GEOTECHNICAL MINING SERVICES

ACN 639 206 983

LAKE COWAL UNDERGROUND SUBSIDENCE MONITORING

EVOLUTION MINING

COWAL OPERATIONS

ASH PAGE

28th JULY 2022

FINAL REPORT

Executive Summary

Geotechnical Mining Services (GMS) have been engaged by Evolution Mining to design and install the geotechnical instrumentation system that will monitor for subsidence and ground movement in the crown pillar of the Lake Cowal underground mine in the current mining area of the Warraga 1050 and 1057 levels. The monitoring system will be progressively designed for the LOM in a phased approach so that the monitoring system can be calibrated for actual conditions as we progress into the mine plan.

GMS proposes the use of both extensometers and instrumented cable bolts as suitable means of measuring ground movement. Other forms of instrumentation were considered but are unsuitable, due to the potential for loss of access to the instrument locations after mining and limited data that would be obtained.

A total of 34 extensometers and 10 instrumented cable bolts have been designed for installation in the Warraga 1050 and 1057 levels. The length of these instruments varies from 6m to 15m. All instruments have 6-point nodes that transmit a digital reading through a combination of hardwire and a mesh node telemetry system.

The total cost of this project is $387,077.90, which includes drilling, instrument supply, design and installation and is inclusive of GST. A final quote for the supply of instrumentation, design and installation has been provided by GMS in this report.

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1. Introduction

Geotechnical Mining Services (GMS) was formed by three mine geotechnical engineers with over 40 years of collective industry experience with an aim to support sites with auxiliary geotechnical tasks.

Capabilities of GMS include:

- Design and installation of monitoring instrumentation (digital cable bolts, digital extensometers, stress cells and micro seismic systems).
- Ground support quality control (pull testing, grout sampling, compliance inspections).
- Geotechnical core logging, including photo core logging.
- Site based geotechnical technicians & project engineer secondments.
- All staff are trained and supported by GMS's experienced geotechnical engineering directors.

1.1. Scope of Works

GMS were provided a Scope of Works by Ellen Morton (Geotechnical Superintendent) on the 14th of May 2022, titled "Subsidence monitoring scope of works". The scope of works outlined the following key criteria:

- Project scope requires design and installation of a monitoring system that will provide sufficient information to verify that subsidence is not occurring in the crown pillar above the Galway area of the mine.
- All instrumentation will be installed from the underground accesses.
- The design will incorporate in-rock monitoring at different depths above the crown pillar.
- Monitoring to remote via WIFI or other remote technology as access may be lost in the future.
- System to be compatible with Geoexploerer software (NavStar or Newtrax in future).
- Stoping beneath the crown pillar will commence in January 2023 and installation of all equipment is required in November 2022.

2. Instrumentation Options

GMS were requested to review the different instrumentation options available that would be suitable for subsidence monitoring but also for monitoring movement along major faults. A major consideration for selecting the instruments is that it should be assumed that access is lost after stoping occurs on the crown level. As a result, this rendered many manual readout units unsuitable for use.

Surface access above the Galway mining area is restricted by the body of water in Lake Cowal above. This restricts access that would allow surface drillholes to be utilised to install instruments, resulting in all instruments being limited to be installed from underground. Time Domain Reflectometry (TDR) or Fibre would be a cheap and effective means of measuring the entire pillar if surface boreholes were available for use. Although TDR/Fibre only provides point data of where movement occurs and not displacement. Future phases of the underground mine may allow for installation of surface instruments based on the lake water levels and access for surface down holes.

Instrumented bolts are suitable for use when load on ground support is to be monitored. Instrumented rock bolts are available for measuring primary support and instrumented cable bolts are available for measuring deeper support. Instrumented cable bolts have been selected for use in areas which are likely to require crown cable bolting and changes in stress from stoping is likely, particularly around faulted regions. Instrumented cable bolts should be installed at similar angles as to that of crown cable bolt support.

Extensometers (commonly referred to as extos) are the most suitable instrument for use for the Lake Cowal crown pillar monitoring project. They can easily be installed underground and will provide long term measurement of displacement between nodes once the unit if fully grouted. The maximum displacement that can be measured between a node is 125mm. The extensometers selected for use are manufactured by YieldPoint in Canada. Extensometers can be made to order with up to six nodes and vary in length depending on the application.

Tiltmeters were also considered for use in monitoring directional movement in the major faults. Discussions with GMS's instrument experts have recommended that extensometers are the better instrument for use. Tiltmeters are commonly used in civil applications where measurement for fixed structures is required, eg buildings or towers.

A summary of all the instruments considered for use is provided in Table 1.

Table 1. Geotechnical instrument summary.

Instrument	Advantages	Disadvantages	Suitability
Manual Readout Units (Rock-IT, Clock-IT etc)	Cheap Easy to install Does not require grouting	Unit needs to be manually read underground Measures displacement between two anchor points only	Unsuitable for use in monitoring inaccessible areas.
TDR (Time Domain Reflectometry) / Fibre	Cheap Ability to monitor large distances	Requires down holes from the surface Only provides point data, not displacement. Current surface down holes are covered with water from Lake Cowal.	Suitable for use in surface drillholes / down holes only
Slough meters	Cheap Easy to install in down holes.	Only provide point data, no displacement. Requires to be installed in down holes	Unsuitable for use when installing from crown drives
Tilt meters	Provides directional movement Suitable for use on fixed objects, eg buildings	Only provides point data, no displacement	Initially considered for use in faults Instrument specialists recommended the use of extensometers instead.
Instrumented Rock Bolts	Gives an indication of load on primary support	Expensive Not as sensitive as extensometers Short embedment length	Unsuitable
Instrumented Cable Bolts	Gives an indication of load on deep support.	More expensive that extensometers. Requires grouting and cable protection for long term use.	Suitable in stope crowns where cable bolts are likely to be installed.
Extensometers	Accurate monitoring of deformation between instrument nodes. Order in custom length for application.	Cost. Requires grouting and cable protection for long term use.	Suitable for use. Longer extensometers ordered for areas likely to experience larger deformation.

3. Design

The design of the instrumentation locations required GMS to be provided will all geotechnical, geological, as-built and engineering files. A summary of the files that were provided to GMS used in the design is detailed in Table 2.

Table 2. Files provided to GSM used in the instrumentation design.

Item	File Name
Report – Beck Engineering Geotechnical Assessment of Surface Impacts for Proposed Underground Mining at Lake Cowal	COWAL2020JUN15_SUBSIDENCE ASSESSMENT FOR UNDERGROUND MINING.pdf
Surface layout & open pit	Site_Plan_01_January_2022.dtm
Underground design files	Upper levelssx_26052022.dxf Currentsolids_1020.dcf Currentsolids_1020_990.dcf Currentsolids_WARDEC.dcf Futuresolids.dcf Subsidence_Floor_drivenames.dcf
Structures	19 dxf files provided of mine structures along with descriptions
Lithology	16 dxf files provided of mine lithology
Weathering	BOX_Master.dxf BOSOX_Master.dxf TOFR_Master.dxf
RQD data	GRE46 RQD export_160622.ddd
Open Pit LOM	Satellite Pits_Dec21 MROR_Stage H.dcf

3.1. Instrument Design

The design component consisted of constructing a geotechnical model to gain an understanding of the mine layout and geological features. The layout of the Warraga 1050 and 1057 levels GMS has allocated for designing the instruments are pictured in Figure 1.

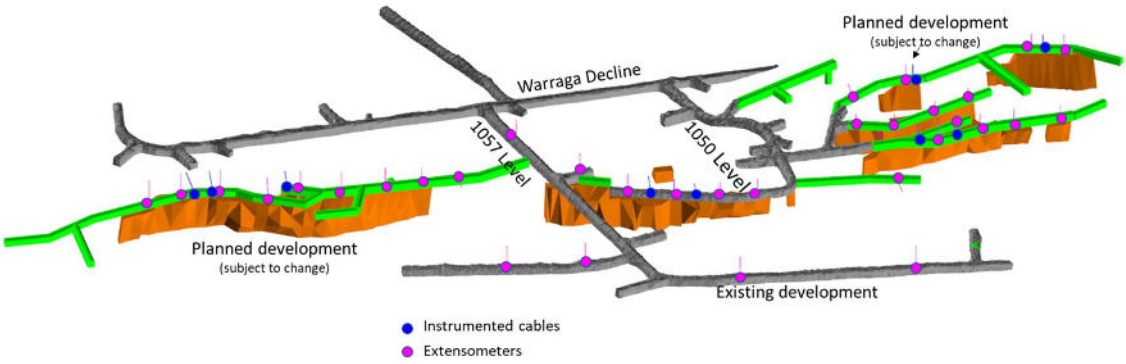


Figure 1. Layout of Lake Cowal underground used for the instrument design.

3.1.1. WAR_1050 Northern Ore Drives

In the Warraga 1050 northern ore drives, a total of 14 extensometers and 4 instrumented cable bolts are to be installed between the 1050_OD_N1, 1050_OD_N11, 1050_OD_N2 and the 1050_OD_N3. A isometric view of the Warraga 1050 northern ore drives are presented in Figure 2.

The WAR_1050_OD_N3, being the western most ore drive, contains isolated stopes which are near the Glenfiddich fault zone. Nine-meter extensometers and cable bolts have been selected for use in this drive to ensure that embedment is sufficiently through the Glenfiddich fault to monitor for any movement. Section views of the WAR_1050_OD_N3 are presented in Figure 3.

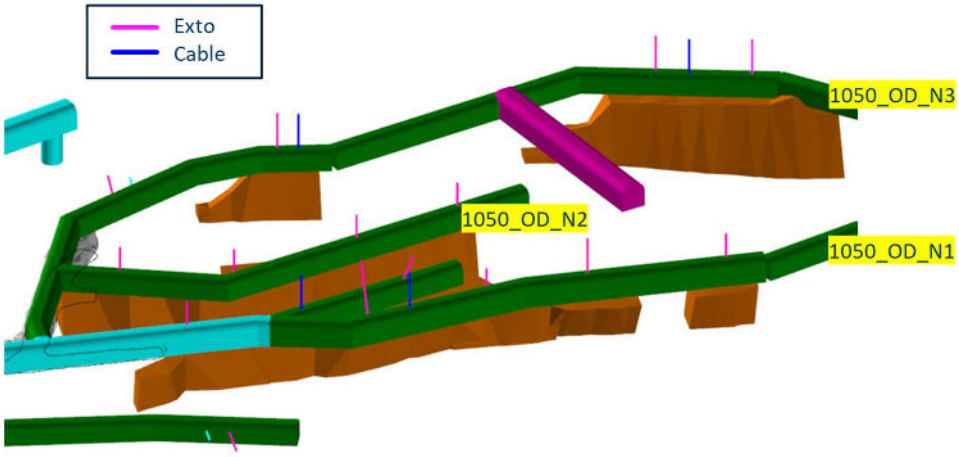


Figure 2. Isometric view of the Warraga 1050 northern ore drives.

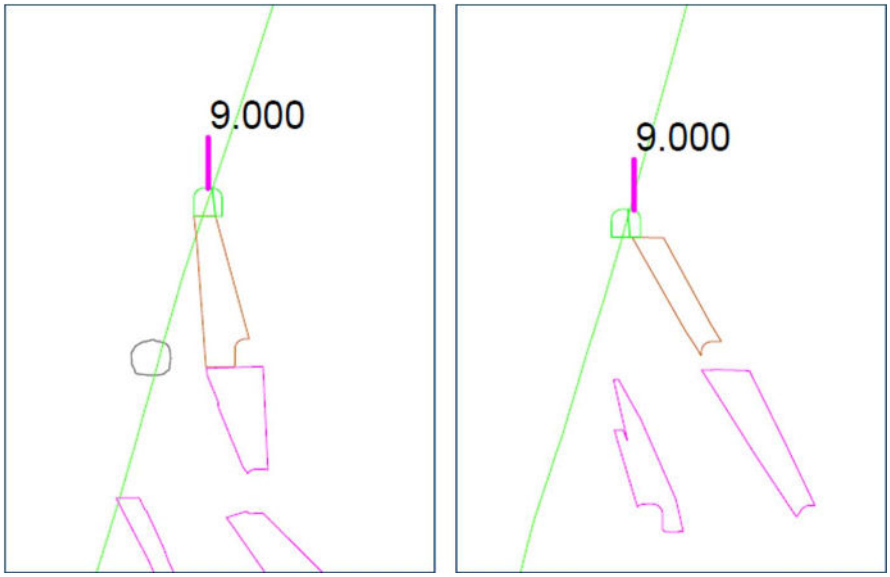


Figure 3. Section view of the WAR_1050_OD_N3 with the intersecting Glenfiddich Fault (green).

The WAR_1050_OD_N2 in the Northern Mine Area is considered to be of low risk, as no faults from the structural model intersect the drive. Section views of this drive are presented in Figure 4. Six-meter extensometers will be installed in the WAR_1050_OD_N2.

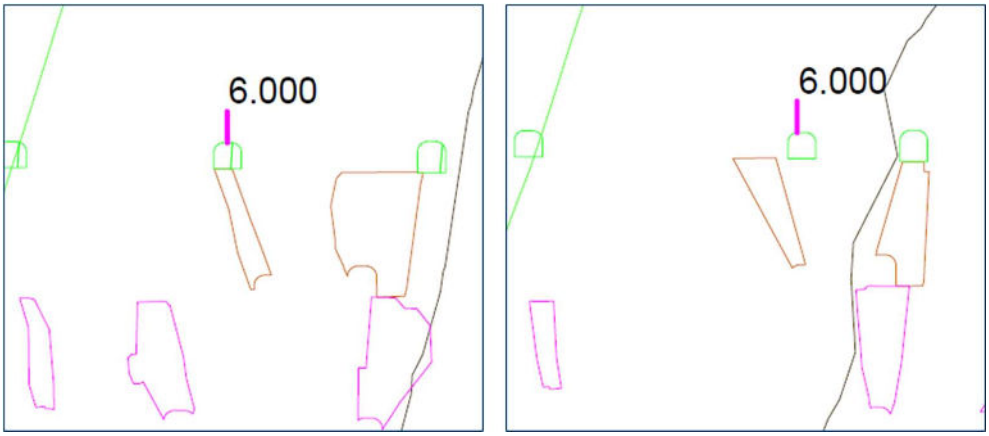


Figure 4. Section view of WAR_1050_OD_N2.

The WAR_1050_OD's N1 & N11 will have combination of 12m, 9m and 6m extensometers and two 9m instrumented cable bolts. Planning shapes indicate that Drive 3 may contain wider stopes which are intersected by the Galway Splay #7. In the areas where wide spans are likely, longer instruments are to be installed. Section views of the 1050_OD's N1 & N11 are presented in Figure 5.

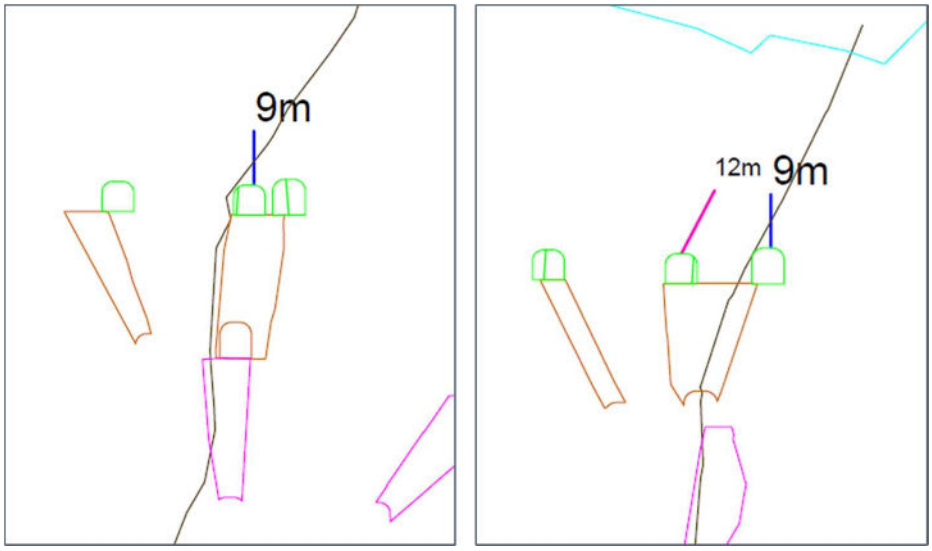


Figure 5. Section view of instruments installed in the WAR_1050_OD_N1 & N11.

A summary of all the instruments that are to be installed in the Warraga 1050 northern ore drives are presented in Table 3.

Table 3. Warraga 1050 Northern ore drive instrument summary.

	ID	Instrument	Length (m)	Leadwire	Comments
WAR_1050_OD_N3	Exto 1	d6Exto	9	250	
	Exto 2	d6Exto	9	230	
	Exto 3	d6Exto	9	220	
	Exto 4	d6Exto	9	100	
	Cable 1	d6Cable	9	100	
	Cable 2	d6Cable	9	60	
	MUX 1	d8MUX			For drive 1 instruments
	Ackcio Logger 1	BEAM DG			For MUX 1
WAR_1050_OD_N2	Exto 5	d6Exto	6	125	
	Exto 6	d6Exto	6	100	
	Exto 7	d6Exto	6	75	
	Exto 8	d6Exto	6	50	
	MUX 2	d4MUX			For drive 2 instruments
	Ackcio Logger 2	BEAM DG?			For MUX 2
WAR_1050_OD_N1 & N11	Exto 9	d6Exto	6	200	
	Exto 10	d6Exto	9	170	
	Exto 11	d6Exto	9	150	
	Exto 12	d6Exto	9	130	
	Exto 13	d6Exto	12	120	
	Exto 14	d6Exto	12	80	
	Cable 3	d6Cable	9	130	
	Cable 4	d6Cable	9	110	
	MUX 3	d8MUX			For drive 3 instruments
	Ackcio Logger 3	BEAM DG			For MUX 3

3.1.2. WAR_1050 Ore Drive South

In the WAR_1050_OD_S1, four extensometers of 12m and 9m lengths and three 9m instrumented cable bolts will be installed. Planning shapes indicated that the area would contain several wide stopes that are likely to create wide spans after mining. The ore drive is also heavily faulted with several of the Galway Splays intersecting the drive and present in the hanging wall and footwall.

The extensometers will be installed vertically to monitor for any movement that above the drive. The instrumented cable bolts will be installed in the shoulder of the drive, at an angle of 20° from vertical in a similar arrangement that crown cable bolts are likely to be installed.

An isometric view of the WAR_1050_OD_S1 is presented in Figure 6. Section views of the WAR_1050_OD_S1 with example layouts of the extensometers and cable bolts are presented in Figure 7. A summary of the instruments to be installed in WAR_1050_OD_S1 are presented in Table 4.

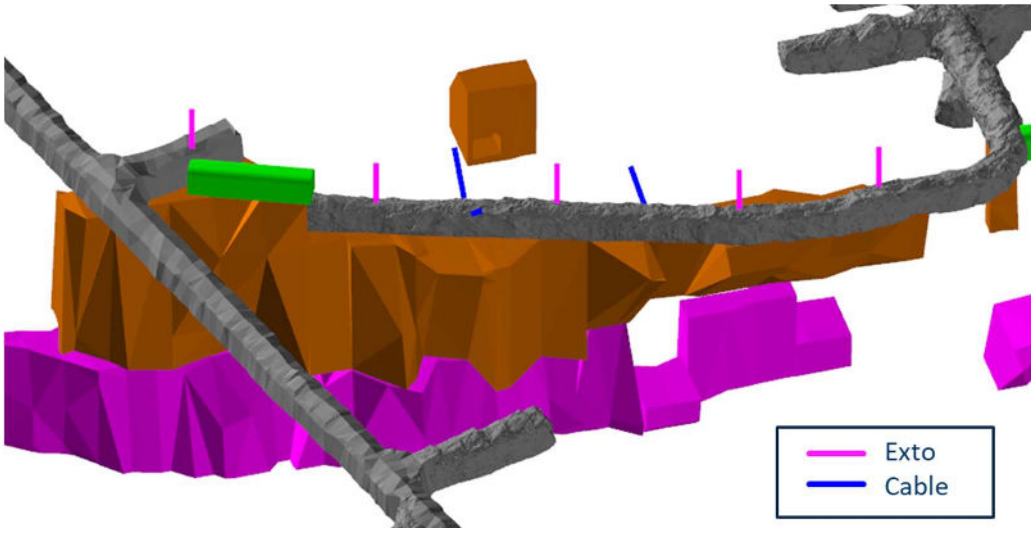


Figure 6. Isometric view of the WAR_1050_OD_S1 (the far left exto is considered part of the WAR_1057_SPL)

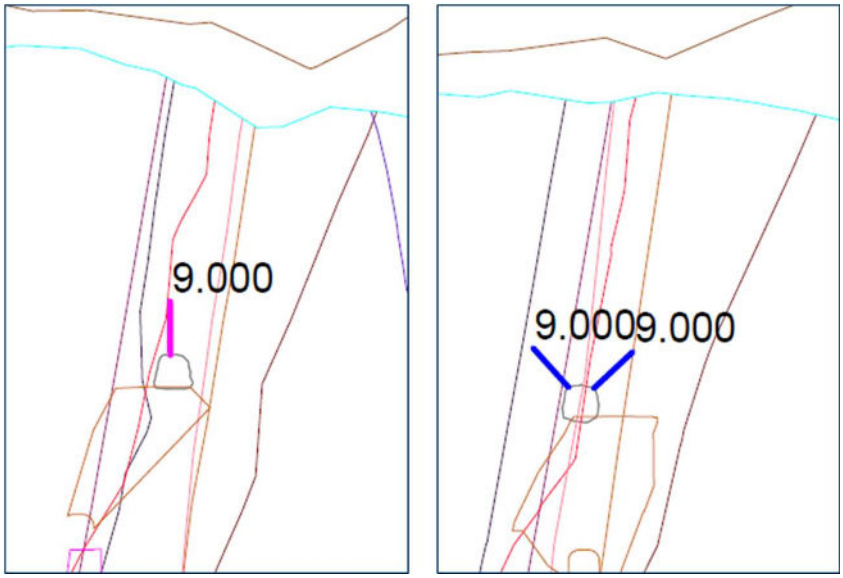


Figure 7. Section views of WAR_1050_OD_S1.

Table 4. WAR_1050_OD_S1 instrument summary.

	ID	Instrument	Length (m)	Leadwire	Comments
WAR_1050_OD_S1	Exto 15	d6Exto	12	180	
	Exto 16	d6Exto	9	150	
	Exto 17	d6Exto	9	120	
	Exto 18	d6Exto	9	100	
	Cable 5	d6Cable	9	170	
	Cable 6	d6Cable	9	170	
	Cable 7	d6Cable	9	140	
	MUX 4	d8MUX			For drive 4 instruments
	Ackcio Logger 4	BEAM DG			For MUX 4

3.1.3. WAR_1057 Southern Ore Drives

Planning shapes for the Warraga 1057 southern ore drives indicate a panel of stopes that vary in width. The area contains several structures that intersect the drives and stopes that may influence stability. At the northern end, several of the Galway Splays intersect the drive and at the southern end, the Glenfiddich fault is present in the hanging wall. The WAR_1057_OD_S1 is also underlying the WAR_DEC / WAR_1093_DDC and has the shallowest depth to the base of the oxidised rock layers. As a result, longer instruments will be installed, particularly where mining will be below the WAR decline. An isometric view of the 1057 southern ore drives are presented in Figure 8.

Nine extensometers which vary in length between 15m, 12m and 9m will be installed with three instrumented cable bolts of 12m and 9m lengths. The extensometers will be installed vertically to monitor for any movement that above the drive. The instrumented cable bolts will be installed in the shoulder of the drive, at an angle of 20° from vertical in a similar arrangement that crown cable bolts are likely to be installed. Section views of the WAR_1057_OD_S1 are presented in Figure 9.

A summary of the instruments to be installed in the WAR_1057 southern ore drives are presented in Table 5.

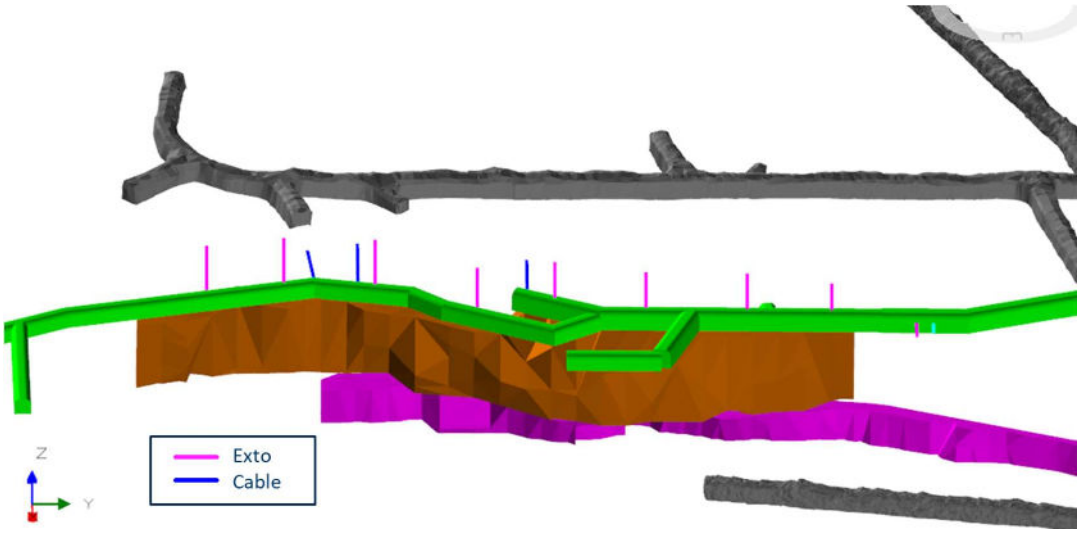


Figure 8. Isometric view of the WAR_1057 southern ore drives.

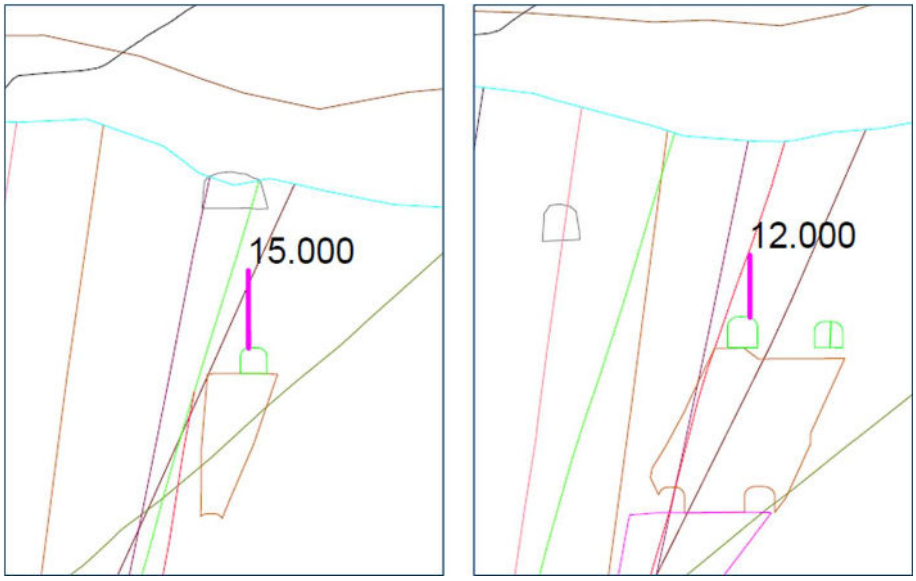


Figure 9. Section Views of WAR_1057_OD_S1 (Glenfiddich fault in green, base of oxidised rock in blue).

Table 5. WAR_1057 southern ore drives instrument summary.

	ID	Instrument	Length (m)	Leadwire	Comments
WAR_1057_OD_S1	Exto 19	d6Exto	15	330	
	Exto 20	d6Exto	15	300	
	Exto 21	d6Exto	15	270	
	Exto 22	d6Exto	12	240	
	Exto 23	d6Exto	12	210	
	Exto 24	d6Exto	12	170	
	Exto 25	d6Exto	12	140	
	Exto 26	d6Exto	9	110	
	Exto 27	d6Exto	9	80	
	Cable 8	d6Cable	12	290	
	Cable 9	d6Cable	12	280	
	Cable 10	d6Cable	9	220	
	MUX 5	d8MUX			For drive 5 instruments
	MUX 6	d4MUX			
	Ackcio Logger 5	BEAM DG			For MUX 5
	Ackcio Logger 6	BEAM DG			For MUX 6

3.1.4. Perimeter Drives

Seven 15m extensometers have been designed for installation in the perimeter drives that will monitor for any changes in ground movement away from the stoping panels. An isometric view of the extensometers to be installed in the perimeter drives are presented in Figure 10. The eastern most drives, the WAR_1057_DDC_B and the WAR_1057_DD_N will contain four extensometers that will provide monitoring where the drives intersect the Galway Splay #8 and the Cragganmore Faults.

One extensometer will be positioned in the WAR_1057_ACC where the Glenfiddich Fault crosses. Another extensometer will be positioned in the WAR_1057_SPL, which planning shapes indicated may be used for stoping. The final of the seven extensometers will be installed in the WAR_1050_OD_N. Section views of two of the extensometers installed in the perimeter drives are presented in Figure 11. A summary of the instruments to be installed in the perimeter drives are presented in Table 6.

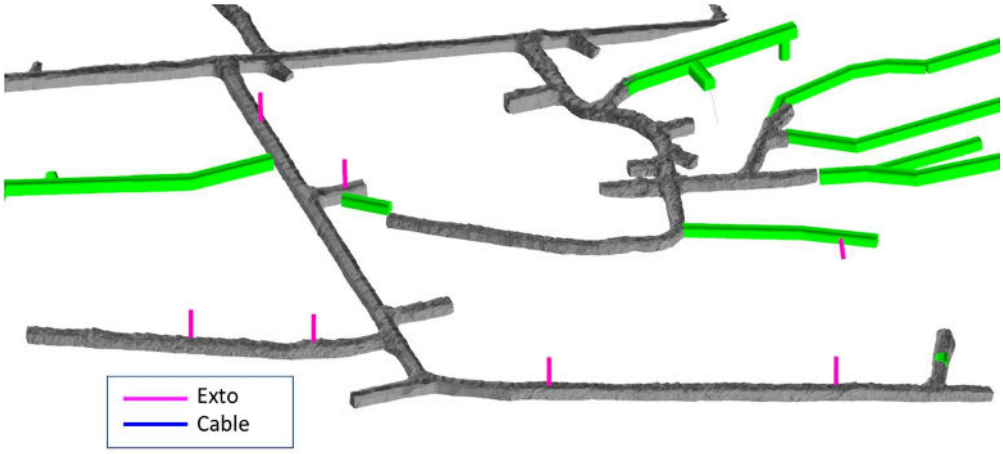


Figure 10. Isometric view of extensometers to be installed in the perimeter drives.

Figure 11. Section views of 15m extensometers to be installed in the WAR_1050_DD_N (left) and the WAR_1057_ACC (right).

Table 6. Perimeter drive instrument summary.

	ID	Instrument	Length (m)	Leadwire	Comments
Perimeter Drives	Exto 28	d6Exto	15	10	BEAM DG
	Exto 29	d6Exto	15	10	BEAM DG
	Exto 30	d6Exto	15	10	BEAM DG
	Exto 31	d6Exto	15	10	BEAM DG
	Exto 32	d6Exto	15	60	BEAM DG
	Exto 33	d6Exto	15	30	BEAM DG
	Exto 34	d6Exto	15	140	To connect to MUX4

3.2. Instrument and Design Summary

A total of 34 extensometers and 10 instrumented cable bolts are required for installation based on the current mining area.. As some of the instruments have been designed around mine planning development and stoping shapes, the actual location of instruments may change based on updated designs and as-built development. A summary of the geotechnical instruments required is presented in Table 7.

Section plots have been created for each instrument's current design and are available in Appendix 1.

Table 7. Total geotechnical instruments in design.

Instrument Length	d6 Extensometer	d6 Instrumented Cable Bolt
6m	5	-
9m	12	8
12m	7	2
15m	10	-
Total	34	10

3.2.1. Design Considerations

The aim of the monitoring strategy proposed by GMS aims to identify early onset of deformation or failure utilising borehole instrumentation. The extensometers and digital cable bolts selected for use are considered to most suitable option for the unique set of parameters which restrict the use of other types of monitoring instrumentation. The installation of instruments vertically above the crown drive provides the best opportunity for in-rock monitoring of any ground movement or subsidence that may occur.

Without access to the surface to drill surface holes, it is very difficult to monitor the entire pillar. There is no current access to drill and install monitoring holes using TDR and fibre, once lake levels reduce these will be assessed as part of the ongoing phased approach to designing the monitoring program. Monitoring of the surface above the underground workings is difficult due to the movement of sediment in the lake, although it would be worthwhile to capture surface topography during dry

periods to establish a data set to identify trends. Although, it should be of note that any surface topography captured may prove difficult to calibrate due to moisture driven changes.

The monitoring strategy has been to have a higher density of instruments and longer embedment in areas that are faulted or likely to have large spans. In general, instruments have been designed to be installed in every second stope. Based on current planning shapes, instruments will be spaced approximately 30m apart.

However, the monitoring system is unable to capture any chimney type failure that may occur in isolated areas away from monitoring. It is recommended that routine scans of the levels, using a Hovermap or similar drone-based LIDAR scanner will allow monitoring for any changes in rock surfaces in the drives even after stoping has been completed.

3.3. Telemetry Design

A key consideration for the monitoring system design was to assume that personnel access to the instruments is lost after stoping, although in practice this may not be the case. The data from both the extensometers and digital cable bolts can be captured in multiple ways. If access is available to the instrument site, then a Bluetooth BluLink logger can be connected directly to the instrument which allows a user to download data to an Android device via the YieldPoint app. The use of Bluetooth loggers is only suitable in areas where long term access is available.

Due to stope geometries underlying the crown level, it is likely that access into these crown drives will be restricted or not possible after the stopes have been mined. For this reason, data loggers and telemetry from the instrument collar is not an option (no access to replace batteries).

To collect the data from the instruments where access will be lost after stoping, instruments will be hardwired directly into a YieldPoint multiplexing unit (dMUX) at a suitable access point. To allow remote capture of data, GMS proposes the use of Ackcio data loggers which can transfer data between units back to a gateway hub which uploads the data to a cloud server.

To ensure that instrument data loggers can always be accessed, instruments have been designed with sufficient lead wire to run from the instrument back out of the ore drive to an area beyond the stoping front. From this point the instrument lead wires will be plugged in to a YieldPoint multiplexing unit (dMUX). The dMUX comes in either a 4 or 8 channel module which allow the corresponding number of instruments to be hardwired in respectively. The Ackcio digital data loggers (BEAM-DG) extracts the data from the YieldPoint dMUX to allow transfer over the Ackcio telemetry system. To transfer data over long distances and around corners, Ackcio repeater node (BEAM-RN) is required. All data is then transmitted to the single Ackcio central gateway (BEAM-GW) which then transfers data to a WIFI network and onto a cloud server.

Figure 12 displays the transfer of data from geotechnical instruments via data loggers to the WIFI gateway and onto the cloud. The location of the telemetry instruments for the monitoring system throughout the mine are presented in Figure 13.

A summary of the total instrumentation required for the telemetry system is presented in Table 8.

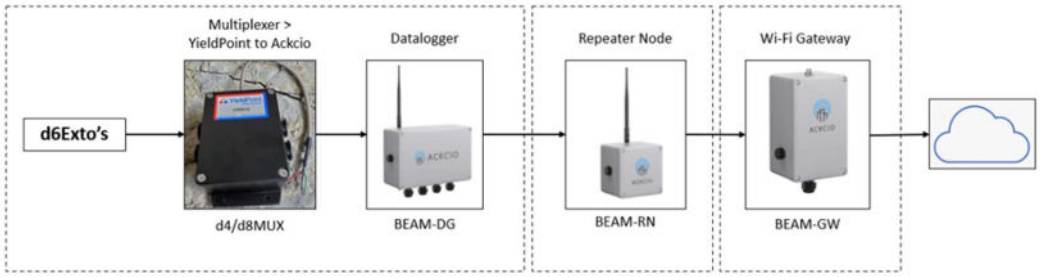


Figure 12. Data flow path with selected telemetry instruments.

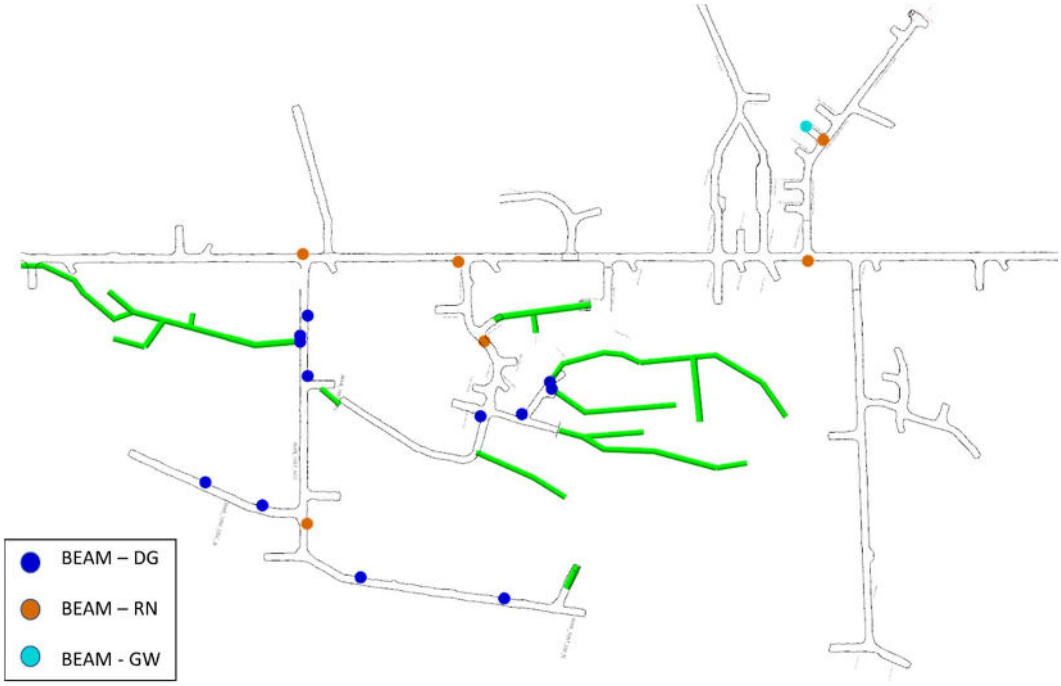


Figure 13. Location of required telemetry instruments.

Table 8. Summary of telemetry instrumentation required.

	Instrument	Quantity
Telemetry	d4MUX	3
	d8MUX	8
	BEAM - DG	12
	BEAM - RN	7
	BEAM - GW	1

3.3.1. Radio Frequencies

The Ackcio wireless data transfer network uses a sub-1GHz radio band that allows low power, long range communication. When used underground, the Ackcio BEAM units will transmit over up to 500m, depending on local conditions. The Ackcio brochures in Appendix 3 to 6 provide information on the Ackcio units that will be used in the telemetry network. A summary of the Ackcio telemetry information is presented in Table 9.

Table 9. Ackcio instrument telemetry information.

Ackcio Instrument	Radio Frequency	WIFI
BEAM - DG	863 – 870MHz 902 – 928MHz	N/A
BEAM - DG		
BEAM - GW		2.4GHz/5GHz

3.4. Cable Protection

A critical component of the Lake Cowal crown pillar instrumentation project is ensuring that sufficient and fit for purpose cable protection is installed.

The instrument lead wires will be run through 40mm electrical conduit that will be secured tightly to the backs/shoulder of the ore drives. The lead wires will have strain relief placed in them every 50m to ensure that any potential deformation of the drive is accounted for.

Once the lead wire (inside the electrical conduit) is securely fastened to the drive backs/shoulder, both the instrument collar and electrical conduit are to be sprayed using 100mm of shotcrete for further protection. The use of shotcrete to cover the instrument collar and electrical conduit will be suitable for protection from fly rock from production blasts.

While it is expected that the combination of the electrical conduit and shotcrete will be sufficient to protect the instruments and their lead wires, the following can also be done to ensure survival of the instruments:

- Ensure all mine personnel are aware of their existence so they are not unintentionally damaged by drilling or some other activity.
- Ensure that all production blast holes on the crown level use a suitable amount of stemming to prevent any blast energy directed towards the instrumentation.

Even with this cable protection in place, there remains the possibility that communication could be lost between the instrument and the data logger due to:

- Failure of the backs/shoulder that breaks the cable.
- Cable protection system is overcome by a piece of fly rock.
- Damage by operations from drilling activities.

4. Installation Method

All of the geotechnical instruments are to be installed using the pressure grouting filler and breather tube method. Before GMS arrive onsite to install instruments the following must be completed:

- All instrument holes drilled to the length of the instrument + 0.5m
- All holes to be drilled at a minimum (and optimum) diameter of 54mm
- Provide a suitable area for storage of instruments on site that is dry, out of weather and secure from access.
- Arrange for GMS personnel and equipment to be transported as required to the job sites around site.
- Schedule the use of an IT and operator from the mining contractor for the period of installation.
- Supply air and water services required for grouting at each installation point.
- Ensure grout pump with sufficient power to pump 0.35-0.40 W:C ratio grout to 15m vertically is available and ready for use
- A sufficient amount of filler and breather tube is available on site (GMS can provide if required)
- A sufficient amount of wadding is available and ready
- A sufficient amount of cement is available and ready
- Provide plate and tensioning equipment for use with the instrumented cable bolts
- 10 x site standard cable bolt plates to have a channel cut out of them as shown in Figure 14

All of the instruments will be installed using the following method:

- Uncoil the instrument and lay it flat.
- Plug the instrument into the d-READER and take a reading with the instrument uncoiled and relaxed. The instrument will scroll through its anchors.
- Check that all the anchor points are reading within their range
- Dip the hole using grout pipe to ensure the hole is at the designed depth and still open
- Cut a length of breather tube to the appropriate length for the instrument, cut the end of the grout hose at a 60-degree angle to make insertion easier.
- Securely attach the breather tube to the instrumented end of instrument with electrical tape, the angled end of the grout hose should be 100mm longer than the instrument
- Insert into the borehole carefully, taping the grout hose to the instrument at regular intervals during insertion.
- Secure the instrument at the collar of the borehole using wadding cloth.
- Take a reading with the d-READER.
- Grout the cables with a 0.35 - 0.38 w/c ratio Portland cement grout. Under no circumstances use a grout greater than 0.40 w:c ratio.
- Continue grouting until grout reports from the breather tube
- Kink and cable tie both the breather and filler tubes

d6Cable specific instructions:

- The installation method for the instrumented cable bolts is the same as for the extensometers, except that the cable bolts can be plate and tensioned once the grout is cured. Curing time will be the same for site specific requirements for plating and tensioning cable bolts.
- The instrumented cable bolts are required to be plate and tensioned with a modified plate that will allow the instrument tail to be slotted in.
- The modified cable bolt plate will have a slot cut out of one side, as pictured in Figure 14.

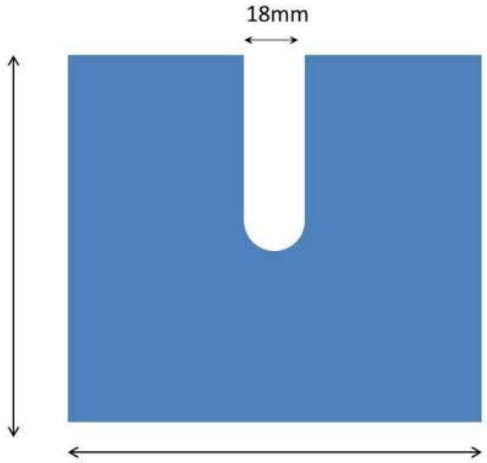


Figure 14. Modified cable bolt plate with slot cut out for instrumented cable bolt.

5. Upload and Importing Data

As most of the data will be uploaded through the telemetry system and onto the cloud server, the data files should be able to be easily downloaded in either a text or csv file which can be used for interpretation in multiple different software packages.

GMS has consulted with NavStar Geomatics in regard to uploading the instrument data onto the NavStar system. As Cowal Gold Operation are currently using vibrating wire piezometers (VWP) which collect data through Ackcio gateways and are uploaded to GeoExplorer, there is already experience onsite with the system that GMS have also proposed to use.

The objective of the telemetry system will be for a seamless integration between the instruments and the plotting software, where live uploading and plotting can be achieved without the need to rehandle data. GMS will provide data analysis advice once provided with sample logs and understand the plotting system of NavStar and the GeoExplorer software.

6. Costs

The cost associated with the project are outlined in Table 10. The drilling cost of $72.36/m has been provided by Evolution Mining and are not associated with GMS's final quote for instrumentation and installation. All holes drilled for each instrument are required to be over drilled by an additional 0.5m. The total drill metres required for the 44 instruments is 490m.

The final quote itemising all costs associated with the supply and installation of the instrumentation can be found in Table 11 and Appendix 7.

Table 10. Drilling, instrumentation, design, and installation costs.

Item	Unit Cost	Item Cost
Drilling	490m at $72.36/m	$35,456.40
Instruments (ex GST)	-	$201,605.00
Design & Installation (ex GST)	-	$118,960.00
GST		$31,056.50
Total Costs	-	$387,077.90

Table 11: Instrumentation and Installation Costs

QUOTE

Evolution Mining (Cowal) Pty Limited
ABN: 75007857598

Date
11 Jul 2022

Expiry
5 Aug 2022

Quote Number
QU-1004

Reference
Lake Cowal

ABN
24 639 206 983

Geotechnical Mining Services
39 Newlands St
TREVALLYN TAS 7250
AUSTRALIA

GMS Supply and Installation of Instrumentation

Trust Our Experienced Team To Take Care Of Your Geotechnical Projects

Description	Quantity	Unit Price	GST	Amount AUD
6 points hard rock extensometer 250mm stroke, head-at-collar, 15m long, equidistant points	10.00	2,950.00	10%	29,500.00
6 points hard rock extensometer 250mm stroke, head-at-collar, 12m long, equidistant points	7.00	2,600.00	10%	18,200.00
6 points hard rock extensometer 250mm stroke, head-at-collar, 9m long, equidistant points	12.00	2,450.00	10%	29,400.00
6 points hard rock extensometer 250mm stroke, head-at-collar, 6m long, equidistant points	5.00	2,150.00	10%	10,750.00
6 points Instrumented cable anchor equally spaced, will be plated/tensioned, head-at-toe, 12 meter long, bulbs every 100 cm	2.00	3,150.00	10%	6,300.00
6 points Instrumented cable anchor equally spaced, will be plated/tensioned, head-at-toe, 9 meter long, bulbs every 100 cm	8.00	2,950.00	10%	23,600.00
D8MUX 8 channel multiplexing module that allows ata to be logged using Ackio telemetry system	6.00	1,400.00	10%	8,400.00
4 channel multiplexing module that allows ata to be logged using Ackio telemetry system	2.00	1,300.00	10%	2,600.00
Smart Instrument Extension Cables -for linking the instruments above stopes to the MUX	6180.00	4.75	10%	29,355.00
Ackio Beam DG Digital Node Looger to extract data from D8/D4 MUX	12.00	2,400.00	10%	28,800.00
Ackio Beam RN Repeater Node Extends wireless range of nodes in mesh allowing communication to central gateway	7.00	1,450.00	10%	10,150.00

GEOTECHNICAL
MINING SERVICES

ACN 639 206 983

Description	Quantity	Unit Price	GST	Amount AUD
Ackio Beam GW Gateway Central gateway to receive all instrument data	1.00	4,550.00	10%	4,550.00
Cable conduit cable protection	250.00	10.00	10%	2,500.00
Miscellaneous items for installation (cable ties, tape, pipe glue etc.)	1.00	1,000.00	10%	1,000.00
Sundry and logistics	1.00	5,000.00	10%	5,000.00
Airfreight (approximation)	1.00	10,000.00		10,000.00
Package and handling (Canada)	5.00	750.00	10%	3,750.00
Project Engineer - Instrumentation Design and Report	50.00	165.00	10%	8,250.00
Project Engineer - Installation	256.00	165.00	10%	42,240.00
Geotechnical Technician - Installation	256.00	120.00	10%	30,720.00
Flights - Travel from QLD and TAS	1.00	5,000.00	10%	5,000.00
Accommodation and meals	32.00	250.00	10%	8,000.00
Hire Car - will attempt to utilise current GMS hire car if Harry Towns still onsite	1.00	2,500.00	10%	2,500.00
			Subtotal	320,565.00
			TOTAL GST	31,056.50
			TOTAL AUD	**351,621.50**

Terms

Quotes are valid for 30 days

Regards

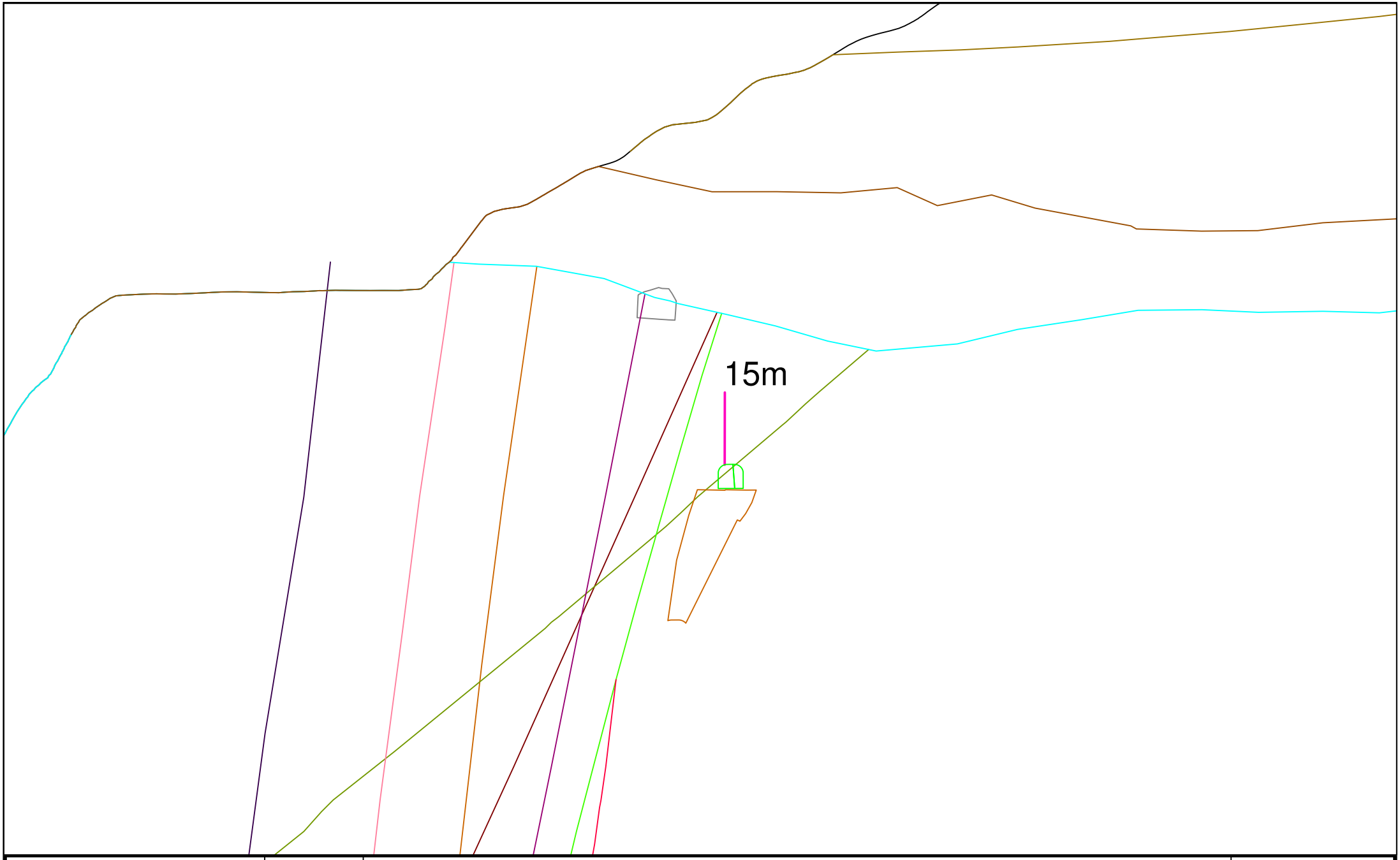
Ash Page

Director

Mingma Sherpa

Project Engineer

Appendix 1 - Section plots of instruments with as-builts, engineering shapes, fault structures, weathering surfaces and surface layout.



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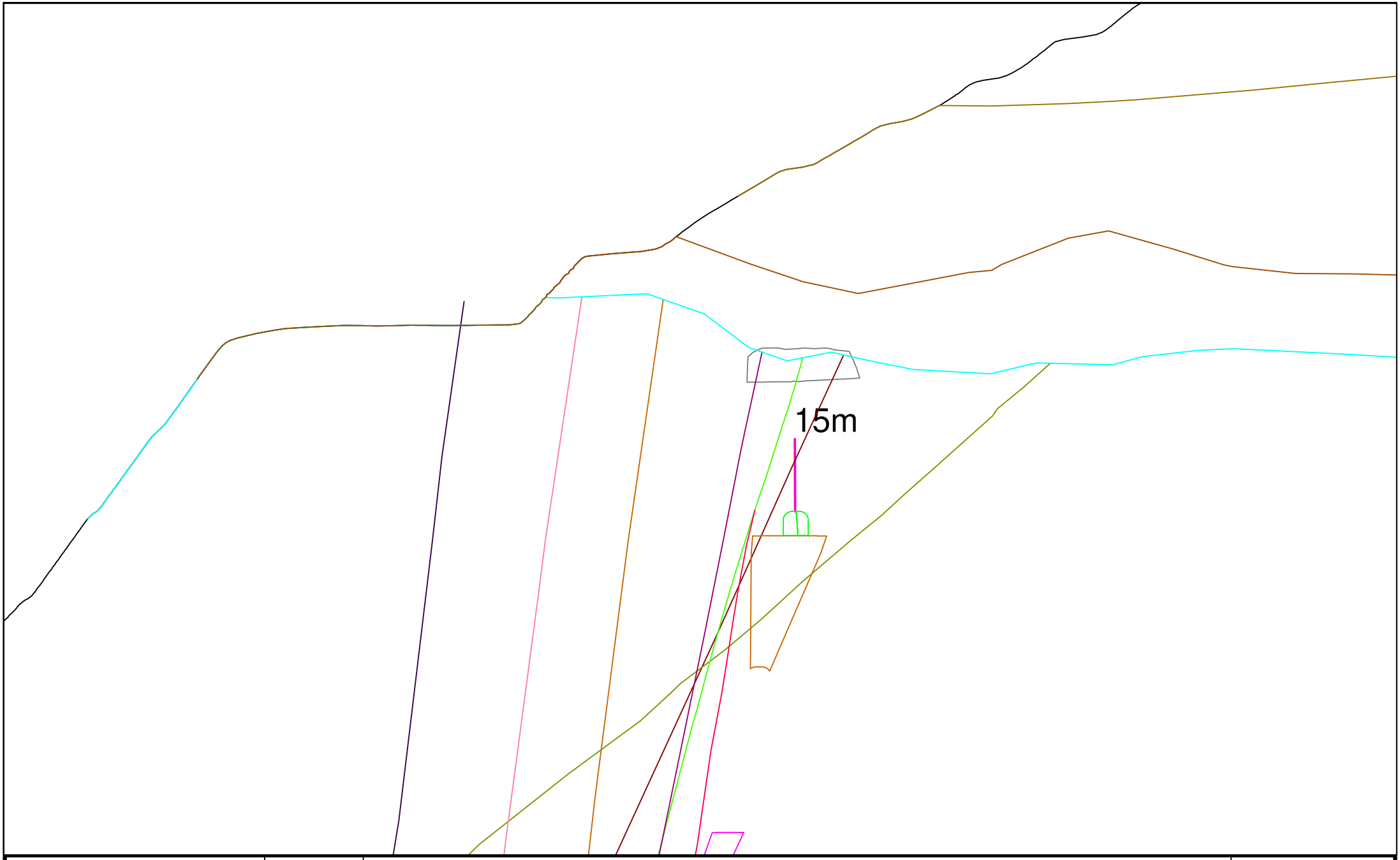
GMS GEOTECHNICAL MINING SERVICES		View Looking North - Section 36,285 mN	



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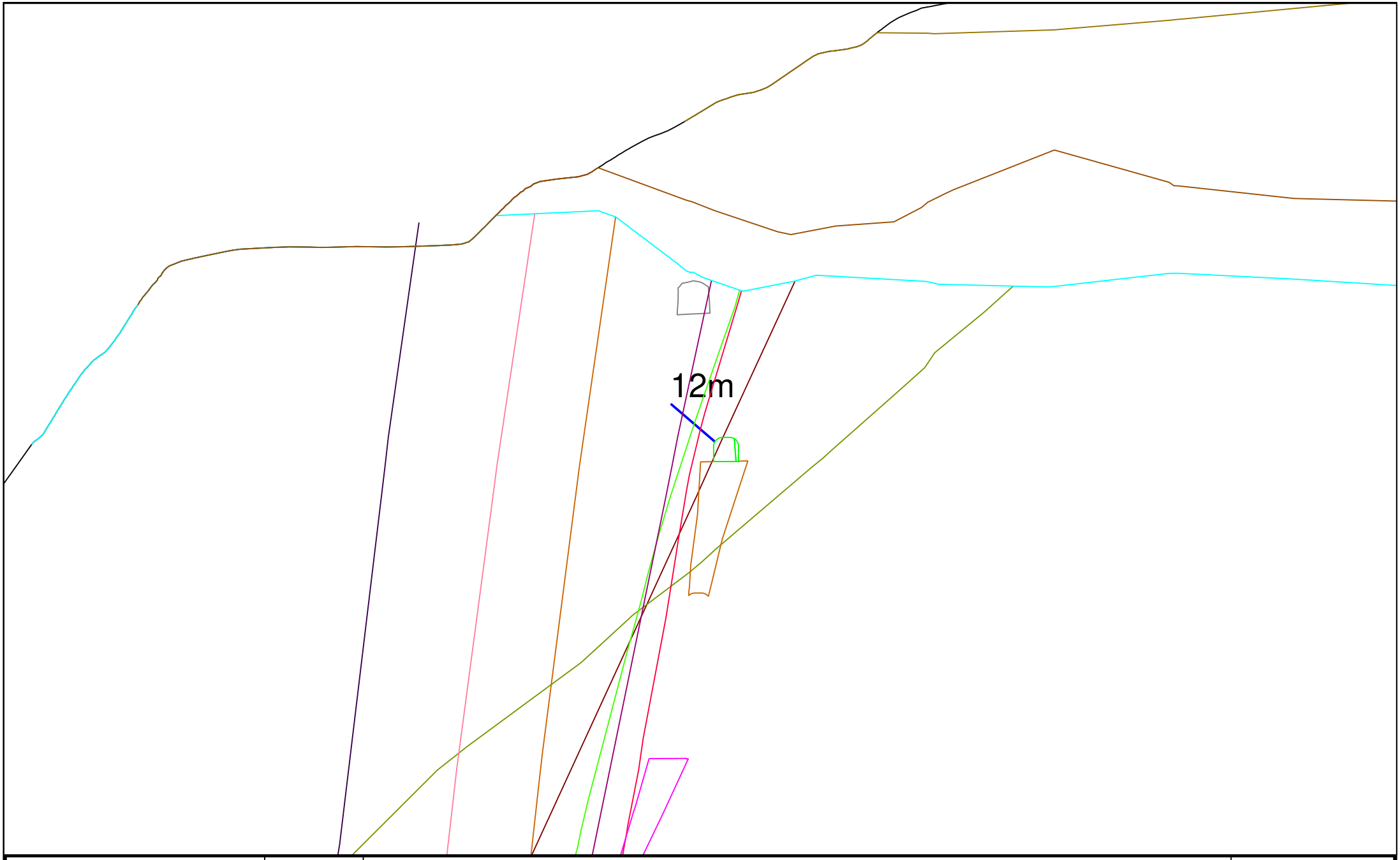

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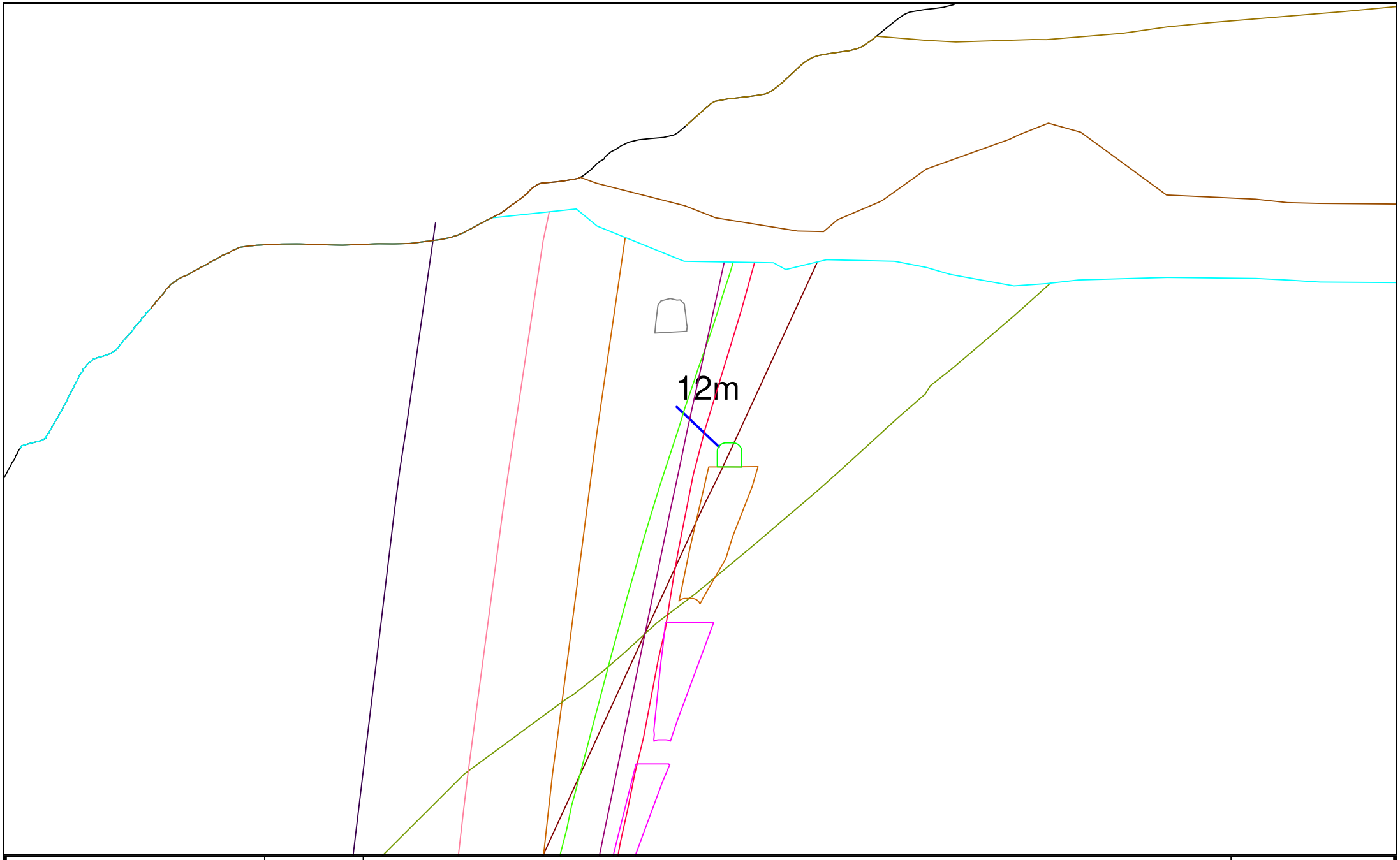

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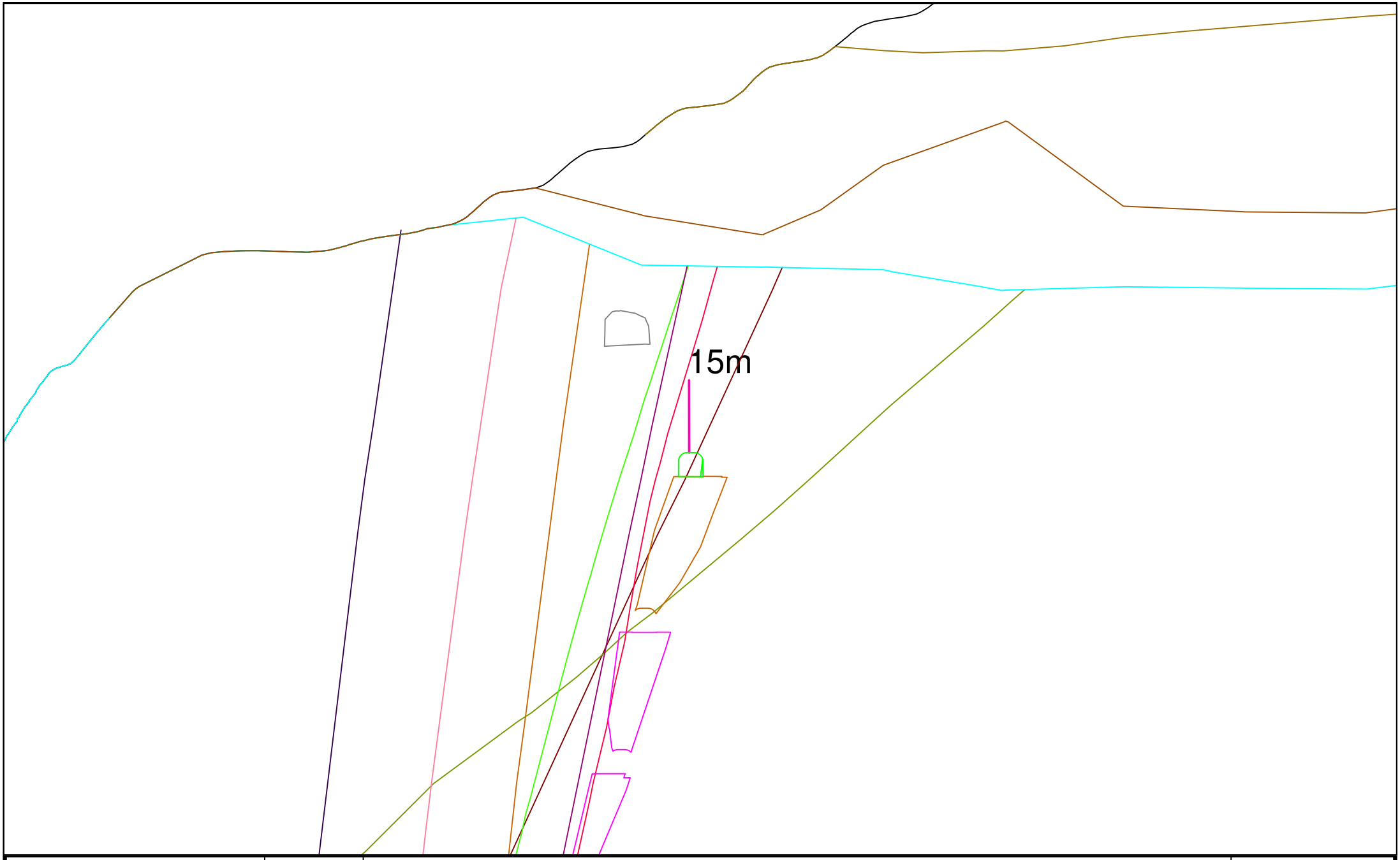

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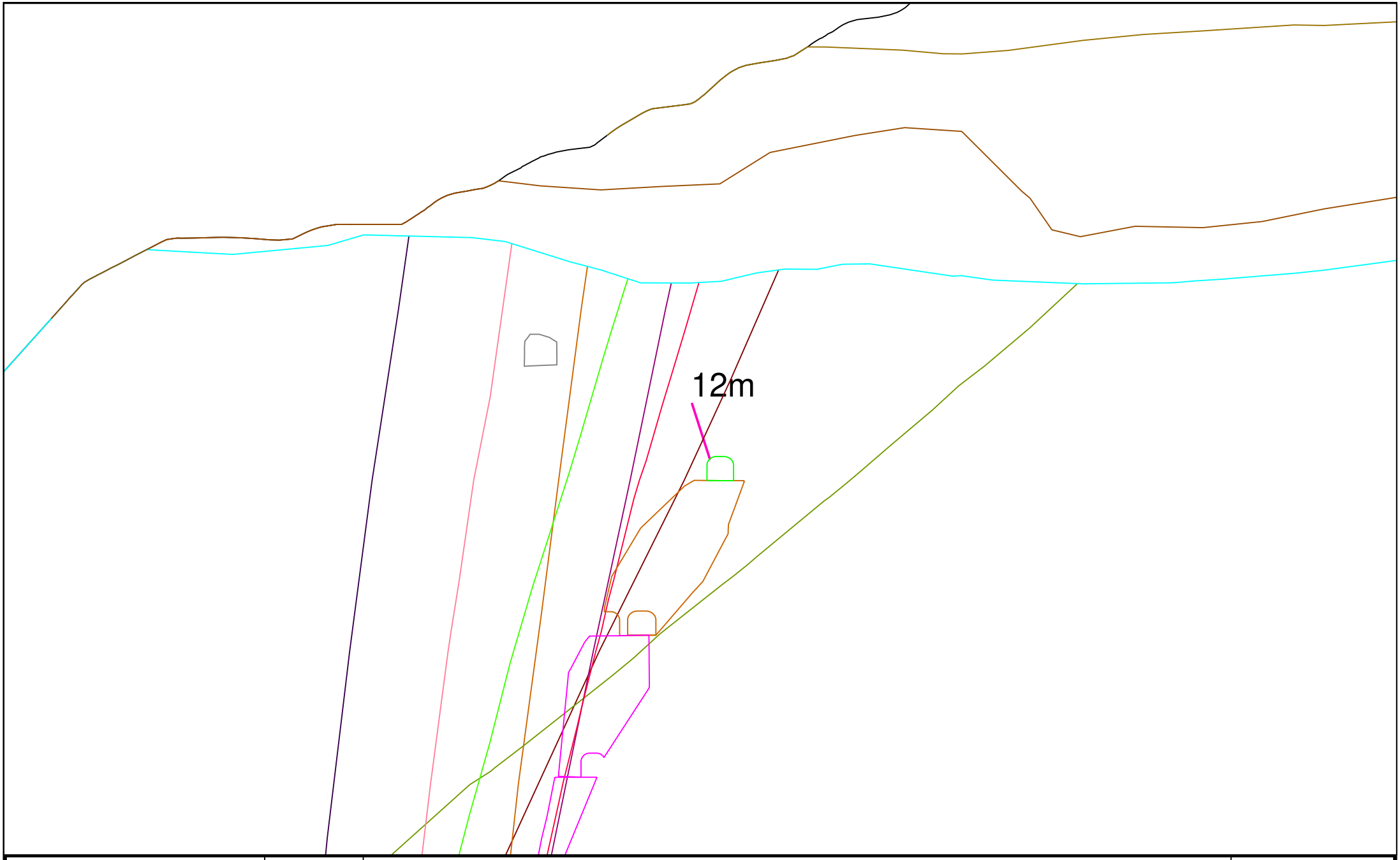

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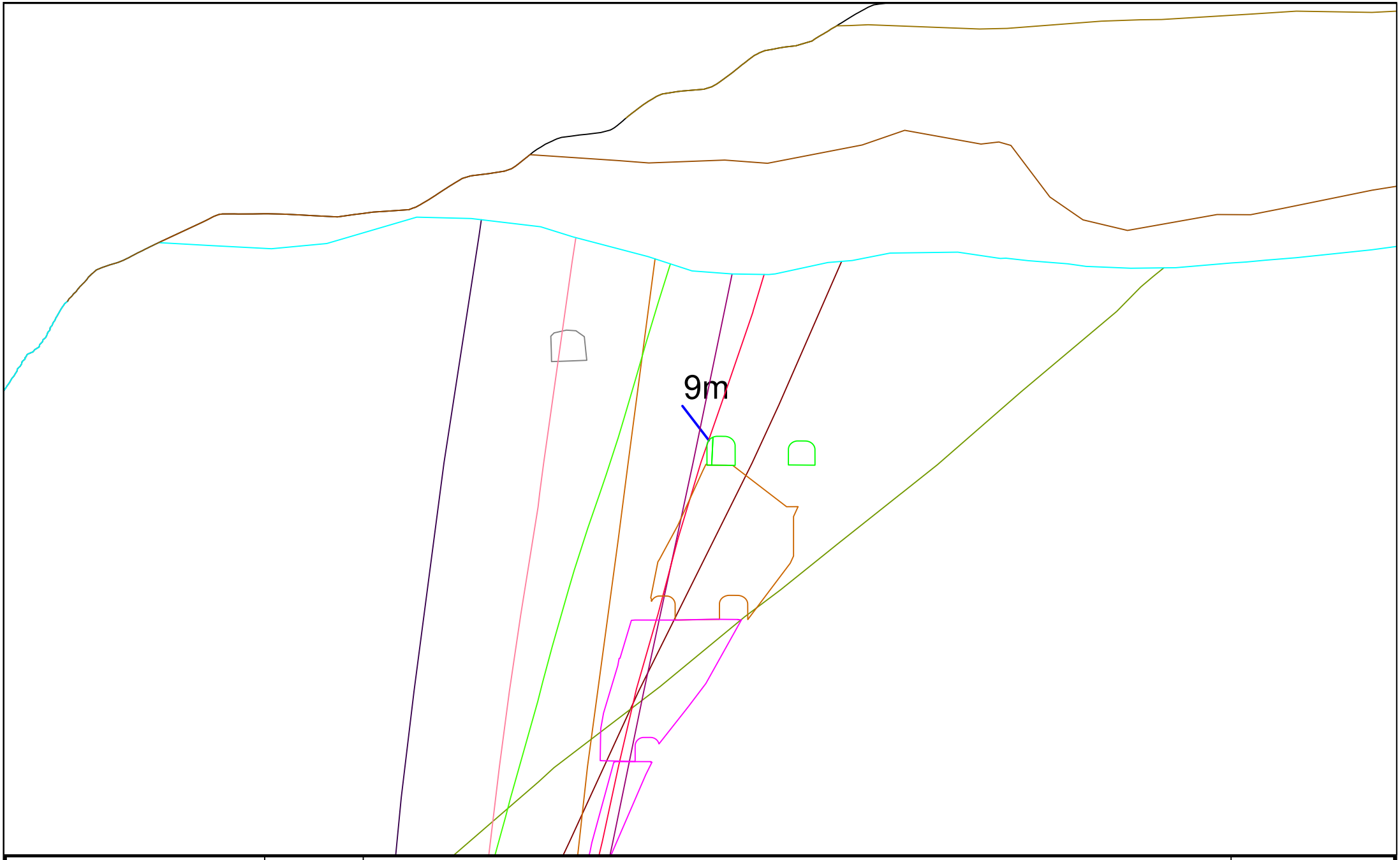

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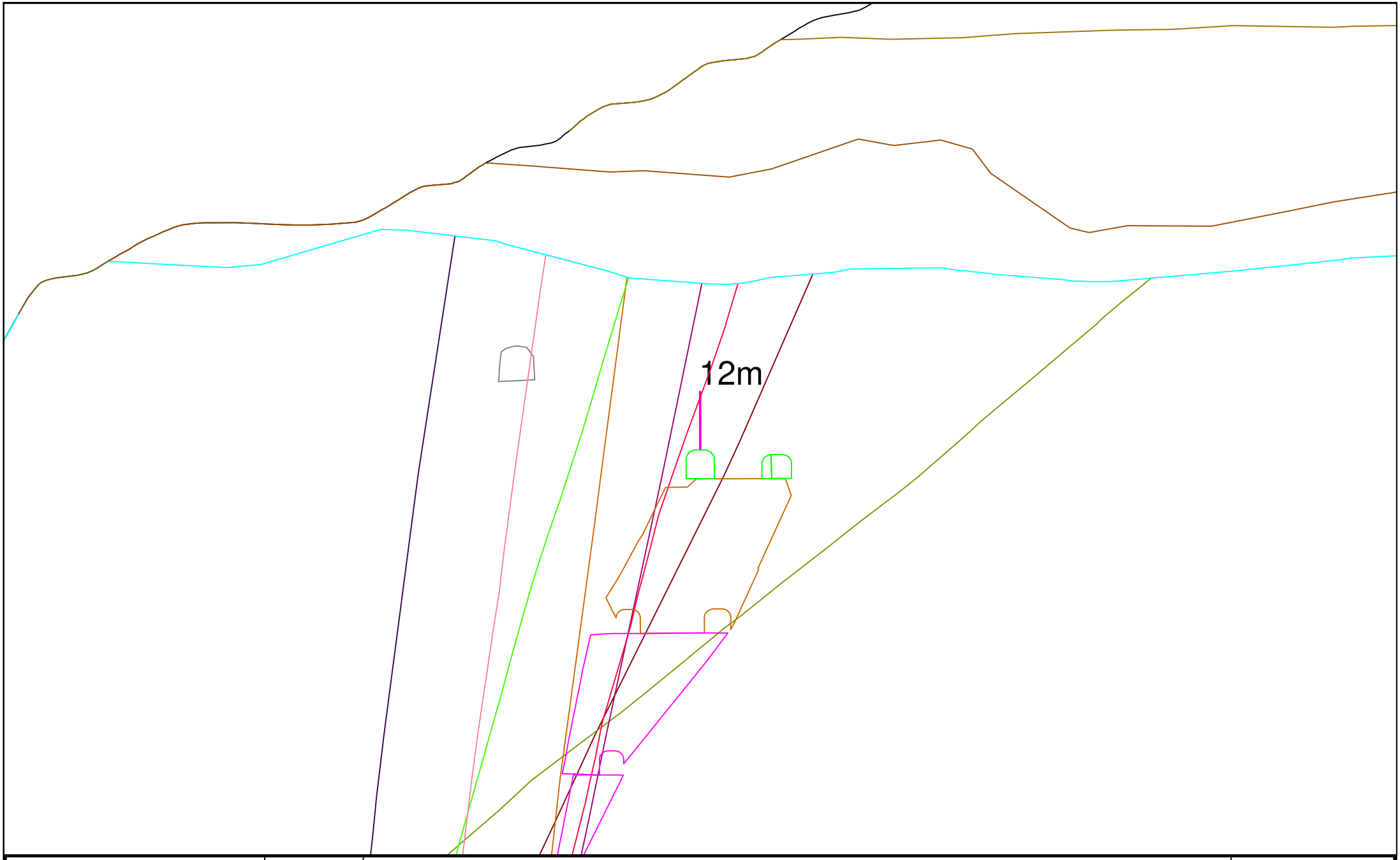

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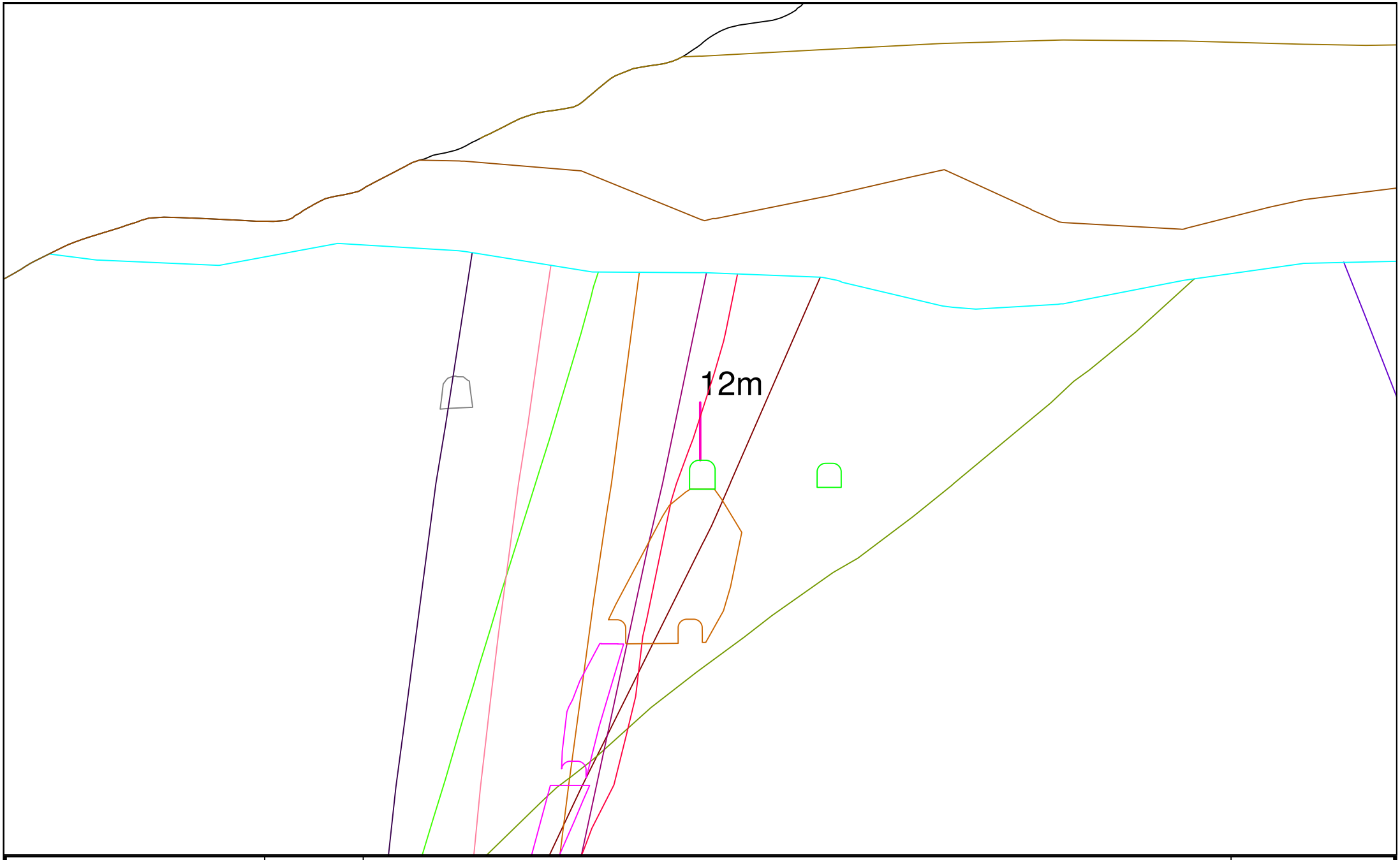

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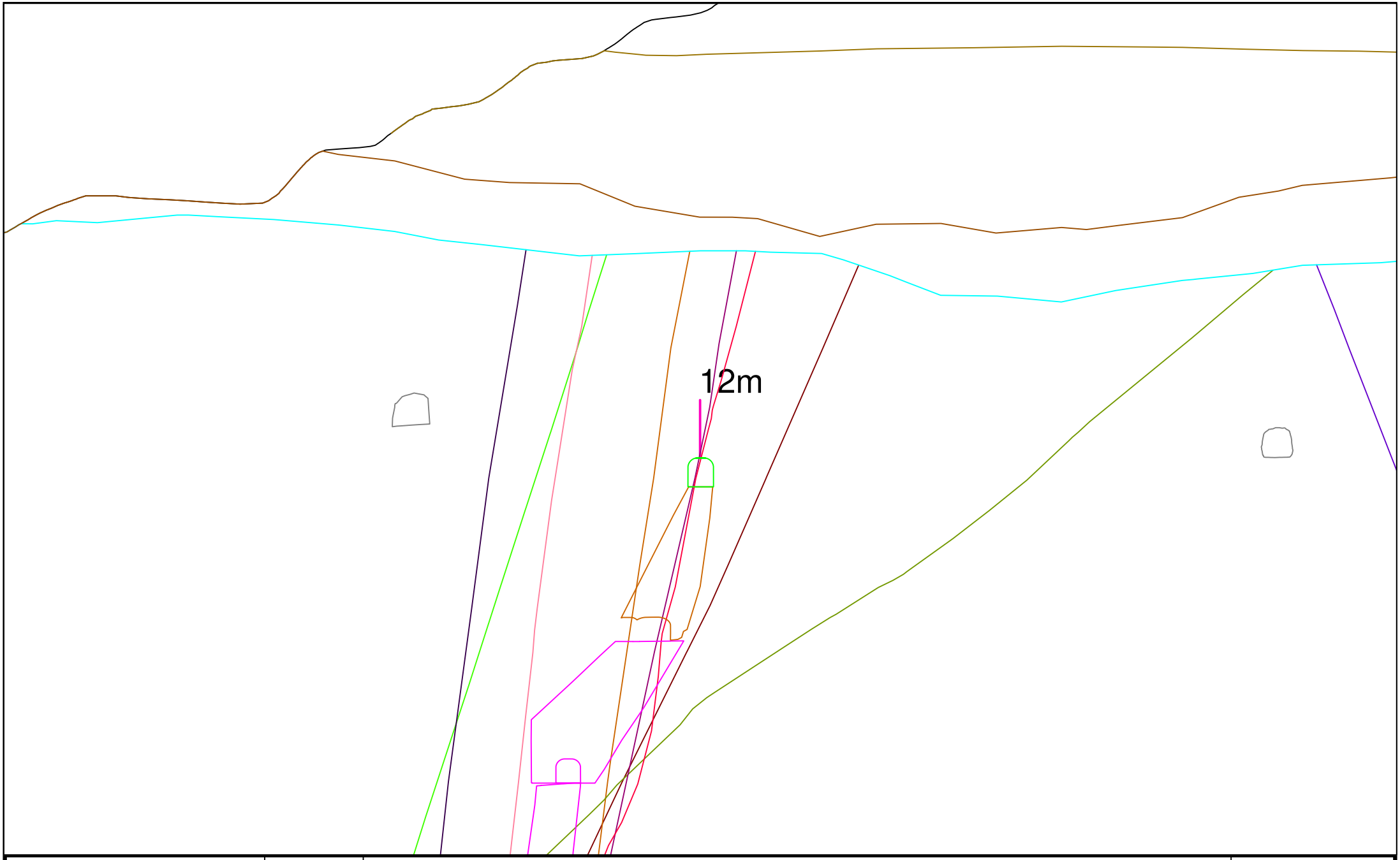

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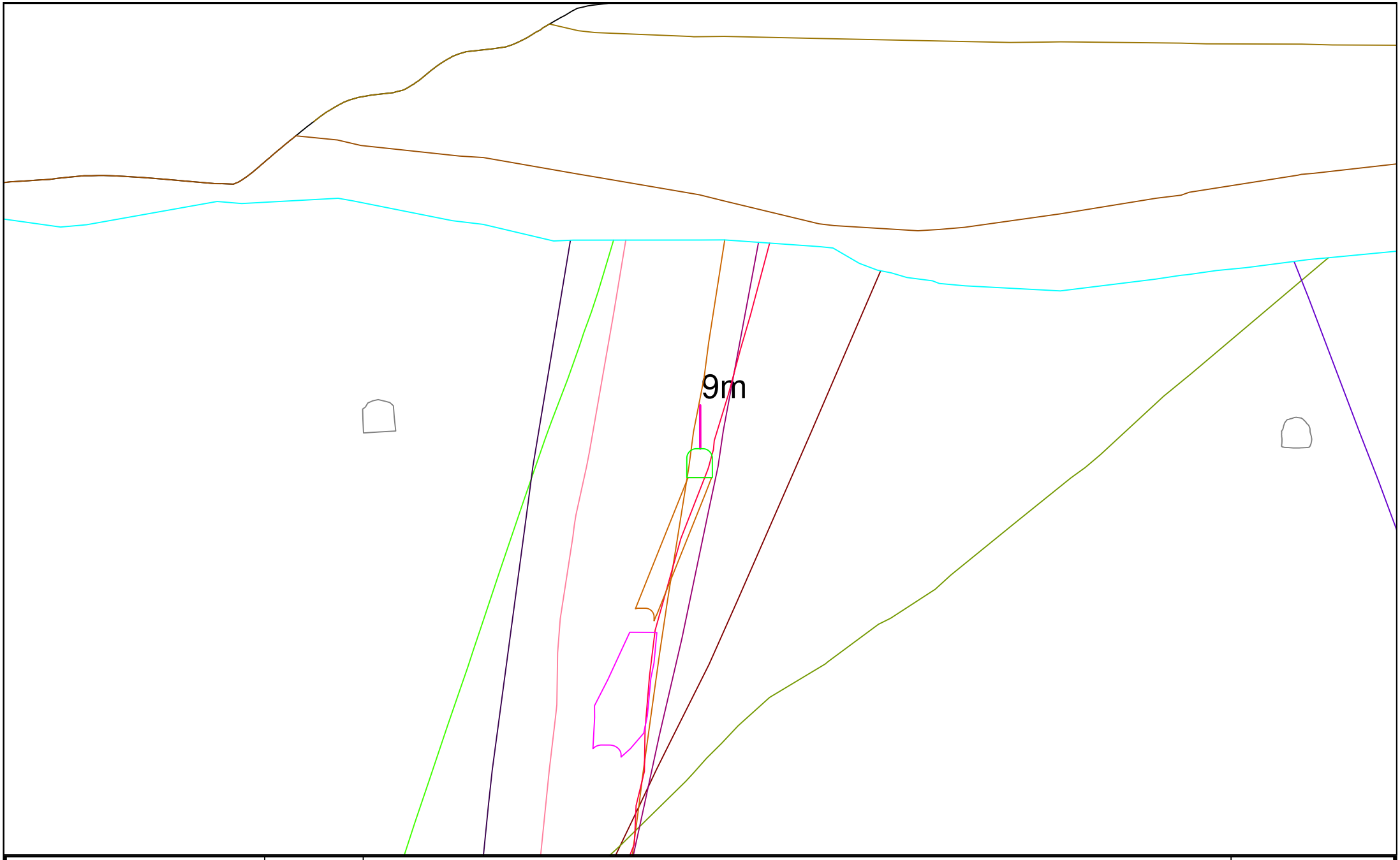

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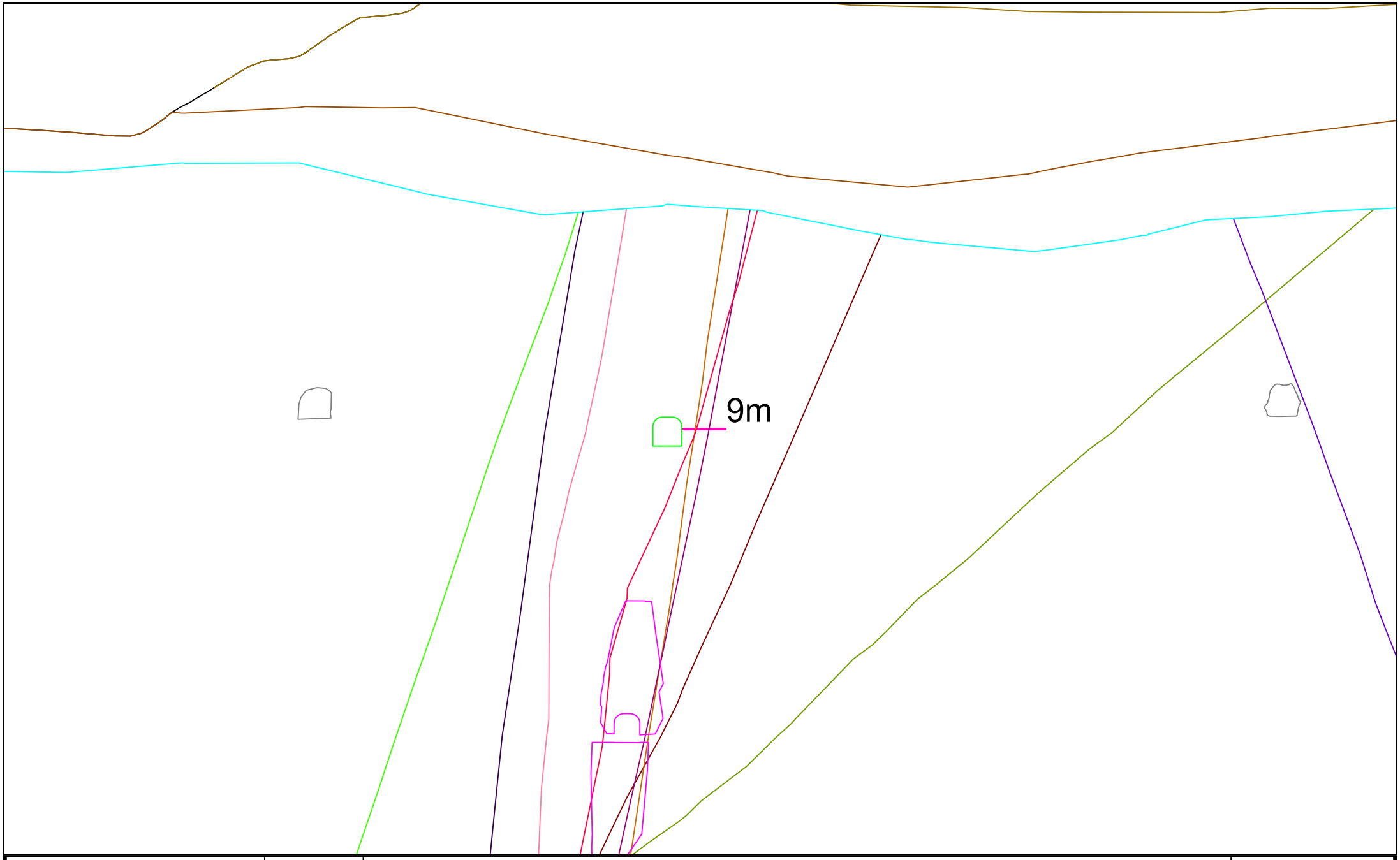

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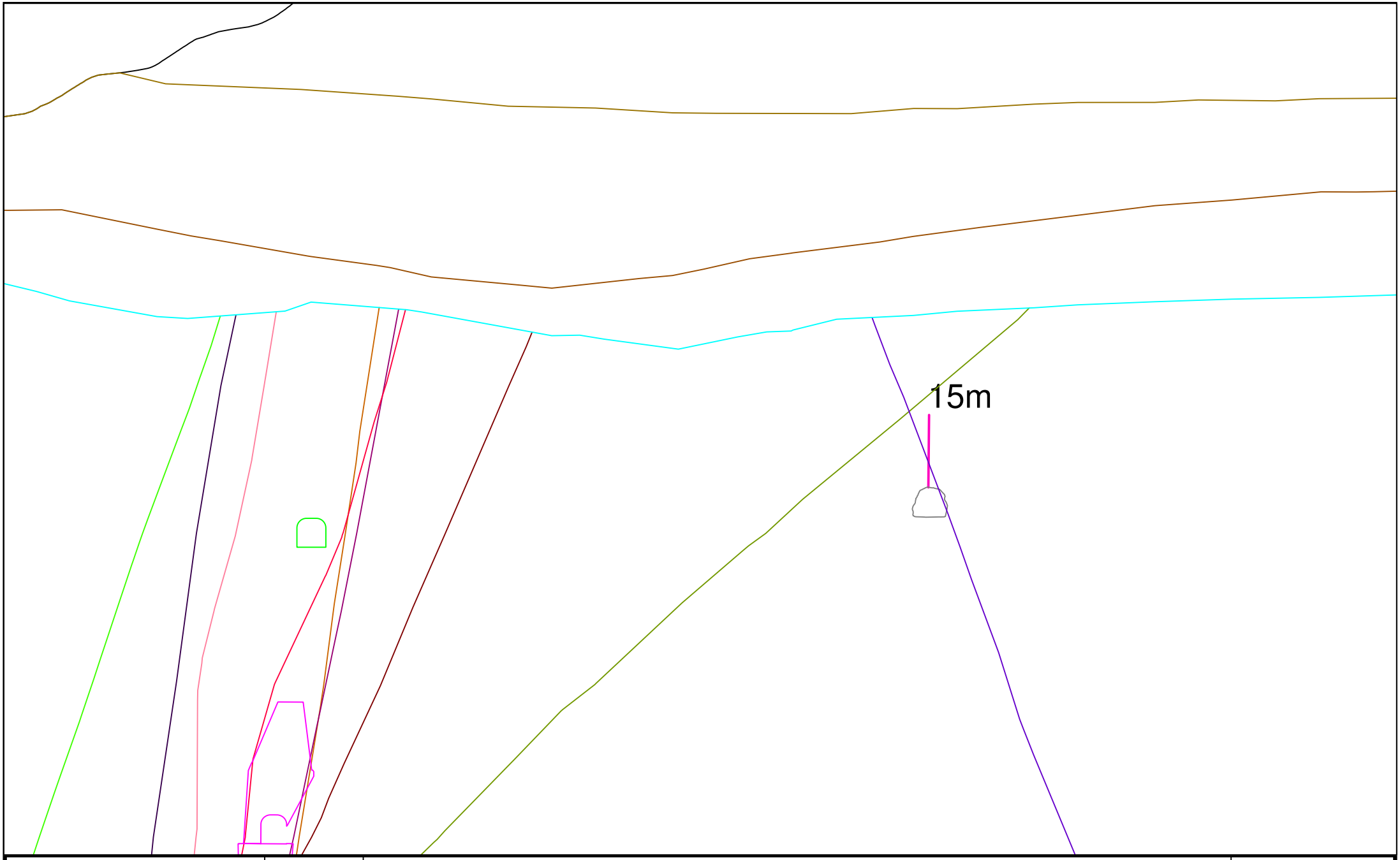

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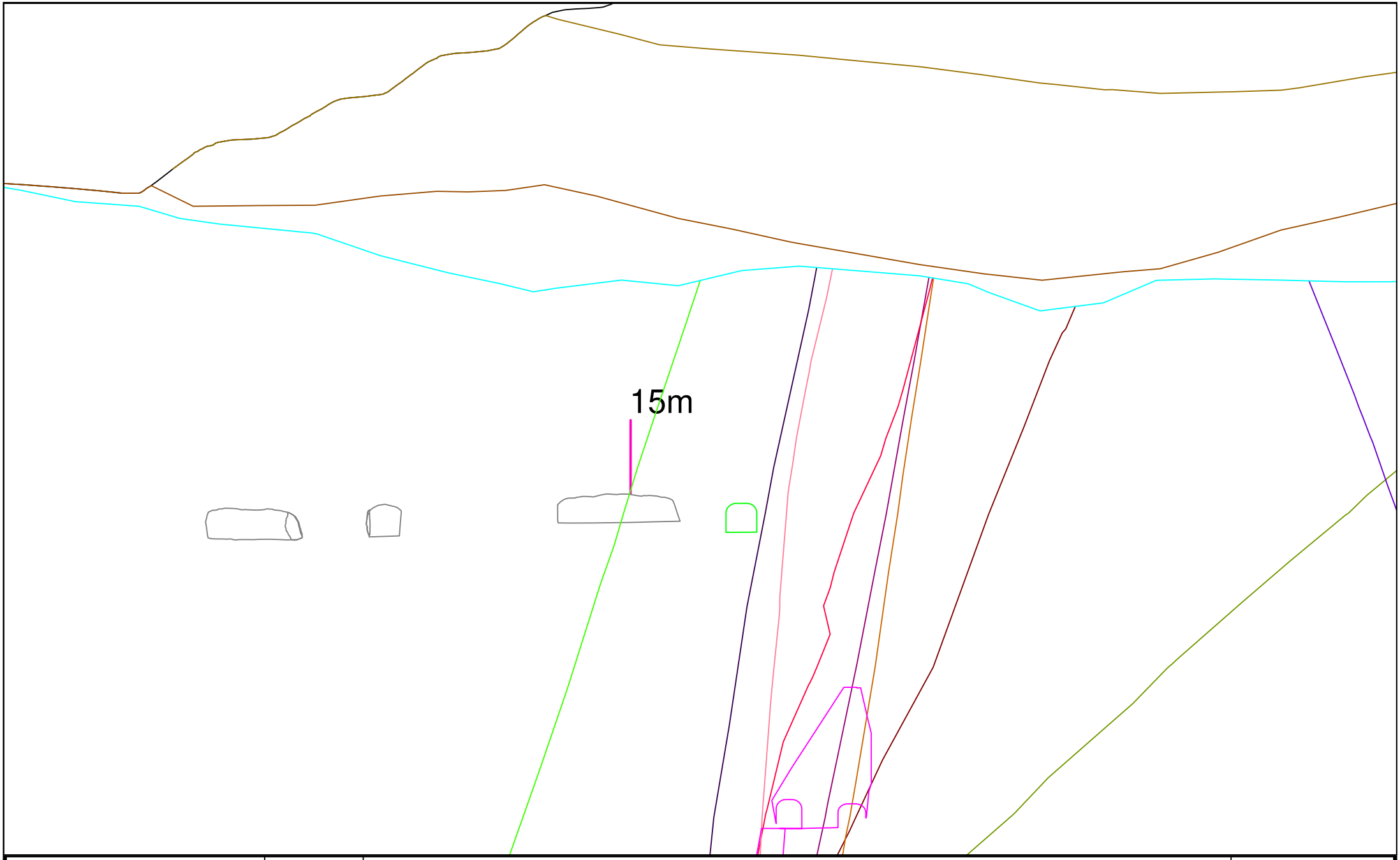

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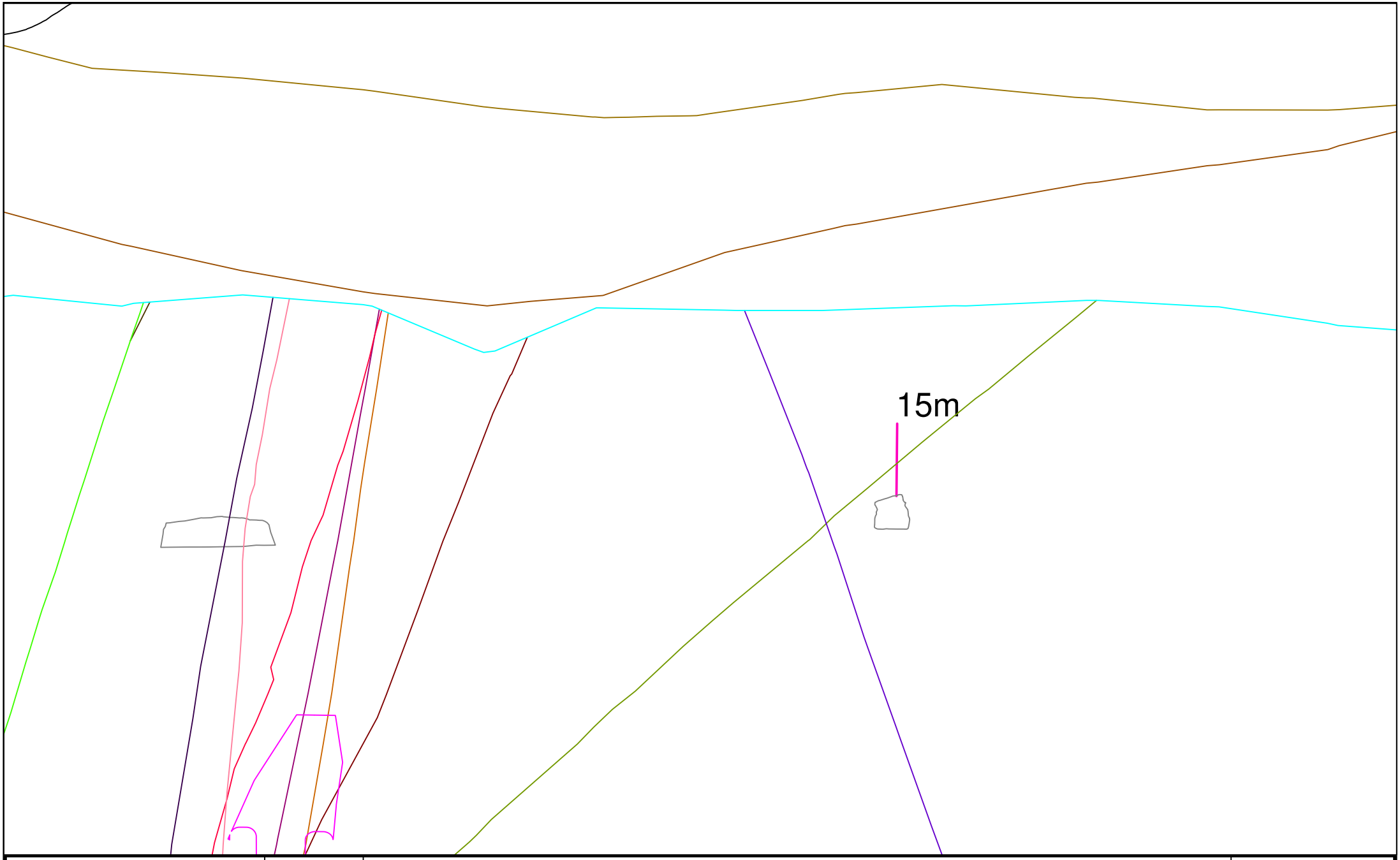

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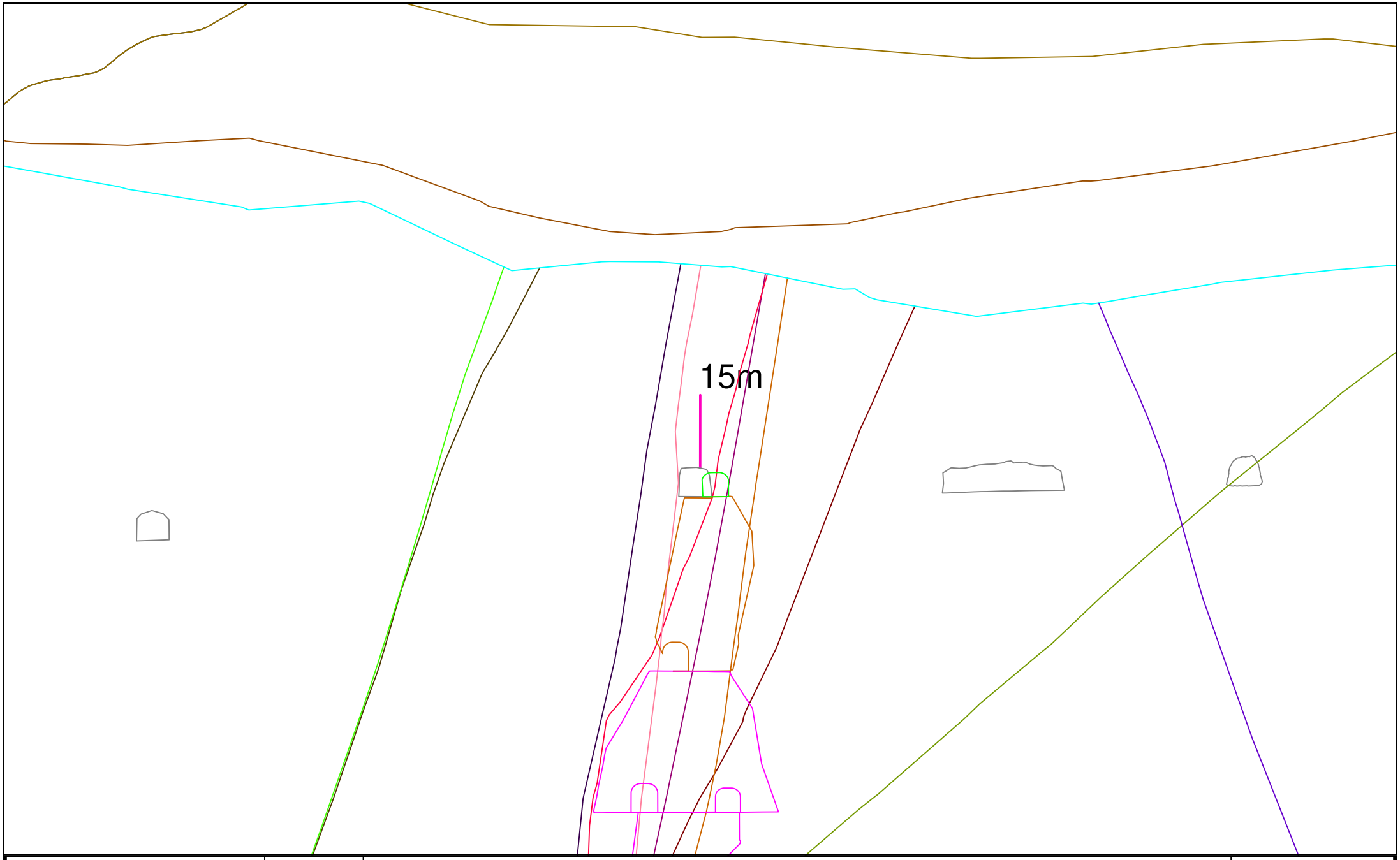

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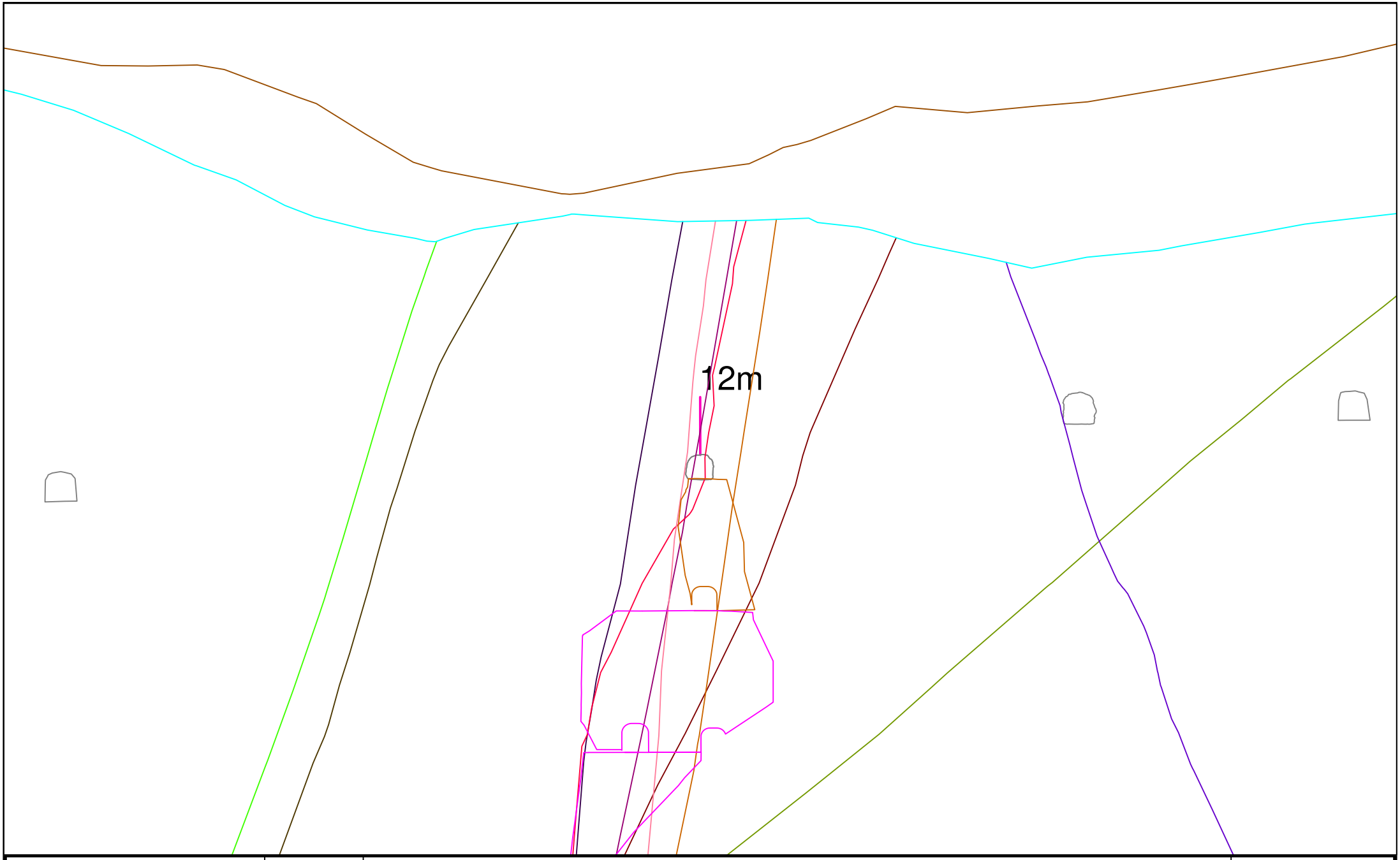

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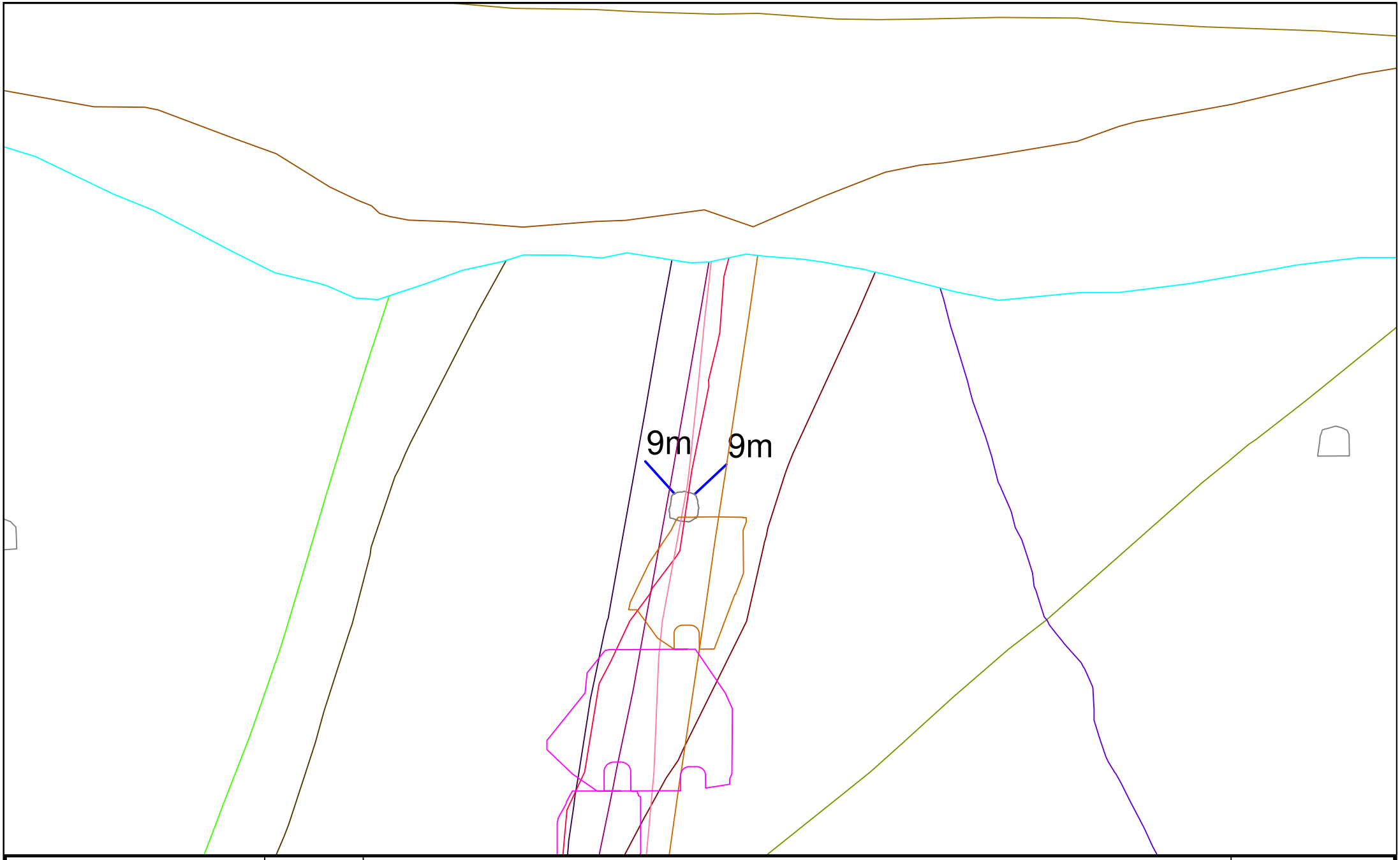

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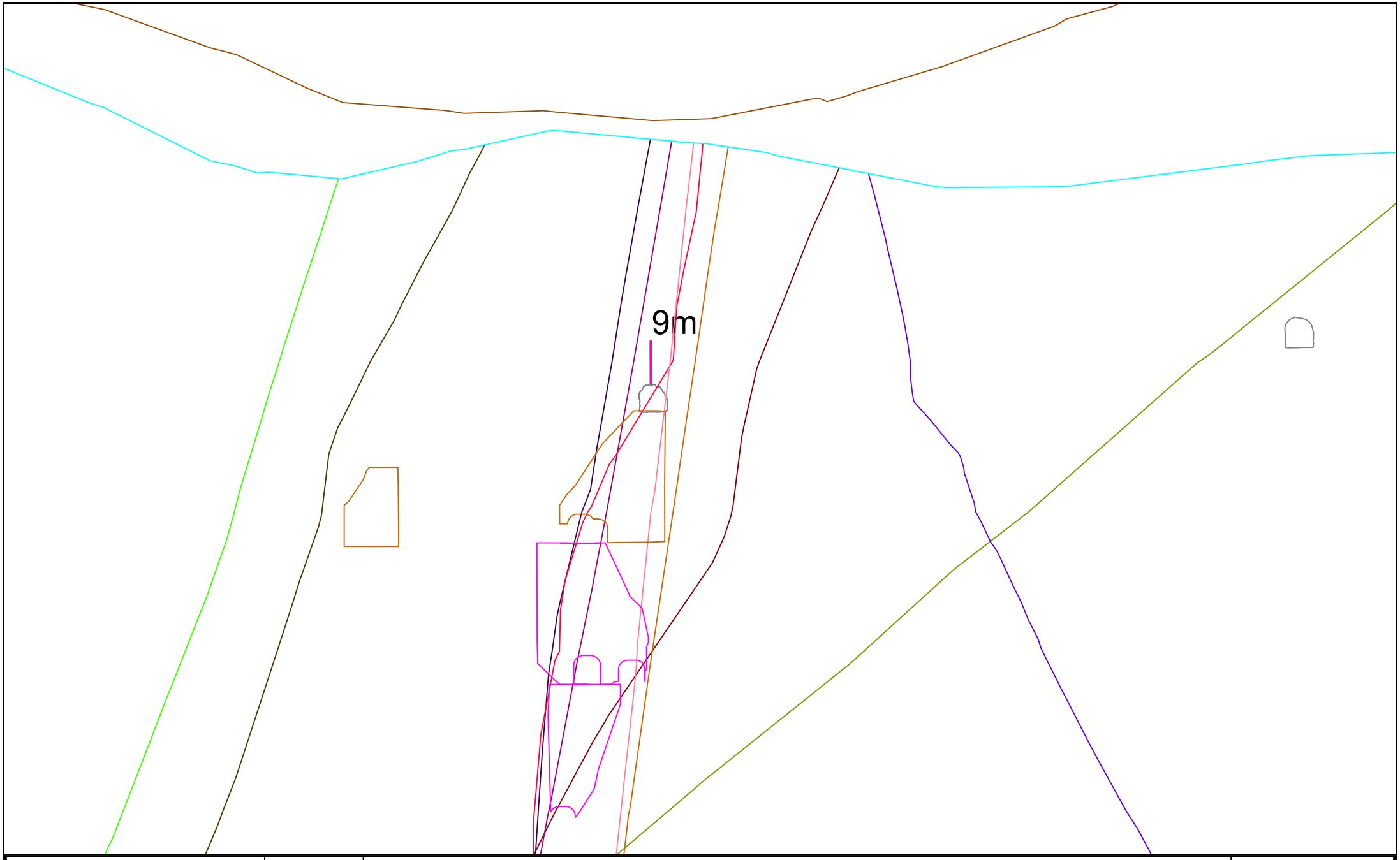

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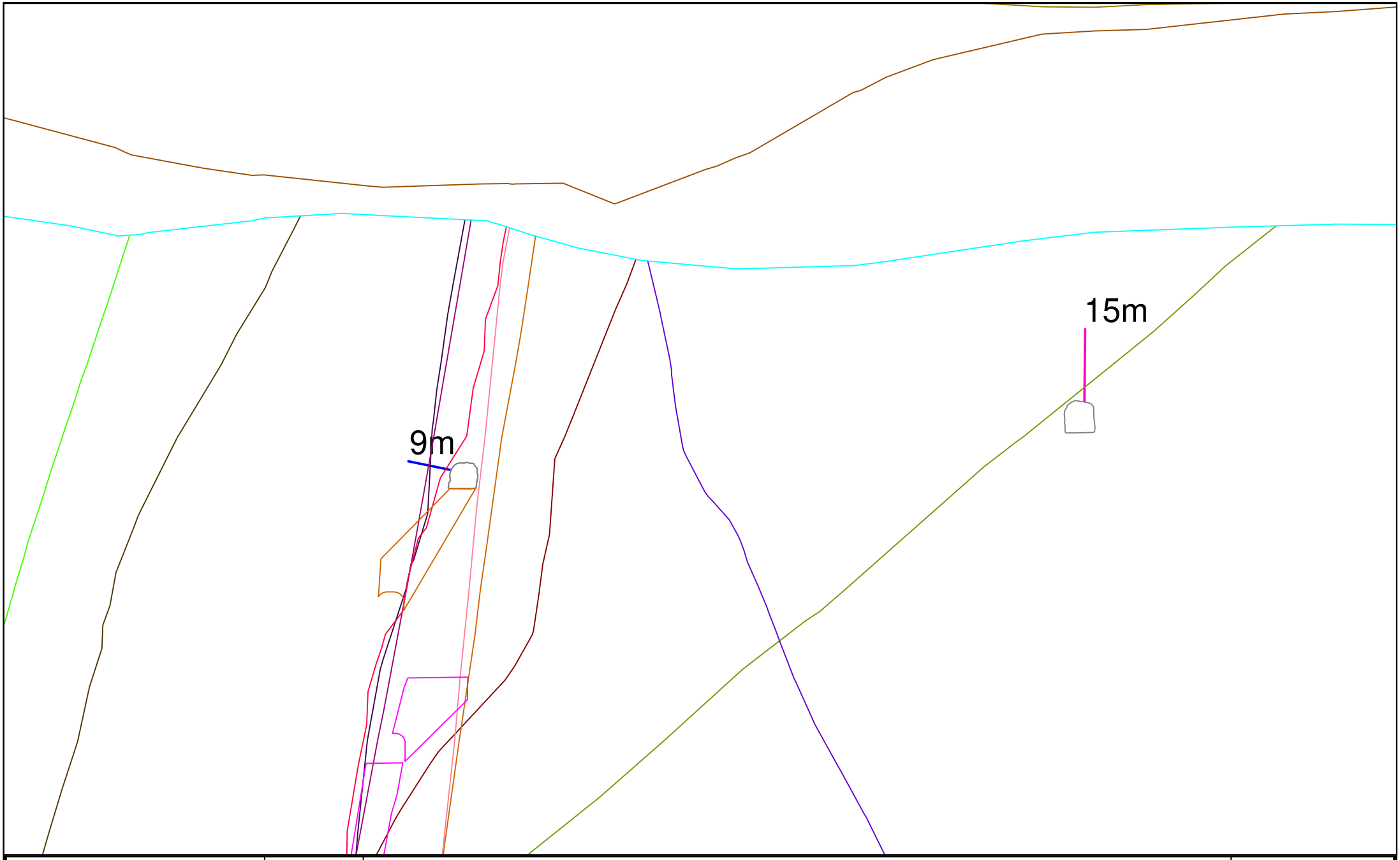

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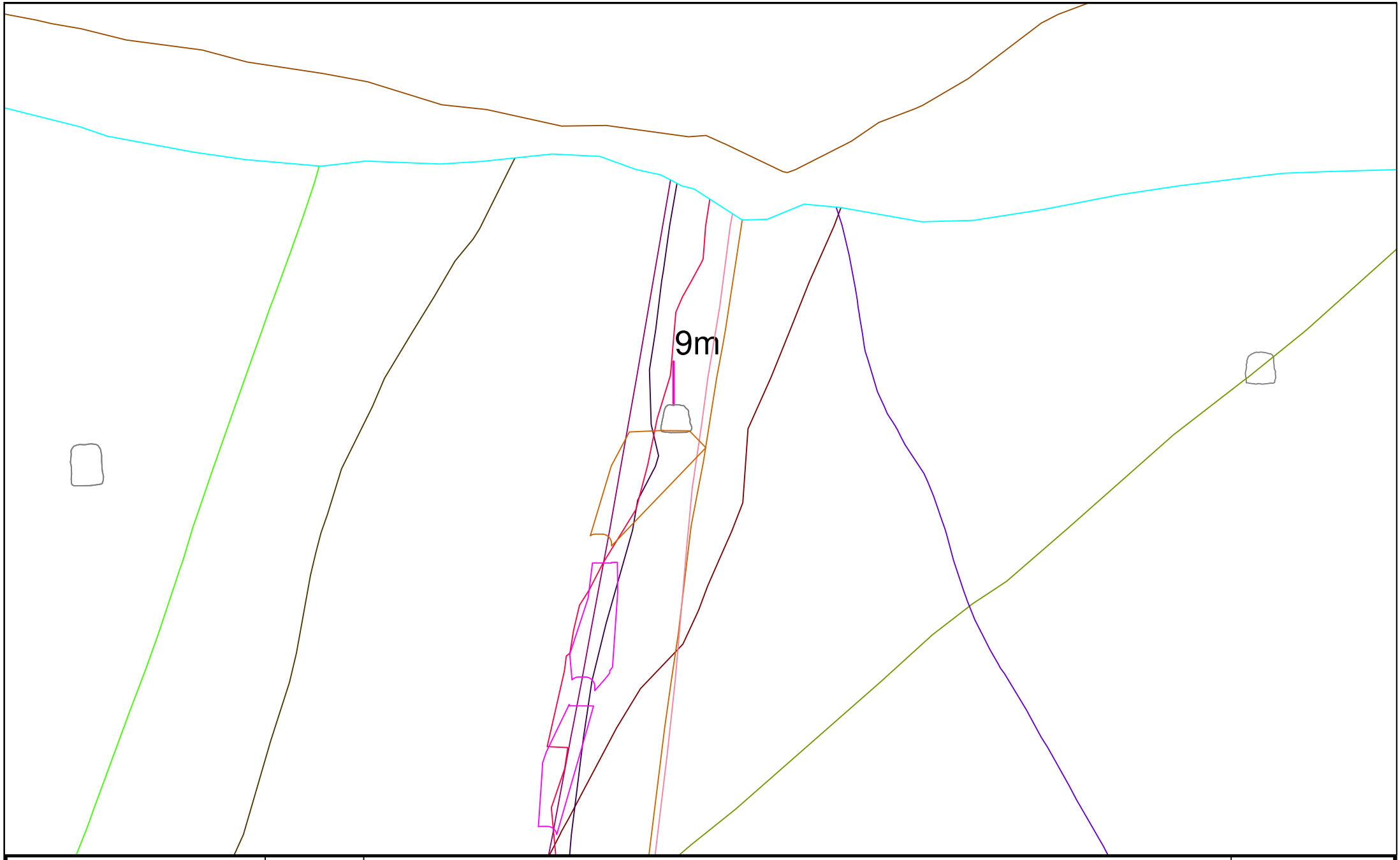

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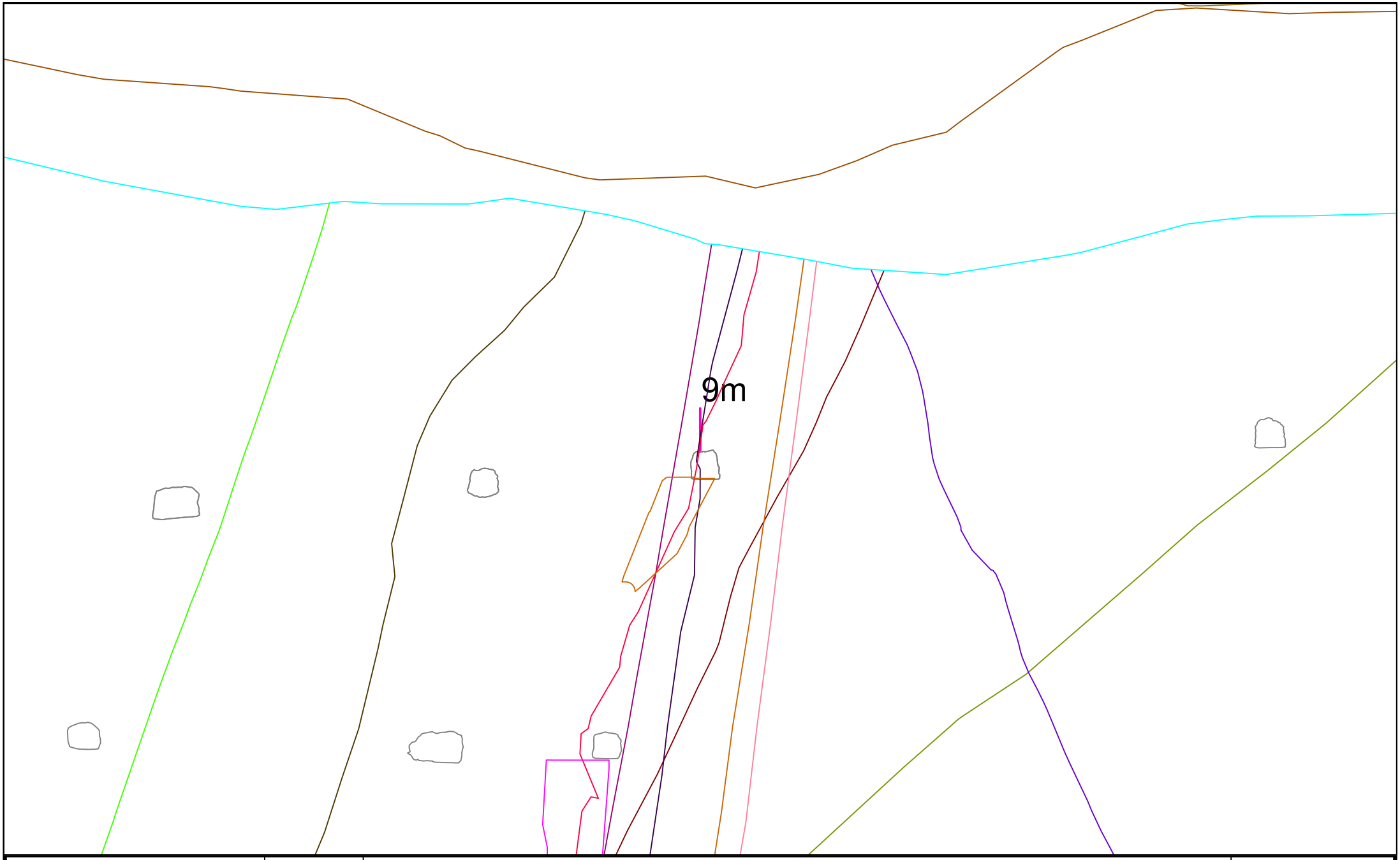

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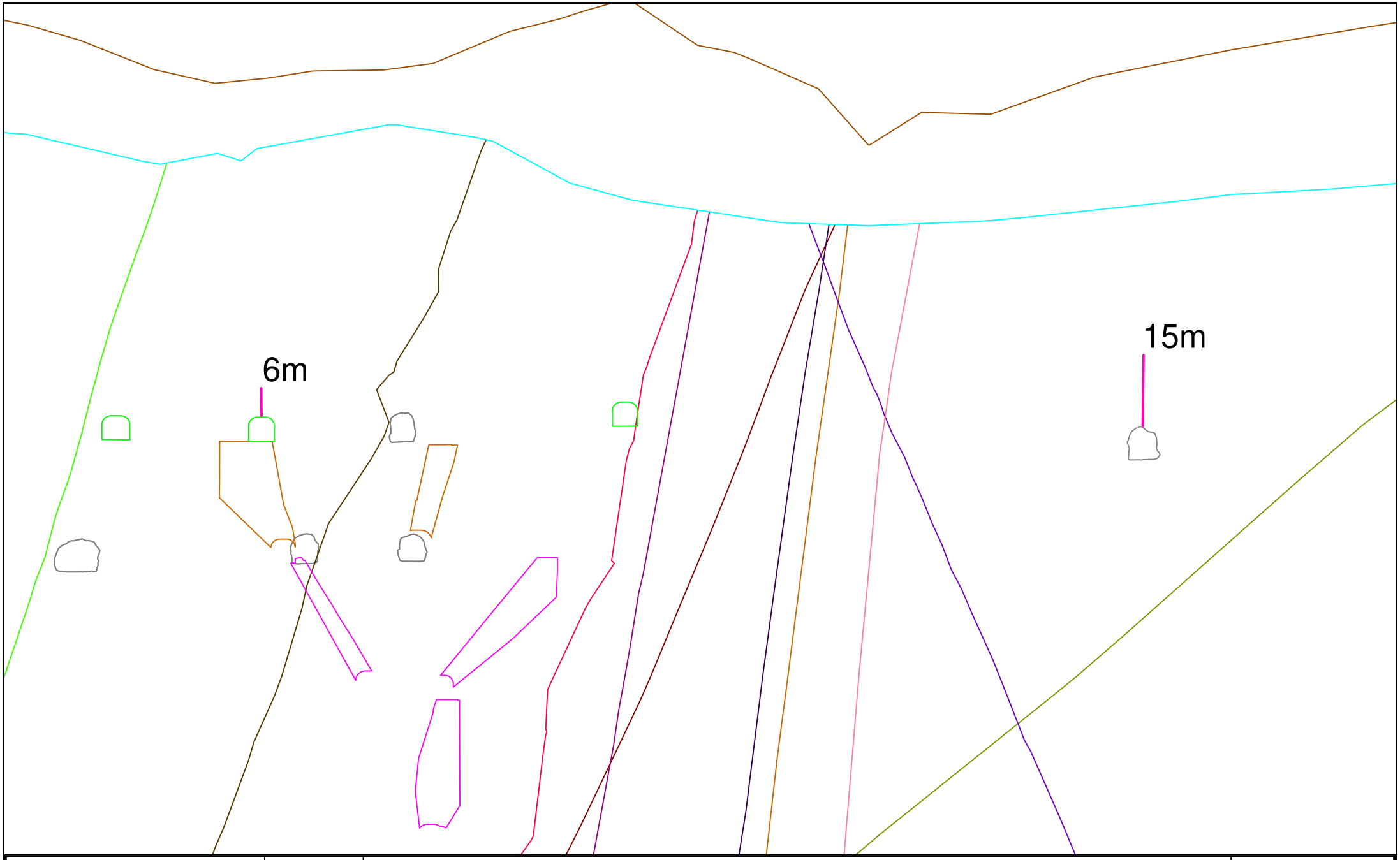

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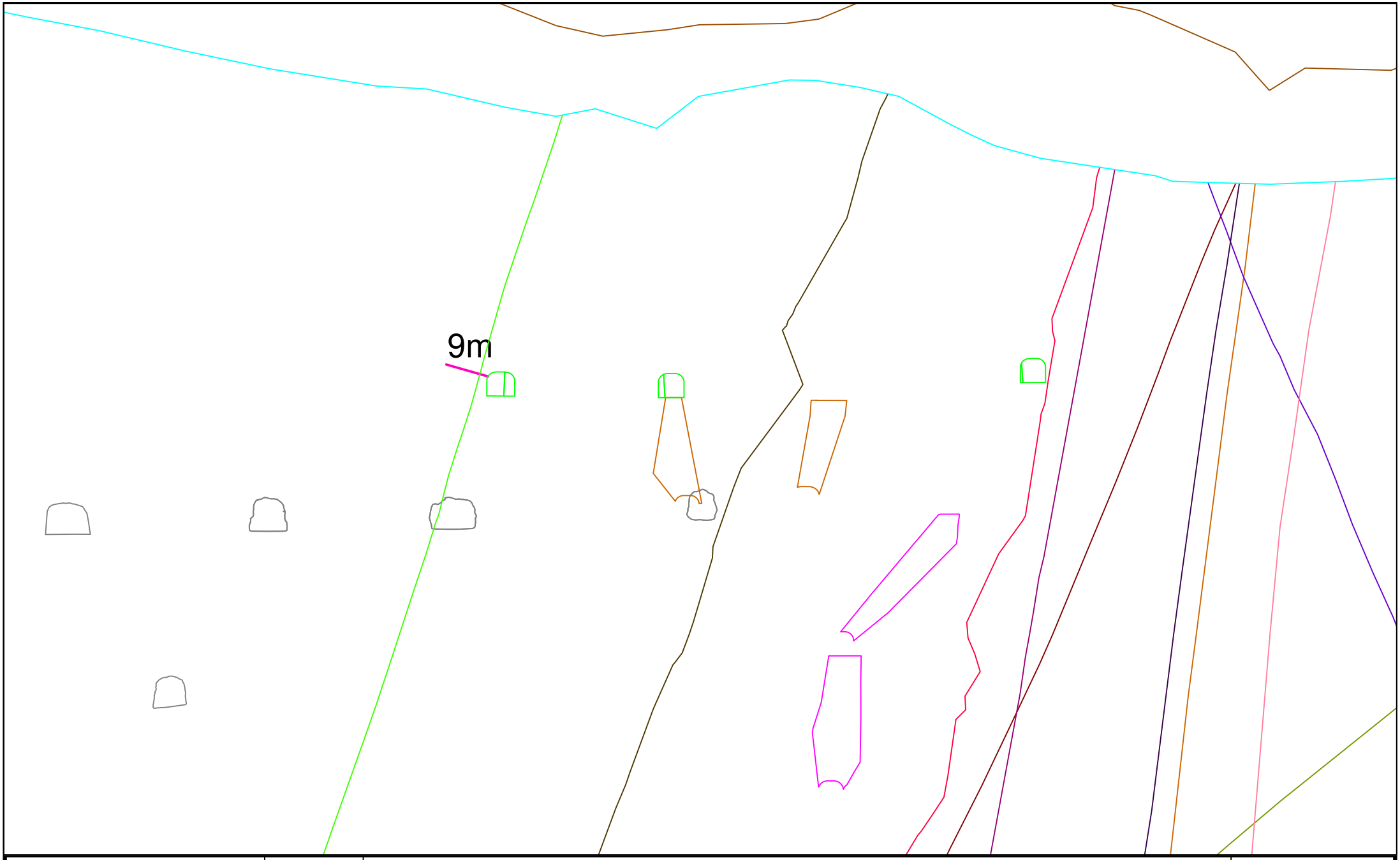

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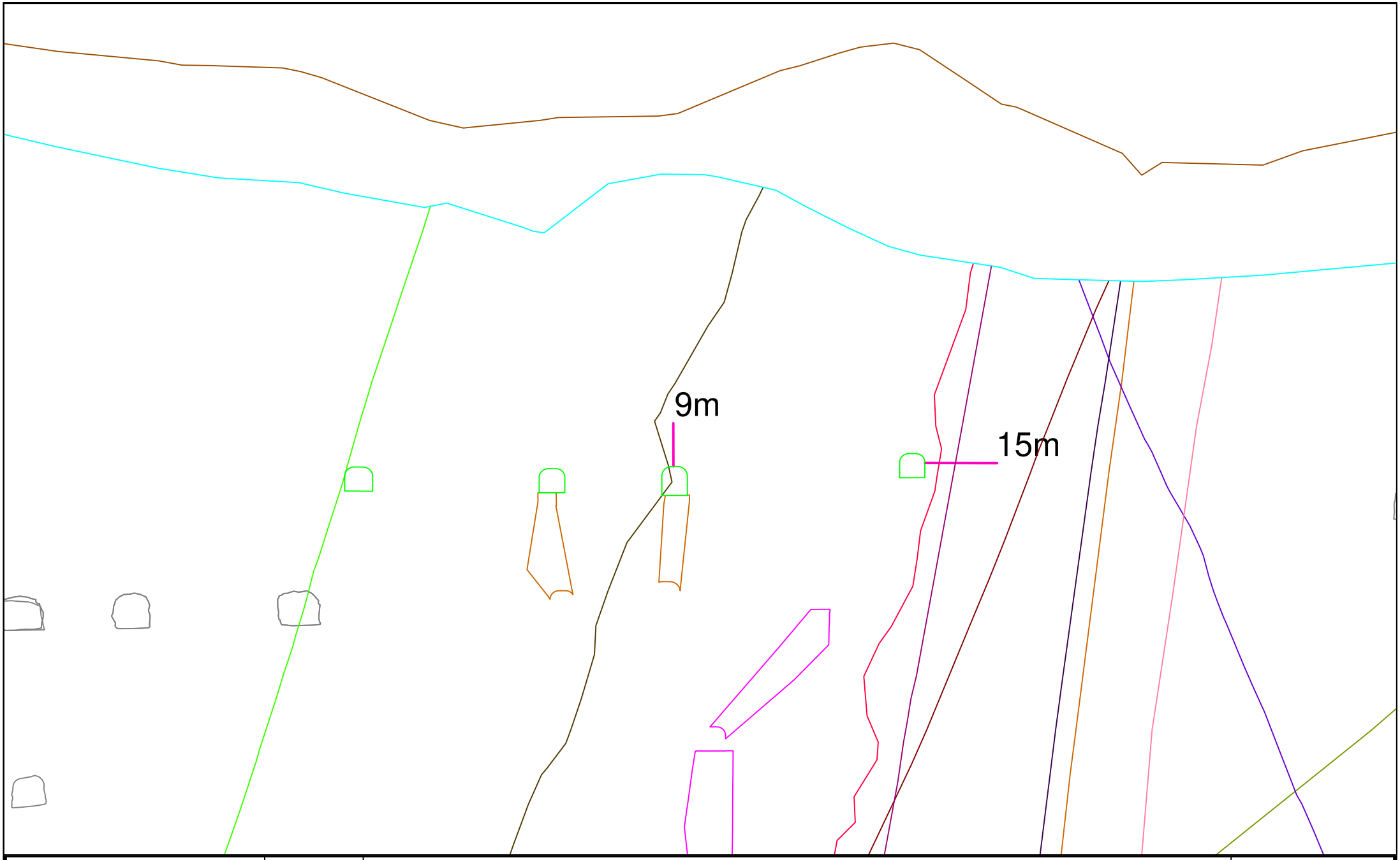

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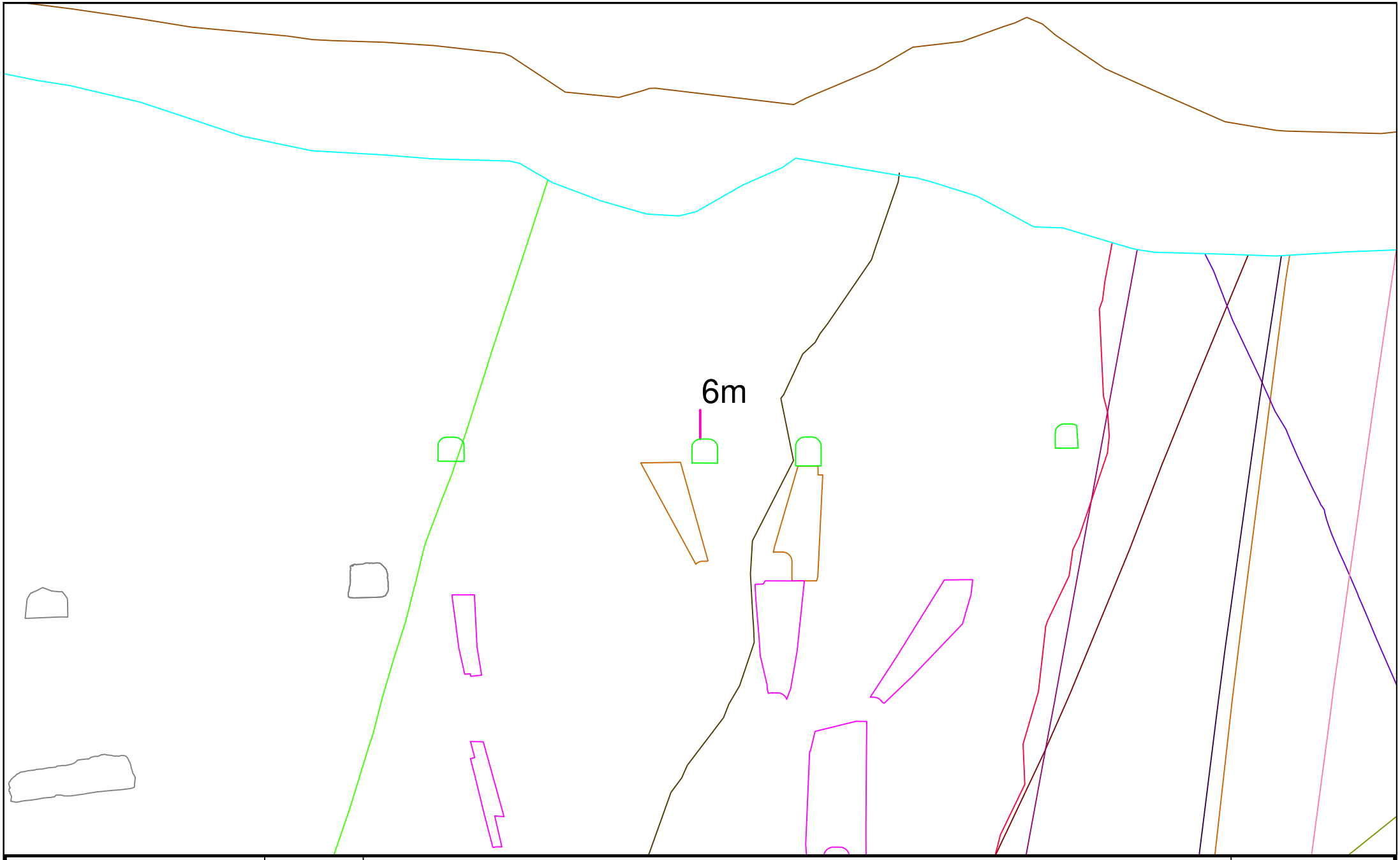

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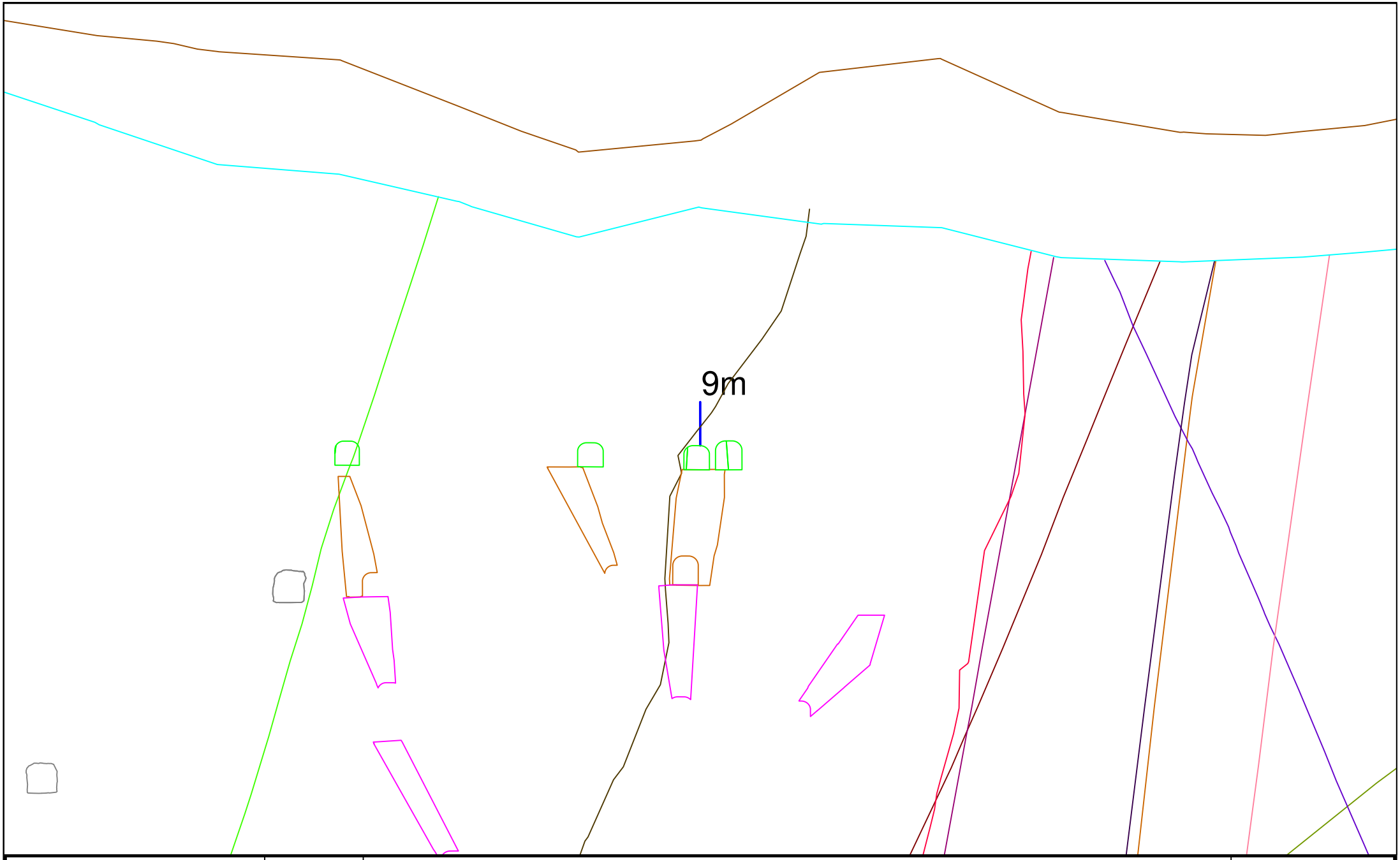

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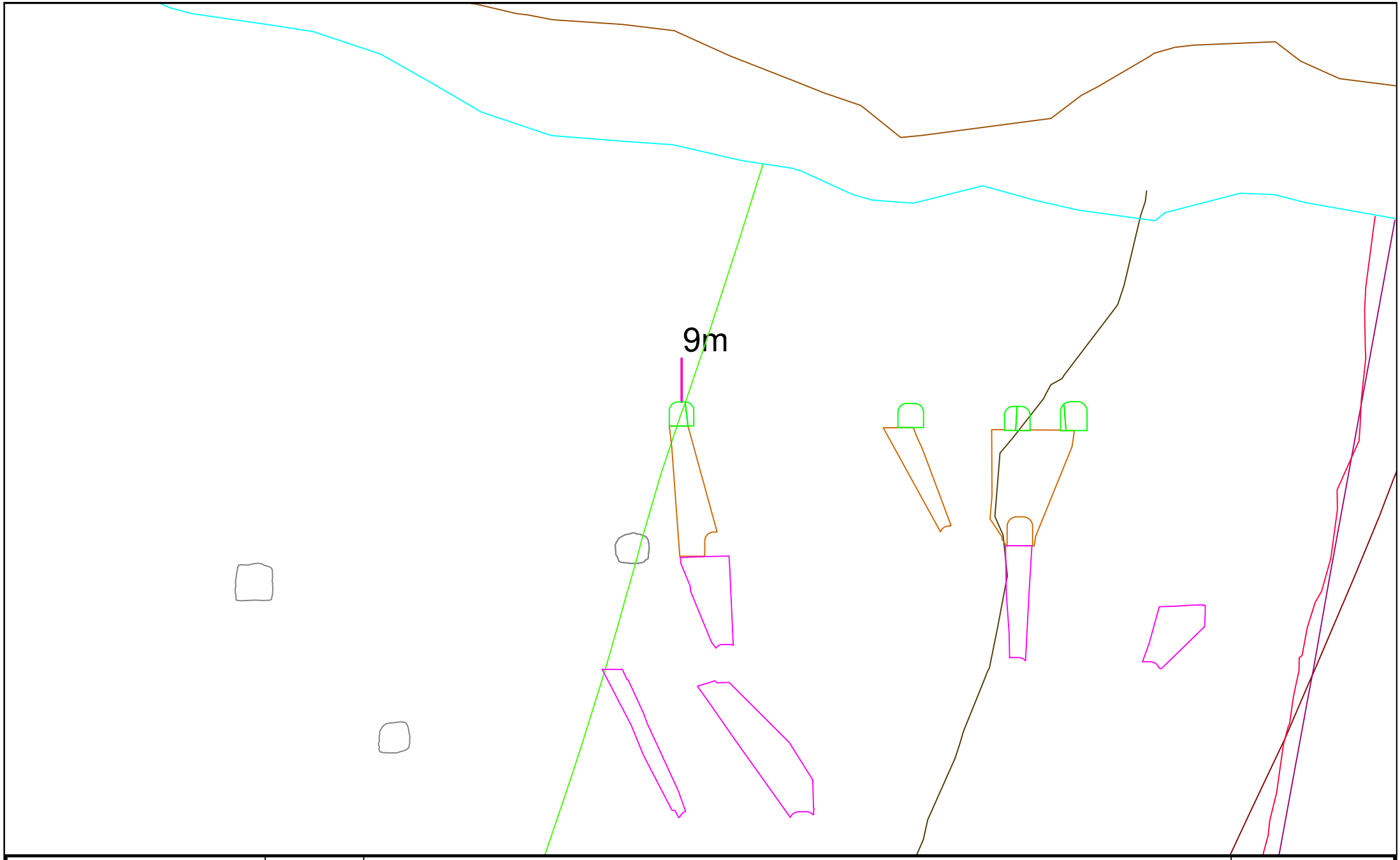

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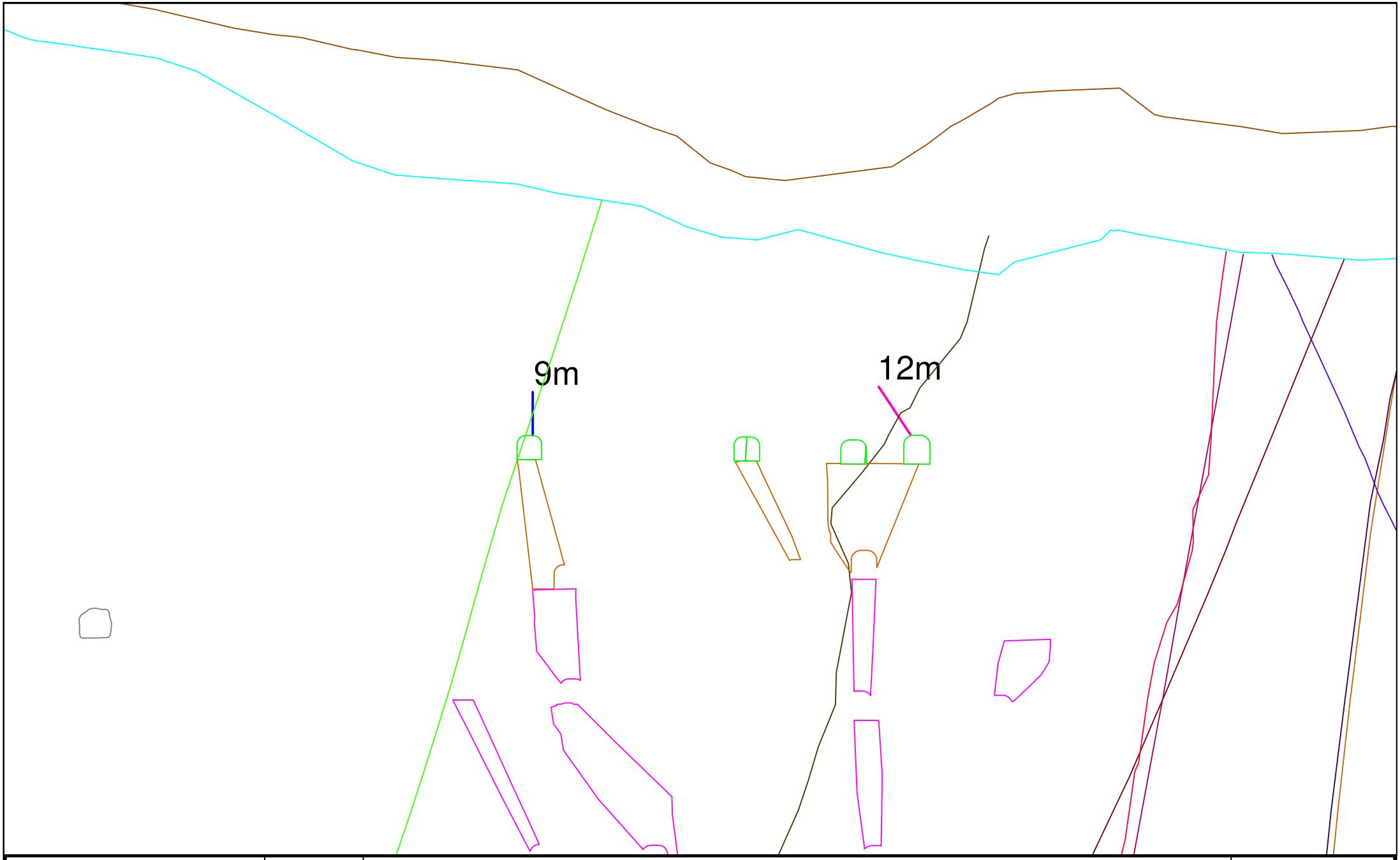

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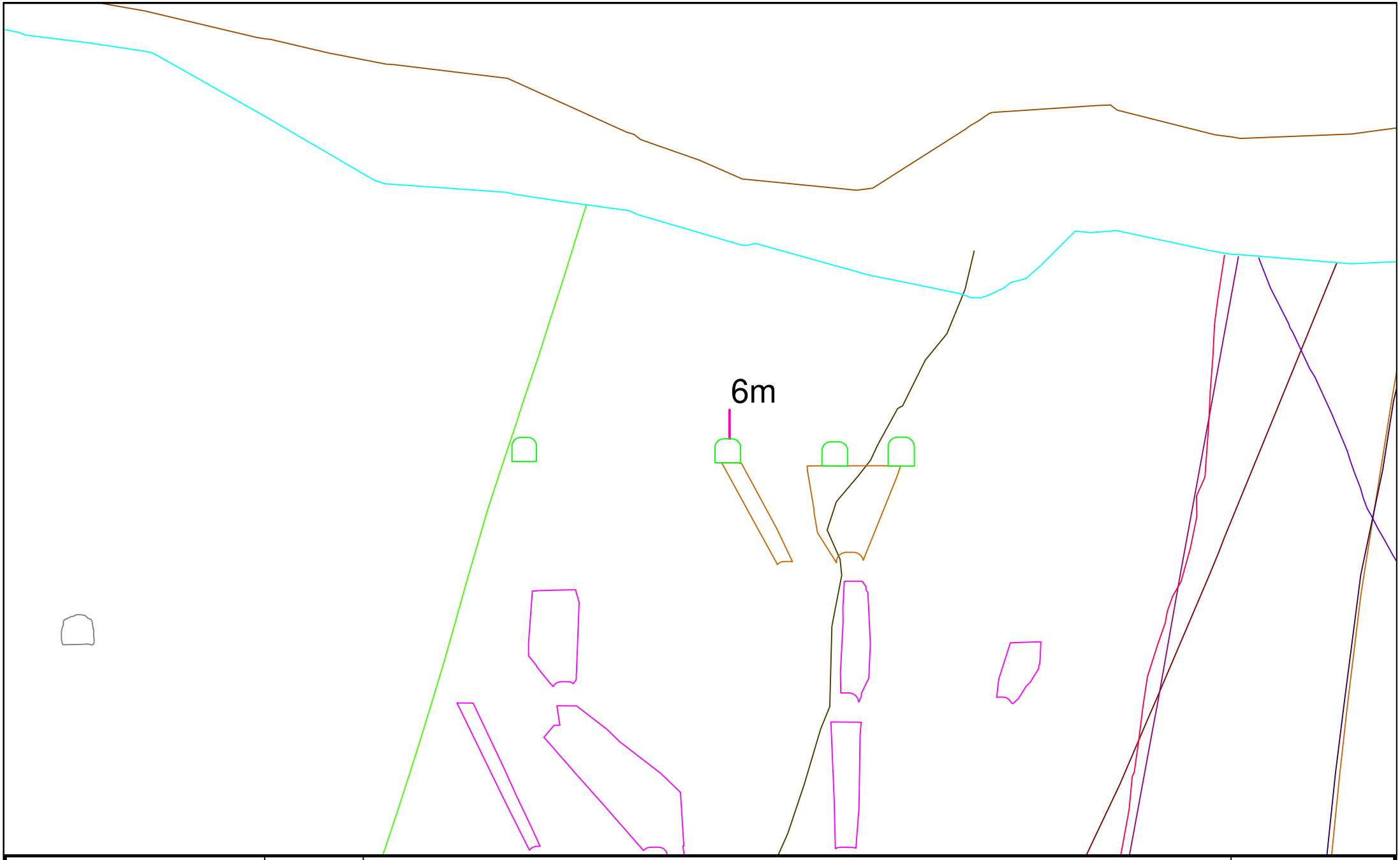

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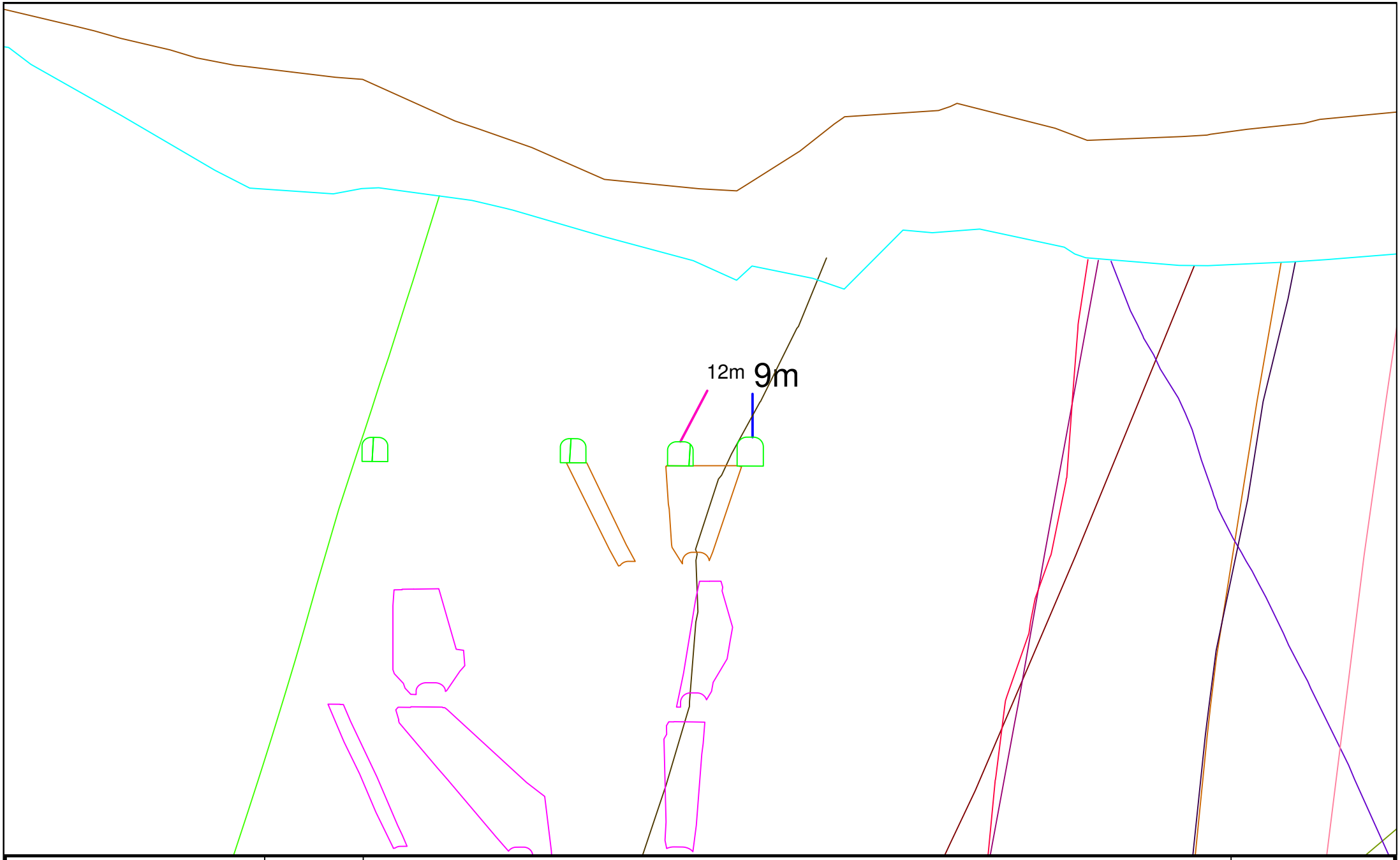

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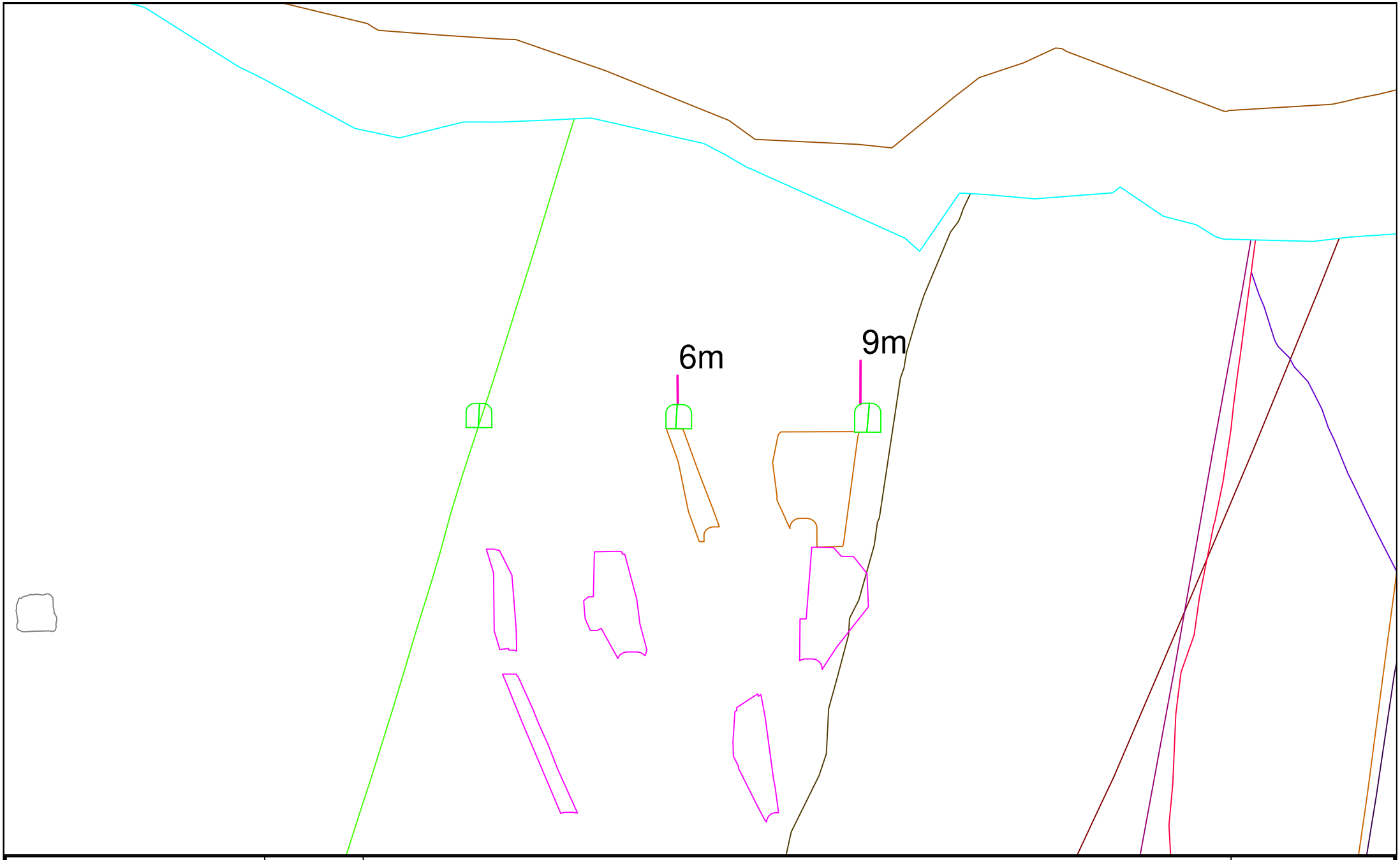

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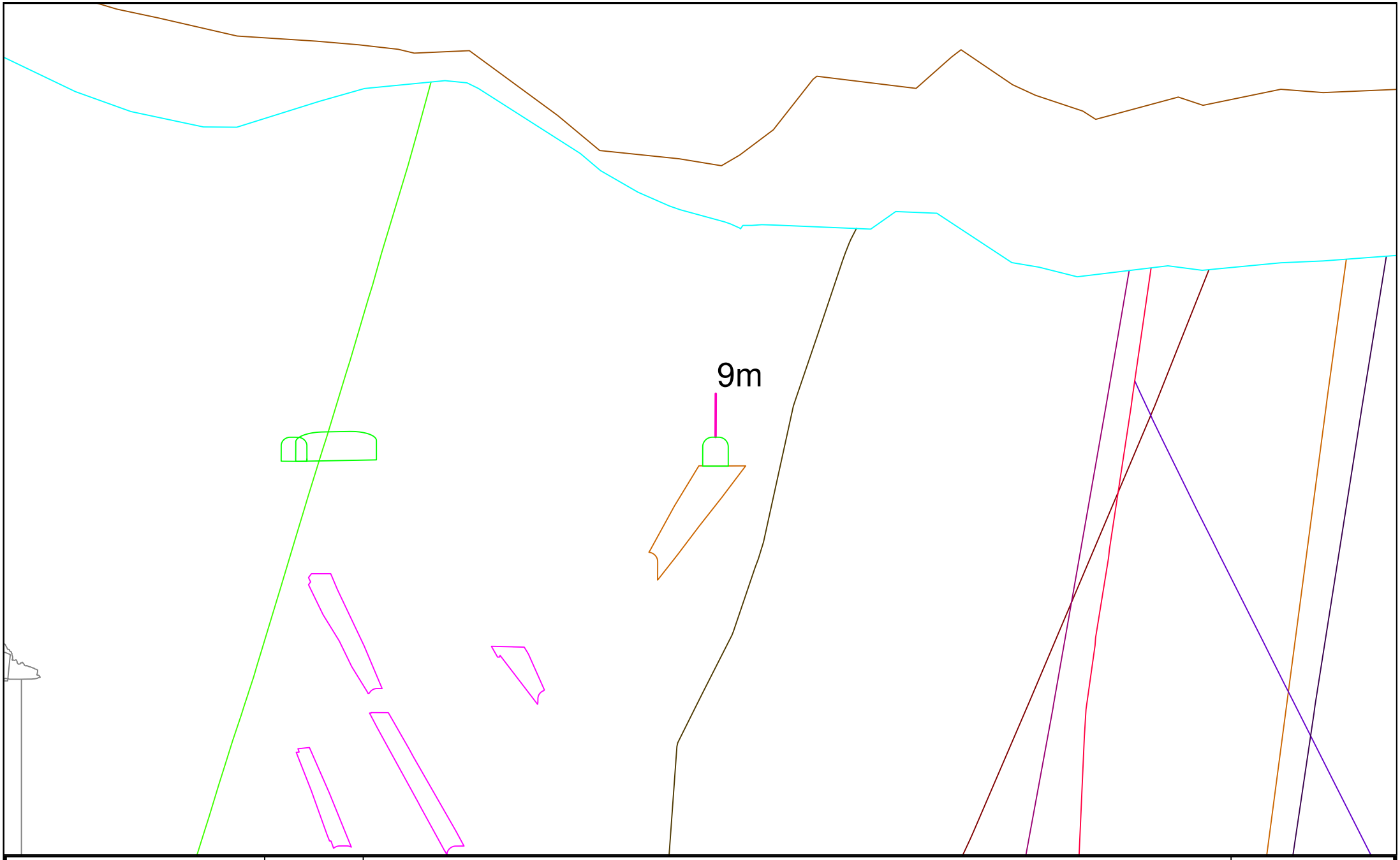

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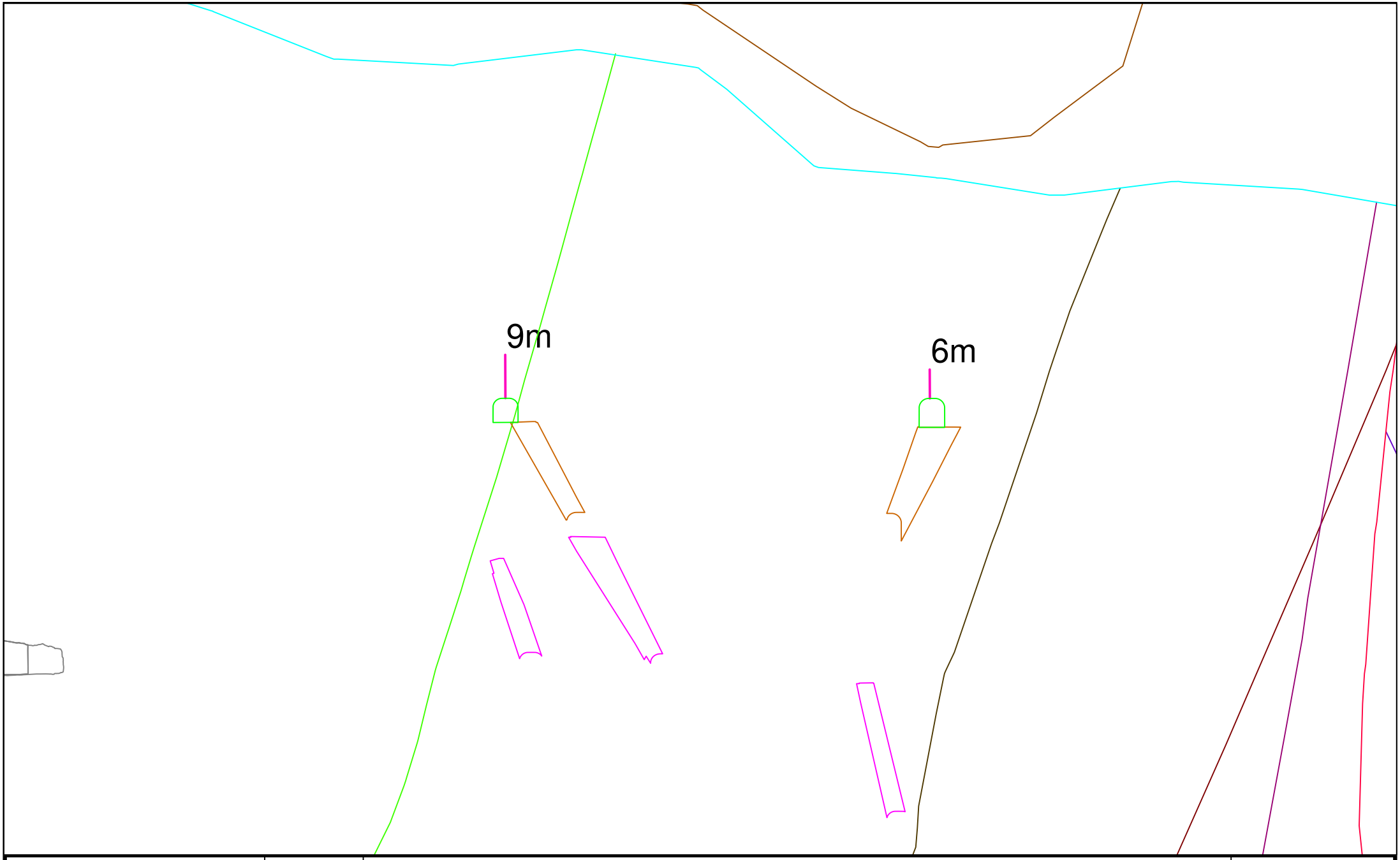

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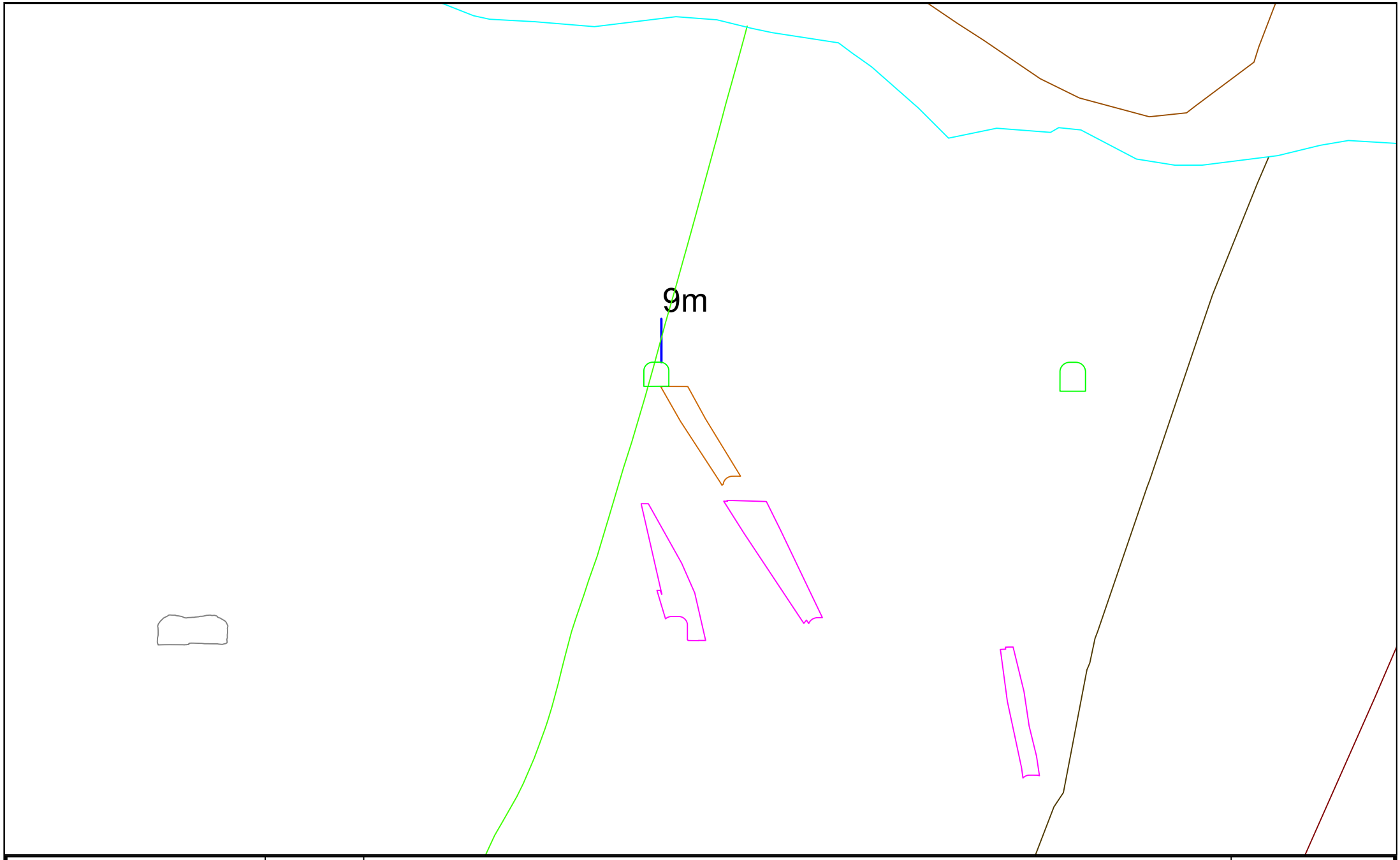
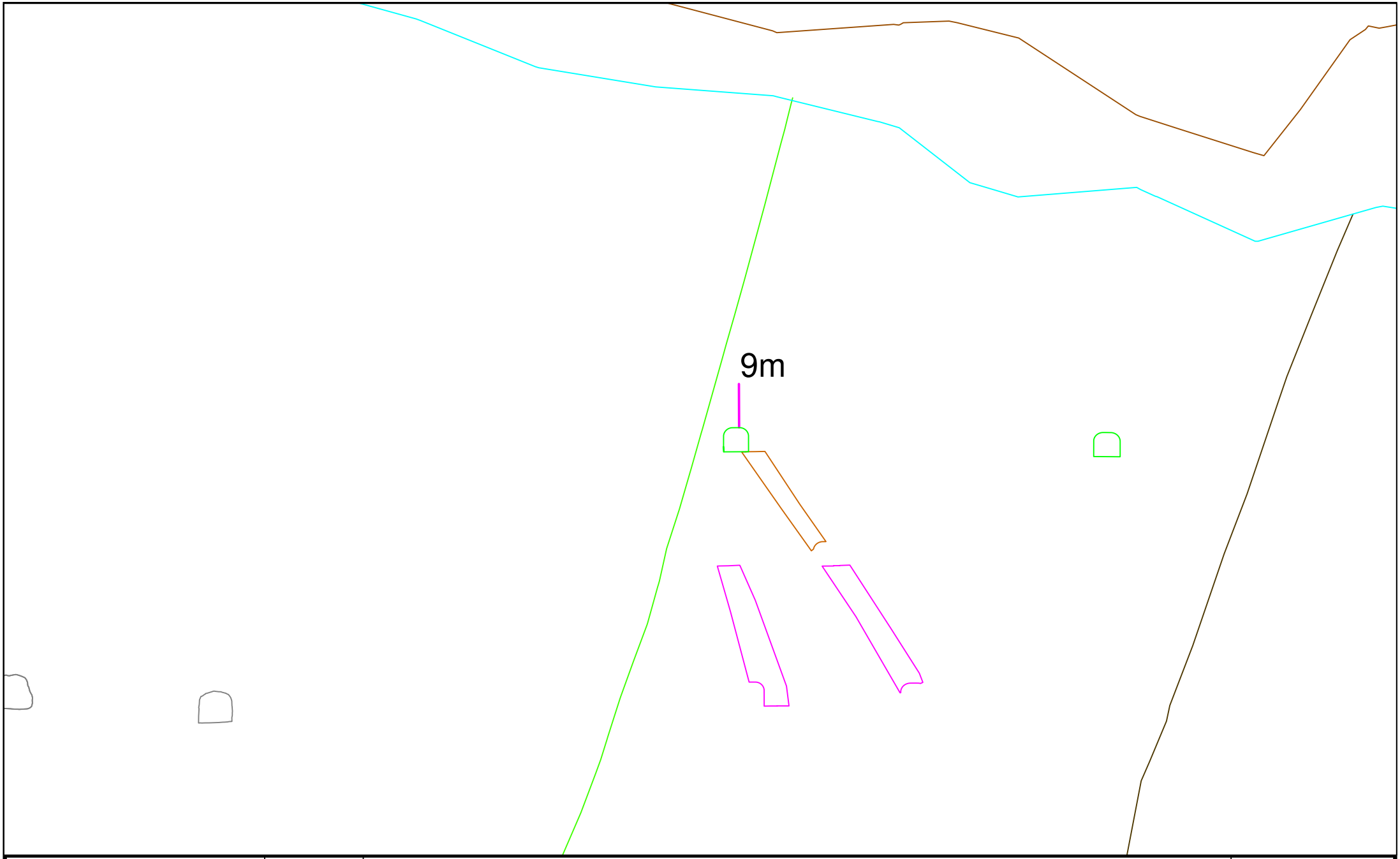
GEOTECHNICAL MINING SERVICES		View Looking North - Section 36,910 mN	



10/07/2022	msherpa	Evolution - Lake Cowal Instruments	1:1000
GMS GEOTECHNICAL MINING SERVICES		View Looking North - Section 36,918 mN	



10/07/2022	msherpa	Evolution - Lake Cowal Instruments	1:1000
GMS GEOTECHNICAL MINING SERVICES		View Looking North - Section 36,931 mN	

Appendix 2 – Yieldpoint Software

YieldPoint offers their own free software (MineScope MPBX) that can be useful for plotting information as well. The software is available for download at the following location:

- https://www.yieldpoint.com/resources/software-downloads.php

The MineScope MPBX software allows the creation of two plots. The first, presented in Figure A-1 shows the displacement of each node and its movement over time. The second shows the displacement of each node over the length of the instrument. It is important to note that the MineScope software is currently being phased out by YieldPoint and no maintenance or support is provided for it. If MineScope is used for instrument analysis, it is recommended that the data is frequently backed-up.

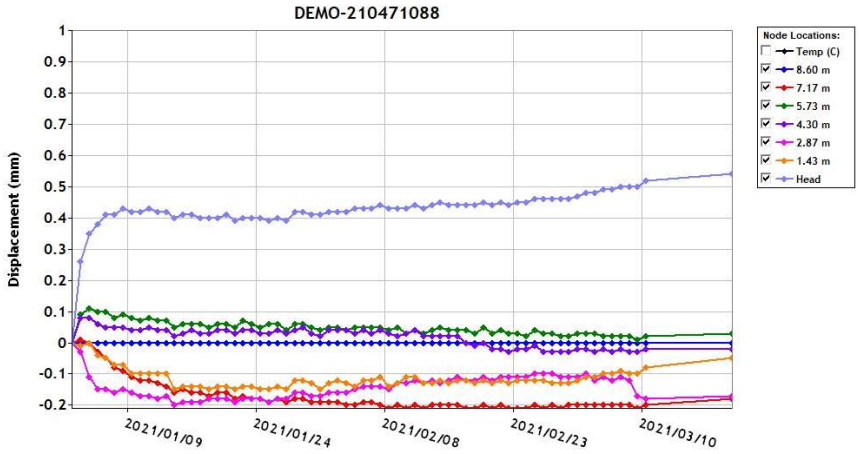


Figure A-1. Example data of displacement over time for a 6-node extensometer.

YieldPoint are moving to a cloud-based data storage and analysis package, VantagePoint. VantagePoint essentially preforms the same processes that MineScope does but it allows you to view the data with no data handling or manipulation. It also allows you to add blast and seismic events to the database to assist with data analysis. VantagePoint is available at a cost of $100USD per instrument, per year. The ACG have recently written a script to reference data from VantagePoint directly into mXrap. This functionality allows for 3D visualisation of instrumentation and analyse instrumentation data against blast and seismic data, is presented in Figure A-2.

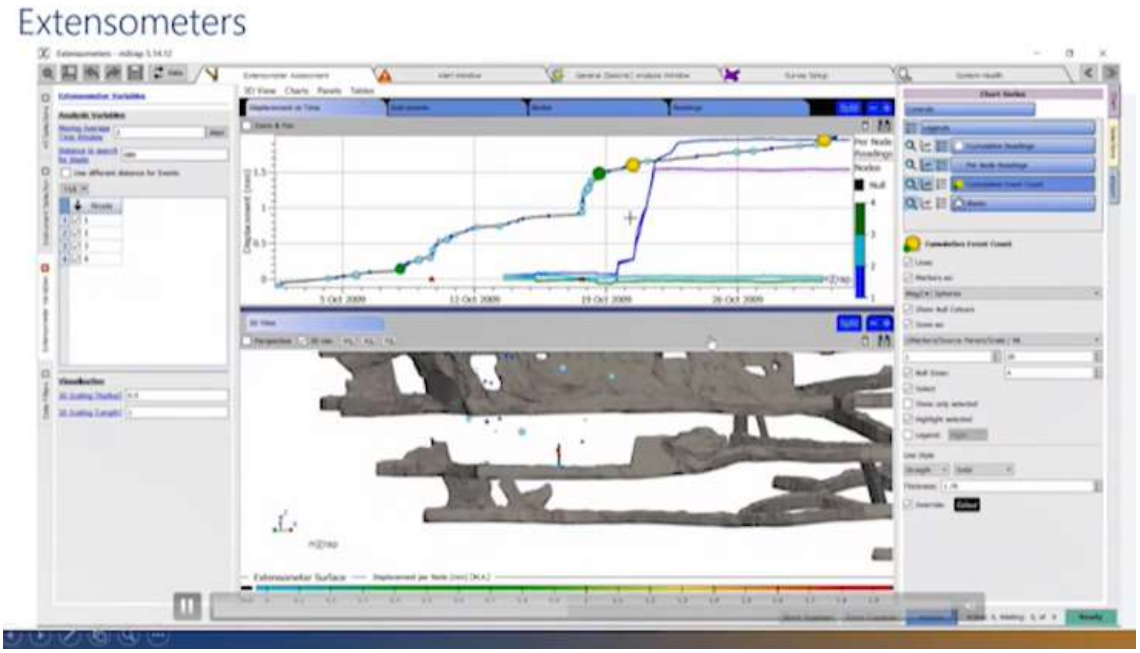


Figure A-215: Extensometer analysis in mXrap

Appendix 3 – Ackcio Beam-DG Brochure

ACKCIO

TECHNICAL SPECIFICATIONS

ACKCIO DIGITAL NODE BEAM-DG

MODEL	
BEAM-DG	Supports digital sensors using RS232, RS485 or SDI-12 communication protocols
MECHANICAL	
DIMENSION	220mm x 140mm x 80mm
WEIGHT	1.7kg
MATERIAL	Die-cast aluminium
DIGITAL MEASUREMENTS	
COMMUNICATION PROTOCOLS	MODBUS RTU SDI-12 Custom* *For custom protocols, contact Ackcio
SUPPORTED BAUD RATES	4800 - 115200
POWER SUPPLY OPTIONS FOR SENSORS	**Battery:** 5V @ 200mA 12V @ 200mA 24V @ 45mA **External power (12V, 3A, 36W):** 5V @ 200mA 12V @ 200mA 24V @ 45mA NOTE: All power modules are within ± 10% tolerance

MEASUREMENT RATE	Dependant on sensor(s)	
MEASUREMENT DURATION	Dependant on sensor(s)	
SUSTAINED INPUT VOLTAGE W/O DAMAGE	±18V DC max	
INPUT IMPEDANCE	120Ω typical for RS-485/232	
INPUT		
DIGITAL PORTS	RS232 Serial Port RS485 Full / Half Duplex Serial Port SDI-12 Bidirectional Port	
WIRING	Push-in CAGE CLAMP (0.2 - 1.5 mm^2 / 24 - 16 AWG)	
LOW-POWER MCU / PERIPHERALS		
MCU	Ultra-low power Arm® Cortex®-M3 48MHz 32-bit CPU	
MEMORY	128KB flash, 20KB ultra-low-leakage SRAM	
CLOCK	High-precision RTC self-compensated in temperature (10ppm from -40°C to +80°C)	
ON-BOARD SENSORS	Temperature sensor (range: -40°C to +80°C, resolution: 0.01°C, accuracy: ±1.8°C) Barometer sensor (range: 300 to 1100hPa, resolution: 0.18Pa, accuracy: ±1.7hPa)	
EXTERNAL FLASH	8MB	
INTERFACES		
DISPLAY / KEYBOARD	**LEDs**	SYS - System status indication SENS - Sensing status indication
	Buttons	TEST - to test the Node RESET - to reset the Node FORMAT - to do a factory reset of the Node
USB DEVICE PORT	USB 2.0 full speed (Micro B connector) 5V, max 500 mA for mobile OTG	
IDC10 CONNECTOR	Only for firmware programming	
RF & MESH SPECIFICATIONS		
RADIO BAND	ISM Band 863 - 870MHz, 902 - 928MHz	
TRANSMIT POWER	Up to 1 W (30 dBm)	
MODULATION	2-GFSK	

CERTIFICATIONS	FCC: 2AT8M-DG-V3X2 IC: 27349-DGV3X2 CE/RED Anatel (in progress)
ANTENNA	¼ λ stub antenna with SMA connector
LINK DATA SPEED	50 kbps bitrate
DATA SECURITY	AES128 encrypted end-to-end data
HOPS	Up to 12
NETWORK SIZE	Up to 50 Nodes
RANGE*	Line-of-sight: Up to 5km Urban: Up to 1km Below ground: Up to 500m

*Ranges are based on a transmission power of 30dbm. Actual transmission distances may vary depending on deployment conditions.

SOFTWARE & FIRMWARE	
FIRMWARE	**Ackcio Mesh:** Ackcio's long-range low-power mesh networking firmware
SOFTWARE	**Ackcio Nimbus:** Android app for device setup, network monitoring, and troubleshooting

PROTECTION	
CIRCUIT PROTECTION	Surge protection DC breakdown voltage 60V (± 20%@100V/µs) Impulse breakdown voltage 500V (@5kV/µs) typical Short circuit protection in power outputs Reverse supply protection
ESD	15kV

SYSTEM POWER REQUIREMENTS	
SUPPLY VOLTAGE	Battery: 2.7V to 4V External power supply: 8-36V, min 36W
INTERNAL NON-RECHARGEABLE BATTERIES	3 x D-Cell Li-SOCl2 3.6V nominal voltage Recommended capacity 19Ah
TYPICAL CURRENT DRAIN	<20µA in system idle <100mA in system RX mode <300mA in system TX mode (depends on output RF power setting)

ENVIRONMENTAL CONDITIONS	
OPERATING TEMPERATURE	-40°C to +80°C
PROTECTION	IP67

SENSOR COMPATIBILITY

SENSOR MANUFACTURER	SUPPORTED SENSORS	MAXIMUM NUMBER OF SEGMENTS/SENSORS	EXTERNAL POWER REQUIREMENT
CAMPBELL SCIENTIFIC WHEN MEASUREMENTS MATTER	All SDI-12 Sensors	14	No
ENCARDIO RITE	All SDI-12 Sensors	32	No
GEOKON®	In-place Inclinometer	TBA	No
GEOSENSE	In-place Inclinometers and tilt sensors	TBA	No
In-Situ®	All SDI-12 Sensors	14	No
MEASURAND	ShapeArray (SAAV/SAAX/SAAV Extend) - Low-power mode	200	No
	ShapeArray (SAAV/SAAX/SAAV Extend) - Regular power mode	100*	No
	NOTE: Compatible with serial number 66,000 and above.		
METER	All SDI-12 Sensors	14	No
Mine Design technologies	Smart-Link	Non-addressable: 1 Addressable: 6	No
rst INSTRUMENTS Monitor with Confidence	Legacy ASCII and Next-Gen (Gen 4) protocol	40	No
SISGEO®	All SISGEO digital instruments	TBA	No
YieldPoint	All sensors up to 13 channels - In RS485 Port	1	No
	All sensors up to 13 channels - Using dMUX	8	No
ZC	In-place Inclinometer - ZC CX100	8	No
	In-place Inclinometer - ZC CX300	24	No

*Contact us for information on larger ShapeArray segments.

NOTE: Compatibility varies depending on the generation of digital sensors, please contact us if you have any questions.

Digital sensor compatibility list is continually expanding, please contact us for most current information.

BATTERY LIFE ESTIMATION (MONTHS)								
SENSOR MANUFACTURER	SENSOR MODEL	NUMBER OF SENSORS	SAMPLING FREQUENCY (MINS)					
			5	10	15	30	60	360
MEASURAND	ShapeArray (SAAV/SAAX/SAAV Extend) - Low-power mode	25	30	41	47	55	60	65
		50	21	32	38	49	56	64
		75	15	25	31	43	52	63
		100	12	20	26	37	48	62
		200	5	9	13	22	33	57
	ShapeArray (SAAV/SAAX/SAAV Extend) - Regular power mode	25	21	32	38	49	56	64
		50	11	19	25	36	47	62
		75	7	13	17	27	39	59
		100	5	9	12	21	31	56
ENCARDIO RITE	Encardio 52M	10	17	27	34	45	53	64
	Encardio 52M	20	10	17	22	33	44	61
	Encardio 52M	32*	6	11	15	25	36	58
ZC	ZC CX100	8*	3	6	8	14	23	50
	ZC CX300	12	4	8	11	18	28	54
	ZC CX300	24*	2	3	4	7	12	37

*Maximum number of sensors that can connect to BEAM-DG Node.

NOTE: Above table is for reference only. Estimation is done under typical Singapore weather conditions. The radio transmission power was set to 21dBm. Battery lifetimes might vary depending on deployment conditions and the formed wireless mesh topology.

MOUNTING BRACKETS / PLATES

BEAM-BK-LG

Large multi-purpose mounting bracket (vertical/horizontal/pole) with mounting screws

Ackcio BEAM-DG

External view

Ackcio BEAM-DG

with our **BEAM-BK-LG** large multi-purpose mounting bracket for vertical/horizontal or pole mounting

Ackcio BEAM-DG

Inner view

ACKCIO

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Appendix 4 – Ackcio Beam-RN Brochure

ACKCIO

TECHNICAL SPECIFICATIONS

ACKCIO REPEATER NODE
BEAM-RN

MODEL	
BEAM-RN	Repeater Node that helps to expand network coverage

MECHANICAL	
DIMENSION	100mm x 100mm x 80mm
WEIGHT	0.7kg
MATERIAL	Die-cast aluminium

LOW-POWER MCU / PERIPHERALS	
MCU	Ultra-low power Arm® Cortex®-M3 48MHz 32-bit CPU
MEMORY	128KB flash, 20KB ultra-low-leakage SRAM
CLOCK	High-precision RTC self-compensated in temperature (10ppm from -40°C to +80°C)
ON-BOARD SENSORS	Temperature sensor (range: -40°C to +80°C, resolution: 0.01°C, accuracy: ±1.8°C) Barometer sensor (range: 300 to 1100hPa, resolution: 0.18Pa, accuracy: ±1.7hPa)

INTERFACES		
DISPLAY / KEYBOARD	**LEDs**	SYS - System status indication
	Buttons	TEST - to test the Node RESET - to reset the Node
USB DEVICE PORT	USB 2.0 full speed (Micro B connector) 5V, max 500 mA for mobile OTG	
IDC10 CONNECTOR	Only for firmware programming	

RF & MESH SPECIFICATIONS	
RADIO BAND	ISM Band 863 - 870MHz, 902 - 928MHz
TRANSMIT POWER	Up to 1 W (30 dBm)
MODULATION	2-GFSK
CERTIFICATIONS	FCC: 2AT8M-RN-V3X0 IC: 27349-RNV3X0 CE/RED Anatel (in progress)
ANTENNA	¼ λ stub antenna with SMA connector
LINK DATA SPEED	50 kbps bitrate
DATA SECURITY	AES128 encrypted end-to-end data
HOPS	Up to 12
NETWORK SIZE	Up to 50 Nodes
RANGE*	Line-of-sight: Up to 5km Urban: Up to 1km Below ground: Up to 500m

*Ranges are based on a transmission power of 30dbm. Actual transmission distances may vary depending on deployment conditions.

SOFTWARE & FIRMWARE	
FIRMWARE	**Ackcio Mesh:** Ackcio's long-range low-power mesh networking firmware
SOFTWARE	**Ackcio Nimbus:** Android app for device setup, network monitoring, and troubleshooting

PROTECTION	
CIRCUIT PROTECTION	Surge protection DC breakdown voltage 60V (± 20%@100V/µs) Impulse breakdown voltage 500V (@5kV/µs) typical Short circuit protection in power outputs Reverse supply protection
ESD	15kV

SYSTEM POWER REQUIREMENTS	
SUPPLY VOLTAGE	2.7V to 4V
INTERNAL NON-RECHARGEABLE BATTERIES	1 x D-Cell Li-SOCl2 3.6V nominal voltage Recommended capacity 19Ah
TYPICAL CURRENT DRAIN	<20µA in system idle <100mA in system RX mode <300mA in system TX mode (depends on output RF power setting)

ENVIRONMENTAL CONDITIONS	
OPERATING TEMPERATURE	-40°C to +80°C
PROTECTION	IP67

MOUNTING BRACKETS / PLATES	
BEAM-BK-SM	Small multi-purpose mounting bracket (vertical/horizontal/pole) with mounting screws

Ackcio BEAM-RN

External view

Ackcio BEAM-RN

with our **BEAM-BK-SM** small multi-purpose mounting bracket for vertical/horizontal or pole mounting

Ackcio BEAM-RN

Inner view

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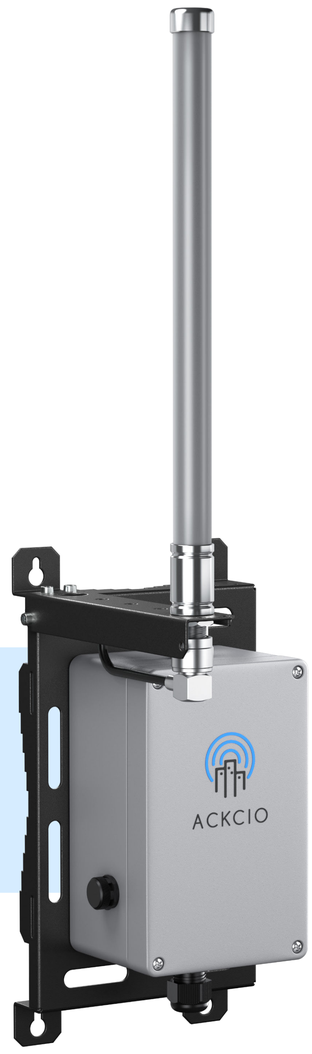
Appendix 5 – Ackcio Beam-GW Brochure

ACKCIO

TECHNICAL SPECIFICATIONS

ACKCIO GATEWAY
BEAM-GW



MODEL	
BEAM-GW	Beam Gateway with Snape, Ackcio's on-Gateway data and device management software

MECHANICAL	
DIMENSION	160mm x 100mm x 80mm
WEIGHT	1kg
MATERIAL	Die-cast aluminium

MAIN CPU / PERIPHERALS	
CPU	Broadcom BCM2837B0 quad-core A54 (ARMv8) 64-bit @ 1.4GHz Raspberry Pi 3A+
FCC ID	2ABCB-RPI3AP
MEMORY	512MB LPDDR2 SDRAM
STORAGE	Industrial-grade microSD Card with 16GB (13 GB usable)
ONBOARD SENSORS	Internal temperature sensor (accuracy ±2°C)
RTC	Internal RTC ±3.5ppm 0°C to +60°C External RTC ±2ppm 0°C to +40°C (Powered by CR3032)

SOFTWARE & FIRMWARE	
FIRMWARE	**Ackcio Mesh:** Ackcio's long-range low-power mesh networking firmware
SOFTWARE	**Ackcio Snape:** Ackcio's on-Gateway data and device management software

LOW-POWER MCU / PERIPHERALS		
MCU		Ultra-Low Power Arm® Cortex®-M3 48MHz 32Bit CPU
MEMORY		128KB Flash, 20KB Ultra-low-leakage SRAM
CLOCK		High Precision RTC self-compensated in temperature (10ppm from -40°C to +80°C)
ON-BOARD SENSORS		Temperature sensor (range: -40°C to +80°C, resolution: 0.01°C, accuracy: ±1.8°C) Barometer sensor (range: 300 to 1100hPa, resolution: 0.18Pa, accuracy: ±1.7hPa)
EXTERNAL FLASH		8MB
INTERFACES		
DISPLAY / KEYBOARD	**LEDs**	SYS - System status indication NET - Cellular status indication RF - MESH status indication WF -WiFi status indication
	Buttons	WIFI - to toggle onboard WiFi SHUTDOWN - to do a complete shutdown of the Gateway
USB DEVICE PORT		USB 2.0 full speed (Micro B connector) 5V
IDC10 CONNECTOR		Only for firmware programming
NETWORK INTERFACES		Integrated 3G/4G Modem & Antenna (LTE, HSDPA, EDGE, GPRS) quad-band Ethernet over USB 2.0 Wi-Fi interface on 2.4GHz
GPS		GNSS High Sensitivity GPS module (excluding antenna)
RF & MESH SPECIFICATIONS		
RADIO BAND		ISM Band 863 - 870MHz, 902 - 928MHz
TRANSMIT POWER		Up to 1 W (30 dBm)
MODULATION		2-GFSK
CERTIFICATIONS		FCC: 2AT8M-GW-V3X0 IC: 27349-GWV3X0 CE/RED Anatel (in progress)
ANTENNA		¼ λ stub antenna with SMA connector
LINK DATA SPEED		50 kbps bitrate
DATA SECURITY		AES128 encrypted end-to-end data
HOPS		Up to 12
NETWORK SIZE		Up to 50 Nodes
RANGE*		Line-of-sight: Up to 5km Urban: Up to 1km Below ground: Up to 500m

*Ranges are based on a transmission power of 30dbm. Actual transmission distances may vary depending on deployment conditions.

CELLULAR MODEM			
FCC ID	XMR201903EG25G		
TRANSMISSION POWER	23dBm ± 2dB		
CELLULAR BANDS	**Technologies**	**Band**	**Data rate**
	LTE	Band 1 (2100) Band 2 (1900 PCS) Band 3 (1800+) Band 4 (1700/2100 AWS-1) Band 5 (850) Band 7 (2600) Band 8 (900) Band 12 (700 ac) Band 13 (700 c) Band 18 (800 lower) Band 19 (800 upper) Band 20 (800 DD) Band 25 (1900+) Band 26 (850+) Band 28 (700 APT) Band 38 (TD 2600) Band 39 (TD 1900+) Band 40 (TD 2300) Band 41 (TD 2600+)	LTE FDD: - Max 150Mbps (DL) - Max 50Mbps (UL) LTE TDD: - Max 130Mbps (DL) - Max 35Mbps (UL)
	WCDMA	Band 1 (2100) Band 2 (1900 PCS) Band 4 (1700/2100 AWS-1) Band 5 (850) Band 6 (850 Japan) Band 8 (900) Band 19 (800 upper)	DC-HSDPA: - Max 42Mbps (DL) HSUPA: - Max 5.7Mbps (UL) WCDMA: - Max 384Kbps (DL) - Max 384Kbps (UL)
	GSM	B2 (1900 PCS) B3 (1800 dcs) B5 (850) B8 (900)	EDGE: - Max 296Kbps (DL) - Max 236.8Kbps (UL) GPRS: - Max 107Kbps (DL) - Max 85.6Kbps (UL)

WIFI MODULE	
MODEL	In-built WiFi module on Raspberry Pi 3A+
FCC ID	2ABCB-RPI3AP
WIFI BANDS	2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN
TRANSMISSION FREQUENCY AND POWER	2.4GHz/5GHz Max power: 30mW

PROTECTION	
CIRCUIT PROTECTION	Reverse supply protection

SYSTEM POWER REQUIREMENTS						
SUPPLY VOLTAGE	12VDC @ 3A Nominal Max: 24VDC Min: 11VDC					
INTERNAL NON-RECHARGEABLE BATTERIES	1 x D-Cell Li-SOCl2 3.6V nominal voltage as backup power Recommended capacity 19Ah					
TYPICAL CURRENT DRAIN	250mA typical operating current					
MAX CURRENT DRAIN	3A					
	Solar Panel Output Voltage	**Solar Panel Peak Output Current**	**Rated Power Generation** (6hrs peak sun)	**Battery Type**	**Battery Capacity** (21hrs standby operation)	**Maximum Charging Current**
EXTERNAL SOLAR PANEL	12V /24V	3A @12V / 1.5A@24V	80W minimum	12V / 24V lead-acid battery	18Ah minimum	2A or check battery specs on recomm. value

ENVIRONMENTAL CONDITIONS	
OPERATING TEMPERATURE	-40°C to +80°C
PROTECTION	IP67

MOUNTING BRACKETS / PLATES	
BEAM-BK-GW	Vertical/pole mounting bracket with mounting screws

Ackcio BEAM-GW

External view

Ackcio BEAM-GW

with our **BEAM-BK-GW** vertical/pole mounting bracket for vertical or pole mounting

Ackcio BEAM-GW

Inner view

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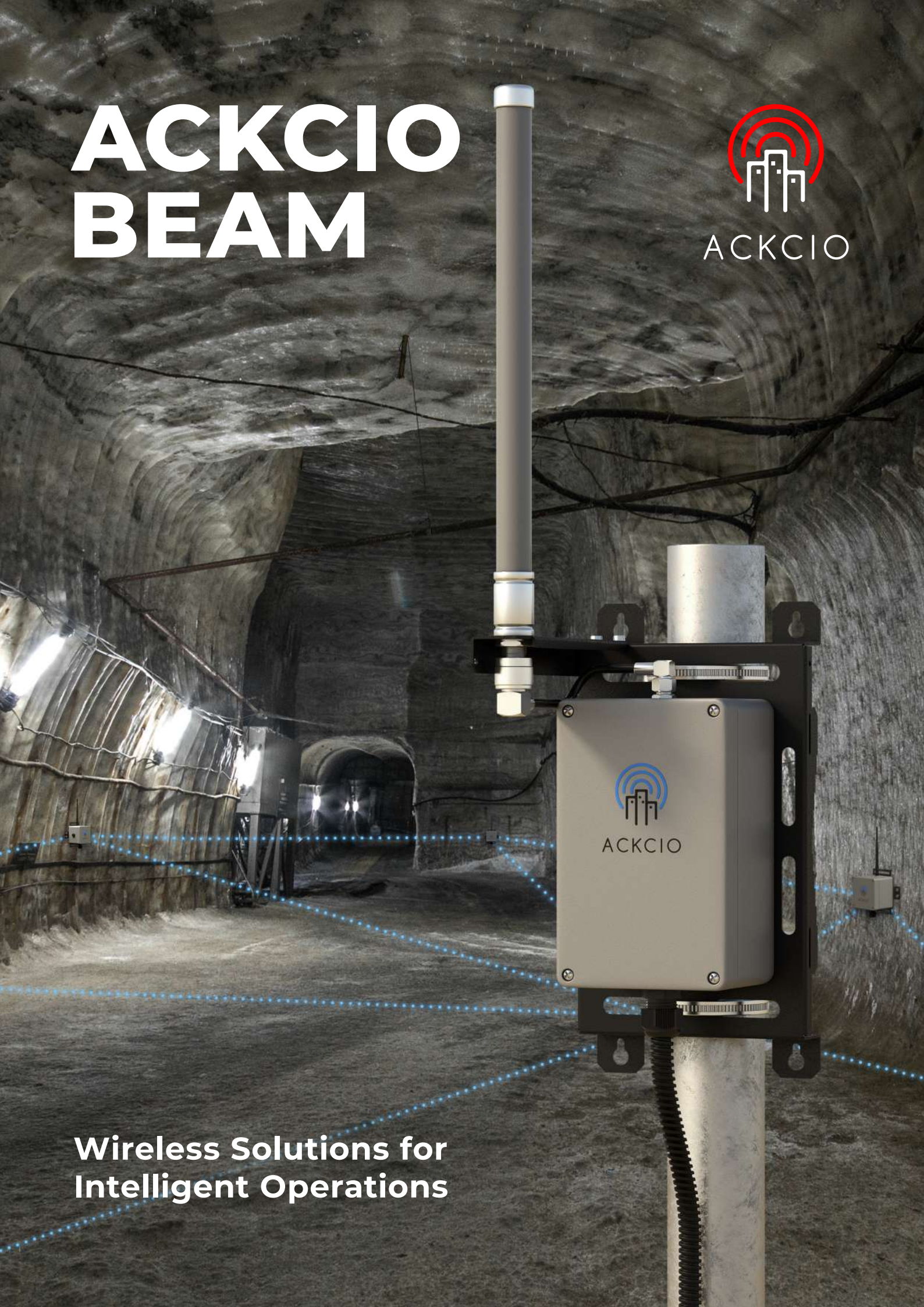
Appendix 6 – Ackcio General Brochure

ACKCIO BEAM

ACKCIO



Wireless Solutions for Intelligent Operations

ACKCIO BEAM

Wireless Monitoring Solution

Enhance Safety Manage Risk Increase Productivity

ACKCIO BEAM is our revolutionary, wireless industrial data acquisition platform that allows for reliable, remote monitoring of industrial sensors, providing intelligent data to users in mission-critical industries to help them make faster, better-informed decisions.

Our solution combines 3 main components

Nodes

Plug-and-play style setup and user-friendly system.

Compatible with leading geotechnical, structural, and environmental sensors.

Battery life of up to 5 years.

Wireless Mesh Network

Innovative patented Ackcio Mesh wireless data collection protocol provides seamless connectivity in both above ground and underground environments.

Low-power, long-range wireless radios that provide up to 5 km of range for each hop of the mesh network.

Reliability at its core – Ackcio Mesh technology is self-healing and incorporates retransmission of data to ensure the highest reliability.

Software

Secure and private on-Gateway data and device management software.

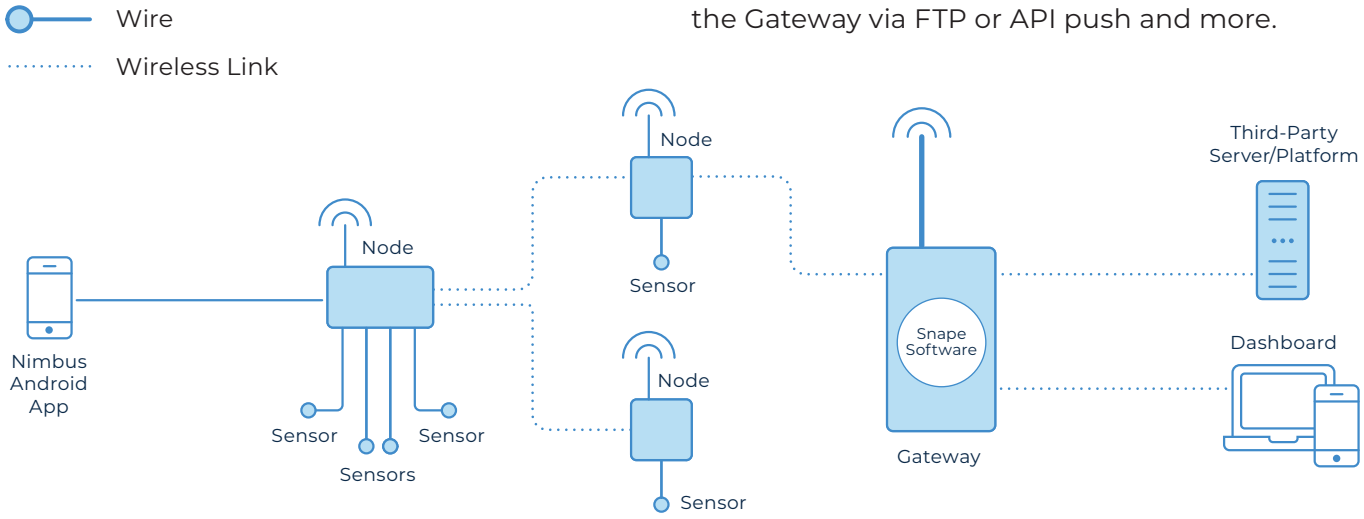
Out-of-the-box compatibility with popular third-party data analytics software platforms.

Easy-to-use smartphone application for device commissioning and diagnostics.

ACKCIO BEAM

How it works

Ackcio Nodes take periodic readings from sensors and transmit them via the Ackcio Mesh to the Ackcio Gateway, where they are then uploaded to any third-party server/software platform. Ackcio Snape software allows you to configure the Gateway and Nodes, and also set up other key operations such as uploading sensor data out of the Gateway via FTP or API push and more.



ACKCIO MESH

Reliable Wireless Sensor Data Collection

Ackcio Nodes use long-range wireless radios to communicate with the Ackcio Gateway as well as with each other.
The Ackcio Mesh network automatically mitigates common wireless problems such as signal interference and blockage, thereby allowing Nodes to reliably transmit their data to the Gateway every time.

Radio bands
Sub-1GHz band
(863-870MHz, 902-928MHz)

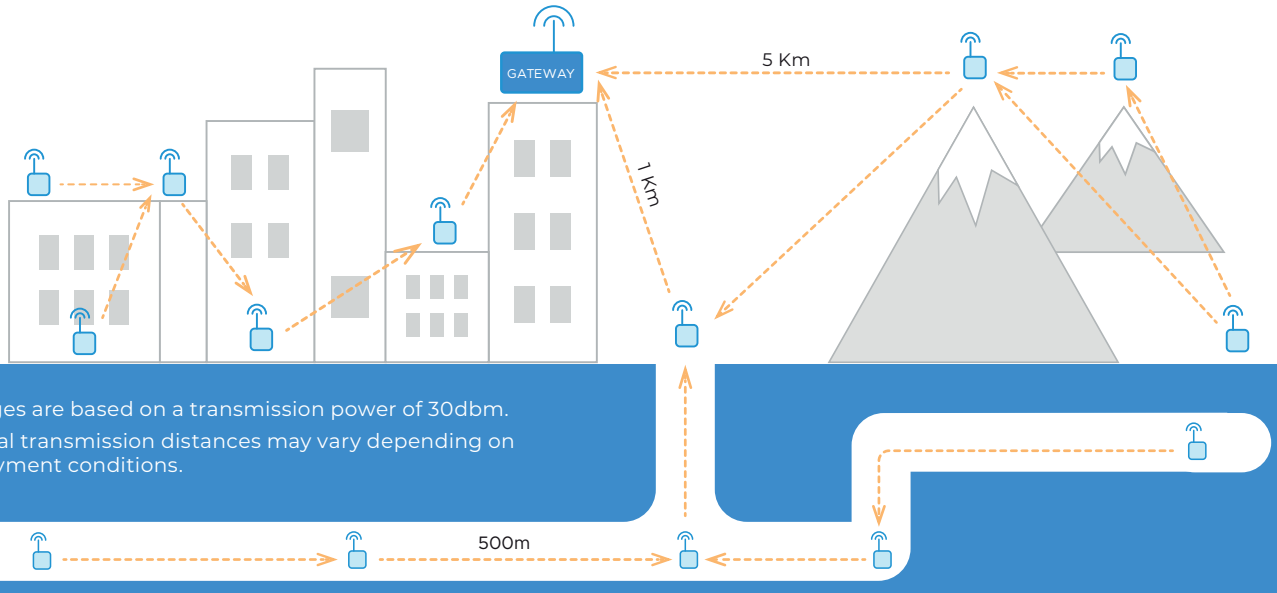
Mesh hops
Up to 12

Nodes per Gateway
Up to 50

Line-of-sight
Up to 5 Km per hop*

Urban
Up to 1 Km per hop*

Below ground
Up to 500m per hop*



* Ranges are based on a transmission power of 30dbm.
* Actual transmission distances may vary depending on deployment conditions.

ACKCIO DEVICES

Ackcio Analogue Nodes

BEAM-AN-S1: Supports 1 sensor (2 analogue channels and 1 thermistor channel)

BEAM-AN-S4: Supports 4 sensors (8 analogue channels and 4 thermistor channels)

Ackcio Vibrating Wire Nodes

BEAM-VW-S1: Supports 1 sensor (1 vibrating wire channel, 1 pulse counter, and 1 thermistor channel)

BEAM-VW-S8: Supports 8 sensors (8 vibrating wire channels and 8 thermistor channels)

Ackcio Digital Node

BEAM-DG: Supports digital sensors using RS232, RS485 or SDI-12 communication protocols.

Supports digital sensors like in-place inclinometers, digital tiltmeters, borehole extensometers, water level sensors, ShapeArrays etc.

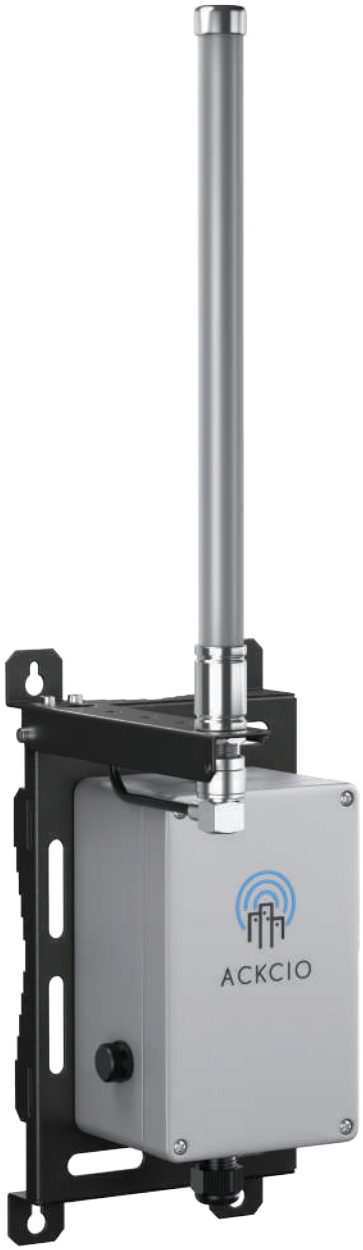
Supported Digital Sensor Brands

CAMPBELL SCIENTIFIC · GEOSENSE · MEASUREND · rst Monitor with Confidence

ENCARDIO RITE · In-Situ · GEOKON · Mine Design technologies

SISGEO · DTC · METER · YieldPoint · ZC · & more

ACKCIO DEVICES



Ackcio Gateway

BEAM-GW: Beam Gateway with Snape, Ackcio's on-Gateway data and device management software.

Ackcio Tiltmeter Node

BEAM-TM: Wireless Tiltmeter Node. BEAM-TM uses MEMS bi-axial tilt sensor modules built, installed, and calibrated by Sisgeo Asia Pacific, thus providing highly accurate and reliable tilt readings.

Ackcio Repeater Node

BEAM-RN: Repeater Node that helps to expand network coverage.

ACKCIO SOFTWARE

Snape / Nimbus

On-Gateway Snape Software

Ackcio's Snape software, which runs on the Ackcio Gateway, helps you configure your deployments and manage sensor data collected by our monitoring system.

Ackcio Snape software provides all stakeholders with real-time access to every data point collected from your projects, thereby allowing you to make informed and collective decisions that reduce delays and increase productivity and safety.

Key Features

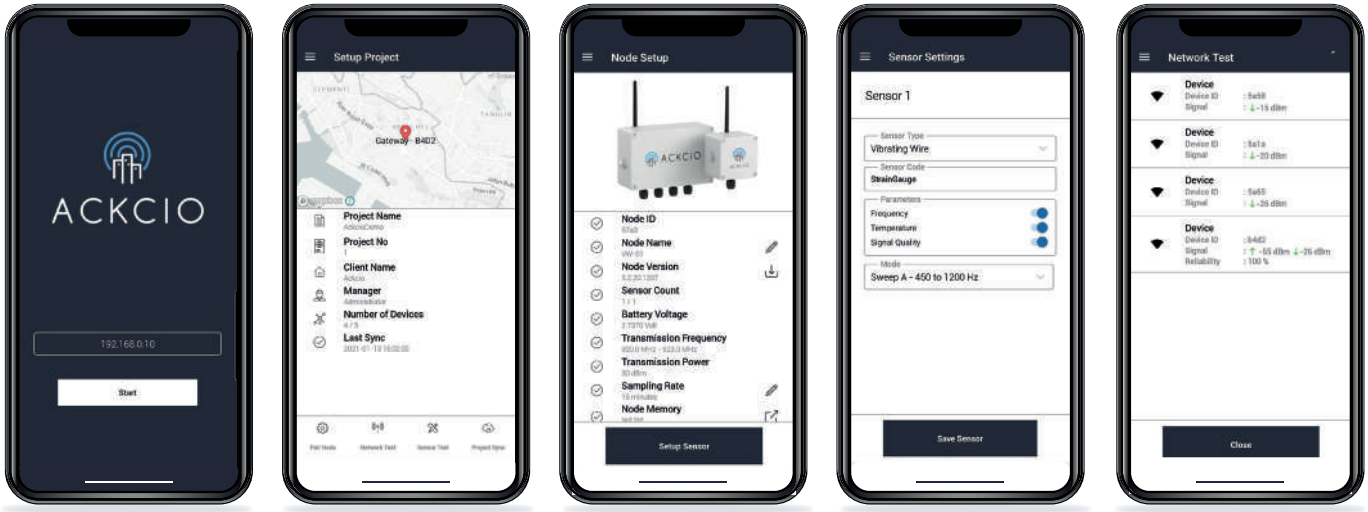
- Simple-to-use and modern interface for data and device management.
- Quick and secure out-of-the-box compatibility with popular data analytics software platforms.
- Remote, real-time access over public and private IP using popular DDNS and remote.it services.
- Over-the-air update and troubleshooting for the Snape software.
- Intuitive Ackcio Mesh network troubleshooting with support for online/offline maps.
- Runs completely on the edge providing for secure and private deployments.

Supported Data Analytics Software Platforms

sensemetrics · VISTA DATA VISION · BEEMETRY · Drishti · iotailor · Geodaisy · & more

ACKCIO SOFTWARE

Snape / Nimbus



Nimbus Android App

All of our Nodes can be set up at the deployment site with an easy-to-use Nimbus Android application that comes free with the system.

Key Features

- Simple and intuitive device commissioning process with Quick Setup feature.
- Easy to use device and network diagnostics functionality.
- In-app reference guides for sensor wiring.
- Noise scanning feature to identify background interference.
- Easy firmware update functionality for Nodes.
- Download Nodes' backup data with a few clicks.

ACKCIO DEPLOYMENT HIGHLIGHTS

Neste Singapore Refinery

Load monitoring on struts

Industry: Construction

Location: Singapore

Devices: BEAM-VW-S8, BEAM-GW

Monitored sensors: Strain gauges

Xinzhuang Depot by Taipei Metro

Structural monitoring of a tunnel

Industry: Infrastructure

Location: Taipei, Taiwan

Devices: BEAM-AN-S4, BEAM-RN, BEAM-GW

Monitored sensors: MEMS tiltmeters, LVDT sensors

UK Rail Monitoring

Railway cutting monitoring

Industry: Rail

Location: United Kingdom

Devices: BEAM-DG, BEAM-VW-S1, BEAM-TM

Monitored sensors: SAAV Extend, GeO flushable piezometers, Tilt

Kalgoorlie Gold Processing Facility

Porewater pressure monitoring

Industry: Mining

Location: Kalgoorlie, Australia

Devices: BEAM-VW-S1, BEAM-DG, BEAM-GW

Monitored sensors: Piezometers, In-place inclinometers

ABOUT ACKCIO

Ackcio builds reliable wireless data acquisition systems for industrial monitoring applications. The company automates monitoring processes and provides remote, intelligent data to enable increased safety and efficient risk management in mission-critical industries, including construction, infrastructure, mining, and rail.

Ackcio's flagship solution, Ackcio Beam, is an industrial data acquisition platform that uses a patented long-range wireless mesh network to monitor sensors accurately and reliably in both above ground and underground environments. Ackcio is headquartered in Singapore and supports clients across the world. In 2021, the company was included in Forbes Asia's inaugural '100 to Watch', a list comprising small companies and startups on the rise across the Asia Pacific.

For more information, visit www.ackcio.com or follow us on social media.

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BEAM-SB-EN-2022-02

Appendix 7 – GMS Quote for Instrumentation and Installation

QUOTE

Evolution Mining (Cowal) Pty Limited
ABN: 75007857598

Date
11 Jul 2022

Expiry
5 Aug 2022

Quote Number
QU-1004

Reference
Lake Cowal

ABN
24 639 206 983

Geotechnical Mining Services
39 Newlands St
TREVALLYN TAS 7250
AUSTRALIA

GMS Supply and Installation of Instrumentation

Trust Our Experienced Team To Take Care Of Your Geotechnical Projects

Description	Quantity	Unit Price	GST	Amount AUD
6 points hard rock extensometer 250mm stroke, head-at-collar, 15m long, equidistant points	10.00	2,950.00	10%	29,500.00
6 points hard rock extensometer 250mm stroke, head-at-collar, 12m long, equidistant points	7.00	2,600.00	10%	18,200.00
6 points hard rock extensometer 250mm stroke, head-at-collar, 9m long, equidistant points	12.00	2,450.00	10%	29,400.00
6 points hard rock extensometer 250mm stroke, head-at-collar, 6m long, equidistant points	5.00	2,150.00	10%	10,750.00
6 points Instrumented cable anchor equally spaced, will be plated/tensioned, head-at-toe, 12 meter long, bulbs every 100 cm	2.00	3,150.00	10%	6,300.00
6 points Instrumented cable anchor equally spaced, will be plated/tensioned, head-at-toe, 9 meter long, bulbs every 100 cm	8.00	2,950.00	10%	23,600.00
D8MUX 8 channel multiplexing module that allows ata to be logged using Ackio telemetry system	6.00	1,400.00	10%	8,400.00
4 channel multiplexing module that allows ata to be logged using Ackio telemetry system	2.00	1,300.00	10%	2,600.00
Smart Instrument Extension Cables -for linking the instruments above stopes to the MUX	6180.00	4.75	10%	29,355.00
Ackio Beam DG Digital Node Looger to extract data from D8/D4 MUX	12.00	2,400.00	10%	28,800.00
Ackio Beam RN Repeater Node Extends wireless range of nodes in mesh allowing communication to central gateway	7.00	1,450.00	10%	10,150.00

Description	Quantity	Unit Price	GST	Amount AUD
Ackio Beam GW Gateway Central gateway to receive all instrument data	1.00	4,550.00	10%	4,550.00
Cable conduit cable protection	250.00	10.00	10%	2,500.00
Miscellaneous items for installation (cable ties, tape, pipe glue etc.)	1.00	1,000.00	10%	1,000.00
Sundry and logistics	1.00	5,000.00	10%	5,000.00
Airfreight (approximation)	1.00	10,000.00		10,000.00
Package and handling (Canada)	5.00	750.00	10%	3,750.00
Project Engineer - Instrumentation Design and Report	50.00	165.00	10%	8,250.00
Project Engineer - Installation	256.00	165.00	10%	42,240.00
Geotechnical Technician - Installation	256.00	120.00	10%	30,720.00
Flights - Travel from QLD and TAS	1.00	5,000.00	10%	5,000.00
Accommodation and meals	32.00	250.00	10%	8,000.00
Hire Car - will attempt to utilise current GMS hire car if Harry Towns still onsite	1.00	2,500.00	10%	2,500.00
			Subtotal	320,565.00
			TOTAL GST	31,056.50
			TOTAL AUD	**351,621.50**

Terms

Quotes are valid for 30 days

Cowal Gold Mine

Underground Subsidence Monitoring Program

Revision Status Register

Section /Page/ Annexure	Revision Number	Amendment/ Application	Distribution	DPE Approval Date
New Document	USMP	Development of New Document as required by SSD 10367	Resources Regulator, DPE	TBE

September 2022