STEEL MAINS.XLSX*