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UNDERGROUND UTILITY MAPPING IN MALAYSIA

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UNDERGROUND UTILITY MAPPING IN MALAYSIA



Underground Utility Mapping is a process to obtain and identify types of installation of public utilities (e.g : power, water, telecommunications etc.) which are buried underground. **The information of utility position and depth** will be presented in digital or printed form according to local projection coordinate system.

There are many types of utility lines buried underground, therefore different types of detection must be used. For metal pipes and cables, this often done with electromagnetic equipment (i.e. metal locator, ground penetrating radar (GPR)) which it can transmit and receive the location of the pipe (depth). For plastic or concrete pipes, ground penetrating radar (GPR) is used.

A manhole or confined space is the top opening to an underground utility vault used to house an access point for making connections, inspection, valve adjustments or performing maintenance on underground and buried public utility and other services including water, sewers, telecommunication cables, power cables, storm drains, and gas.

1.0 Tenaga Nasional Berhad (TNB)

Types of TNB manhole :



External dimension	Internal dimension	Gross Weight (kg)	Duct Ways (Side/End)	Cover Type
1440(L) x 1440(W) x 800(H)	1200(L) x 900(W) x 660(H)	2000	6	Rectangular Iron
1560(L) x 1560(W) x 1600(H)	1200(L) x 1200(W) x 1200(H)	5000	6	Concrete Slab / Rectangular Iron
2120(L) x 1520(W) x 1600(H)	1800(L) x 1200(W) x 1200(H)	6500	6	Concrete Slab / Rectangular Iron
2120 (L) x 2120 (W) x 1600(H)	1800 (L) x 1800 (W) x 1200(H)	8000	6	Concrete Slab / Rectangular Iron

Type of TNB cable :

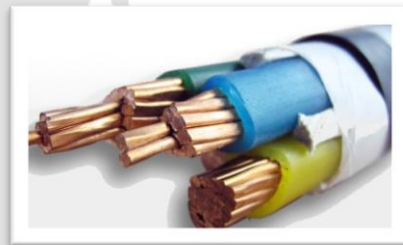


PVC Insulated Cable

These cables are commonly used for the internal electrical wiring of buildings such as residential homes, buildings and commercial administration.

XLPE Insulated Power Cable

These cables are commonly used for electrical installation on the exterior of buildings such as street lighting, area lighting, mains electricity supply between the building and so on.






Fire Resistance Cables

This type of cable used for internal electrical installations for buildings, uninterrupted power supply (essential power supply) as Fire Prevention Pump System, Passenger Lift System and so on. These cables are heat resistant and are among the conditions set by the installation of Fire & Rescue Department (FRD) for buildings that have a design Uninterruptible Power Supply System.






2.0 Telekom Malaysia Berhad (TM)

Types of TM manhole :

	Name	External dimension	Internal dimension	Duct Ways	Weight (kg)	Cover Type
	JB30	950(L) x 650(W) x 630(H)	750(L) x 450(W) x 450(H)	4	580	Concrete
	JC9	1850(L) x 900(W) x 1240(H)	1550(L) x 600(W) x 960(H)	4	3000	Rectangular Iron Concrete
	JC9C	2050(L) x 1400(W) x 1480(H)	1770(L) x 1120(W) x 1000(H)	6	4500	Rectangular Iron Concrete

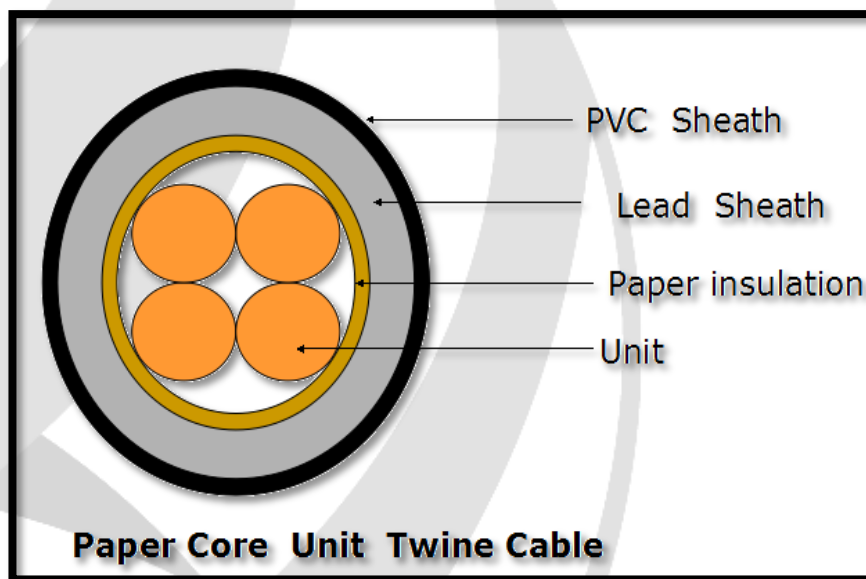
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	R1B	2100(L) x 1500(W) x 2350(H)	1780(L) x 1180(W) x 1800(H)	4	8000	Square Iron
	R2A	3300(L) x 1650(W) x 2450(H)	2940(L) x 1290(W) x 1900(H)	Side :8 End :12	13500 0	Square Iron
	JRC7	1200(L) x 900(W) x 1050(H)	950(L) x 650(W) x 725(H)	4	1500	Rectangul ar Iron Concrete

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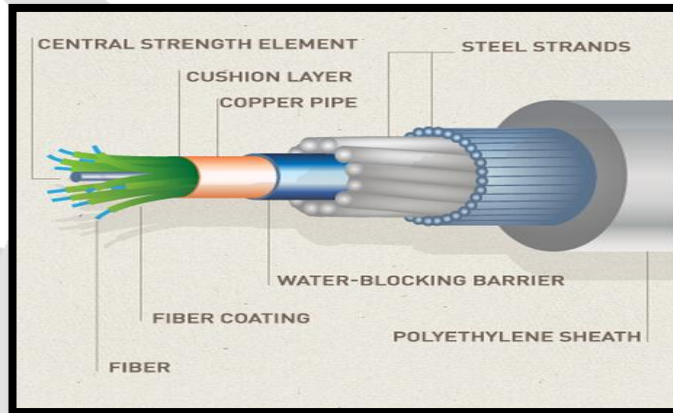
The Telephone Cables are used for transmission of telecommunication signals. Cables are usually known to transmit electric energy (AC/DC). However, cables in telecommunications fields are used to transmit electromagnetic waves. These are the main cable used by Telekom Malaysia (TM):

1) PCUT Cable : Paper Core Unit Twin



PCUT Cables contain essentially copper conductors with paper insulation, and were earlier used for transmission of Telecommunication signals. As this cable is insulated by paper, the same is easily affected by water ingress resulting in low insulation among pairs leading to dislocation of communication facilities. To avoid this problem these cables were pressurized to prevent ingress of moisture. Pressurization of cables was not only expensive but also involved additional maintenance charges for acquisition and maintenance of air compressors and other associated equipments required Polyethylene Insulated Jelly Filled Cables came into.

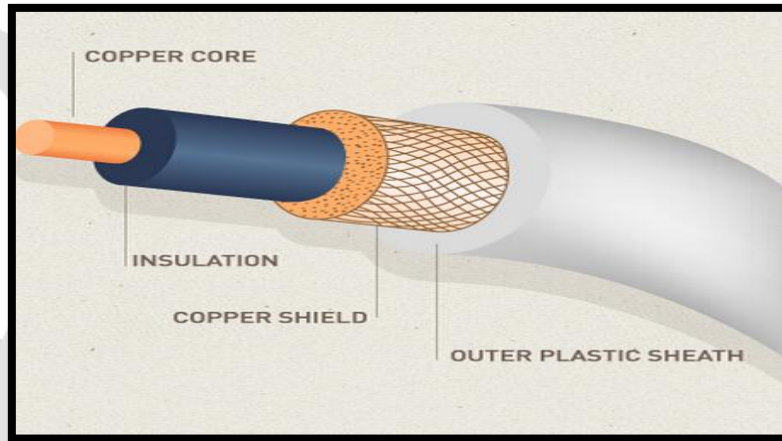
2)Fiber Optic Cable



Optical fiber is the latest underground cable that is being used extensively in all the networks including long distance trunks, junction circuits and even the local subscriber loops to enhance the data transmission. The optical fiber cable is a cable made of fine glass fiber containing core which is equipped with a 'cladding' glass. In addition, the optical fiber also has the quality, reliability and better maintenance. In terms of information, security is guaranteed and it also can reduce congestion in the underground facilities.

Fiber Optic uses light to transmit signals, in contrast to copper cables that use electronic signals. Therefore it can avoid interference optic magnet. Fiber optic cable is suitable for use in areas with many interruptions of optic magnet and distances. Fiber optic cables are being used more often for TV and computer use. The speed of fiber optic cable transmit light is much faster than any other cable technology.

3) Coaxial Cable



Coaxial cable is a two conductor electrical cable consisting of a center conductor and an outer conductor with an insulating spacer between the two. It conducts electrical signal using an inner conductor (usually a solid copper, stranded copper or copper plated steel wire) surrounded by an insulating layer and all enclosed by a shield, typically one to four layers of woven metallic braid and metallic tape. The cable is protected by an outer insulating jacket. Normally, the shield is kept at ground potential and a signal carrying voltage is applied to the center conductor.

The advantage of coaxial design is that electric and magnetic fields are restricted to the dielectric with little leakage outside the shield. Conversely, electric and magnetic fields outside the cable are largely kept from interfering with signals inside the cable. Larger diameter cables and cables with multiple shields have less leakage. This property makes coaxial cable a good choice for carrying weak signals that cannot tolerate interference from the environment or for stronger electrical signals that must not be allowed to radiate or couple into adjacent structures or circuits. Coaxial cable is used as a transmission line for radio frequencies. These cables can carry signals great distances and carry internet connections via Ethernet cable.

3.0 Sewage & Water

The manhole is constructed at suitable intervals along the sewer lines for providing access into them. The manhole helps in inspection, cleaning and maintenance of sewer. These are provided at every bend, junction, change of gradient or change of diameter of the sewer.

Manhole for sewage are classified as follows :

1) Shallow Manhole

These are 0.7 to 0.9 m depth, constructed at the start of the branch sewer or at a place not subjected to heavy traffic conditions .These are provided with light cover at top and called inspection chamber.

2) Normal Manholes

These manholes are 1.5 m deep with dimensions 1.0 m x 1.0 m square or rectangular with 1.2 m x 0.9 m .These are provided with heavy cover at its top to support the anticipated traffic load.

3) Deep Manholes

The depth of these manholes is more than 1.5 m. The section of such manhole is not uniform throughout . The size in upper portion is reduced by providing an offset. Steps are provided in such manholes for descending into the manhole. These are provided with heavy cover at its top to support the traffic load.

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A piped system can vary from simple to extremely complicated. Most piped system have basic component such as pipes, valve and reservoirs. The following describes the various characteristic of the pipe.

Type of Pipe :

High Density Polyethylene (HDPE) Pipe



- Manufactured from virgin pipe grade raw materials
- Excellent corrosion and chemical resistance. Inert to most acidic and alkaline solutions
- Safe for potable water supply
- 20 to 1600 mm sizes at various pressure rating from 2.5 to 16 kg/cm² (35.5 to 227.5 psi)
- Use for Lift and gravity water supply systems
- Sewerage pumping and effluent disposal systems

Polyvinyl Chloride (PVC) Pipe



- Used to distribute water that people aren't going to drink
- Made from unplasticized Polyvinyl Chloride
- Used for pipelines, pipe cleaning and pipe overflow
- Available PVC pipe size is 13 mm, 20 mm, 25 mm, 32 mm and 50 mm.

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Asbestos Cement (A.C) Pipe



- They are made of mixture of 82%-90% of cement and 10%-18% asbestos fibers
- Available in sizes from 3 to 36 inches and length of 13 feet
- The pipes are very durable and resistant to corrosion

Ductile Iron Pipe



- It is a pressure pipe commonly used for portable water and sewage distribution
- Serves to inhibit corrosion from the fluid being distributed
- Pipe sizes vary from 3 inches up to 64 inches
- Ductile iron pipe has a larger inside diameter than pipelines of similar size, thus a greater volume of water can be transported

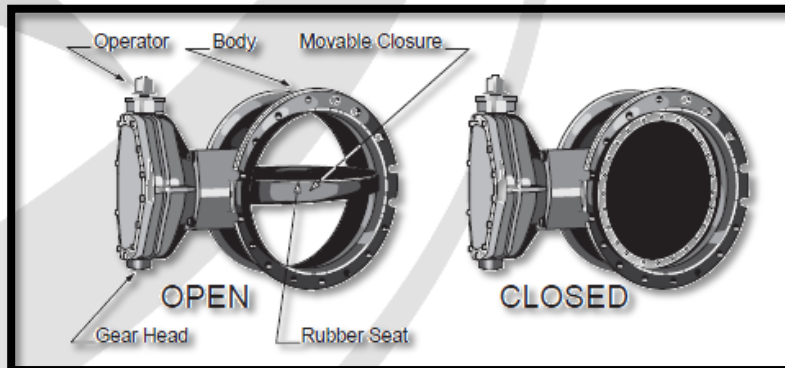
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A valve is a device that regulates, directs or controls the flow of a fluid (gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing various passageways. Common valves used in a wastewater treatment such as :



Gate Valve

Valve that opens by lifting a round or rectangular gate/wedge out of the path of the fluid. The distinct feature of a gate valve is the sealing surfaces between the gate and seats are planar, so gate valves are often used when a straight-line flow of fluid and minimum restriction is desired



Butterfly Valve

A butterfly valve is a valve which can be used for isolating or regulating flow. This type of valve has movable closure that rotates on a shaft inside of the valve body. The body holds the inlet connection and valve set. When it is

closed, the movable closure seats against a rubber like that is set into the valve body.



Ported Ball Valve

A valve with a spherical disc, the part of the valve which controls the flow through it. The sphere has a hole, or port, through the middle so that when the port is in line with both ends of the valve, the flow will occur. When the valve is closed, the hole is perpendicular to the ends of the valve, and the flow is blocked. The handle or lever will be in line with the port position letting you “see” the valve’s position. There are different *body styles* and *port types*.



Check Valve

Check Valve are used to prevent water from reversing direction in a line or flowing in two directions. Check valves are two-port valves, meaning they have two openings in the body, one for fluid to enter and the other for fluid to leave. There are various types of check valves used in a wide variety of applications

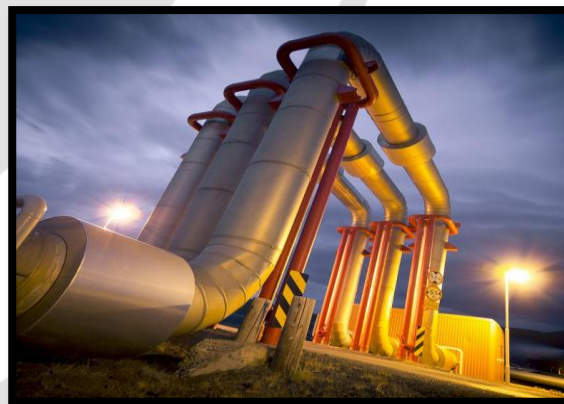
4.0 Gas Reticulation

Pipelines are made with inner diameter from 30 to 120 cm. In more developed, urban, environmentally sensitive or potentially dangerous areas they are buried underground at a typical depth of about 1.3 -1.6 metres (about 3 feet).



Type of pipe :

Carbon Steel



Carbon steel pipe system can be in the form of seamless, stainless or mild steel pipes. Fluctuating gas pressure or shock pressure have little effect

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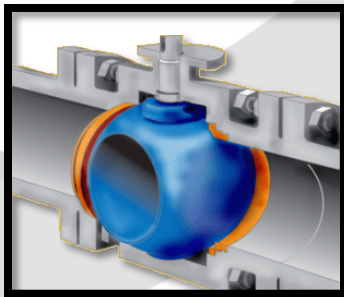
on steel. Today's heavy traffic conditions impose much stress on roadway foundations. Carbon steel pipe is practically unbreakable in transport and service, and for this reason it is okay to lay water mains under roadways.

Polyethylene (PE) Pipe



With superior resistance to leakage and commendable strength, the Polyethylene Gas Pipes are amongst the finest options available for conveying a variety of gases. PE Pipes often used for buried installations in distribution for domestic & industrial use. This type of pipe is also light in weight and it lasts long.

Types of valve :



Ball Valve



Globe Valve



Plug Valve

5.0 Equipments Used

Initially, a visual inspection is done within each area to search for utility poles, utility vaults, manholes, catch basins, drains, conduits, cleanouts, water valves, gas valves, tank pads and basement of each building surrounding each area to search for utilities exiting the basemen wall. The following illustrates the equipments used to carry out underground utilities detection services and mapping.



1. Promark 200 GPS

It includes topographic features typically associated with dual-frequency, and provides extensive data formats and local coordinate system support manufactured by Ashtech.

- Long- range RTK performance, fast initialization and **centimeter-level accuracy.**
- Fast fix with short initialization time.
- Built-in GSM/GPRS, WLAN, and bluetooth wireless connectivity.
- Advanced error detection and quality analysis tools to ensure accurate and reliable results



2. RD8100PDL Pipe and Cable Locator (PCL)

The science of cable and pipe location is based on the principal that a current flowing along a conductor creates a magnetic field, and that magnetic field or signal, which is either passive or active in nature, can be detected via receiver. 1 unit of RD8100 receiver and RD8100 transmitter, both of which were manufactured by the Radio Detection Corp of Bridgton ME. RD8100PDL is an advanced underground cable and pipe locator with :

- Specially designed and positioned antennas.
- Built-in GPS.
- Advanced features measuring of current, Peak / Null tracing methods, **measuring of depth** without the need for transmitter, markers for precise location, compass feature to determine the direction of current.



3. IDS Opera Duo Ground Penetrating Radar (GPR)

Ground Penetrating Radar (GPR) is used to detect non-metallic, inaccessible, unknown or abandoned utilities that can't produce electromagnetic field. GPR principle is differ from PCL where GPR equipment **scans** throughout the survey area. After the scanning is completed, the center of the pipe will appear in the data screen profile as an upside down U, which is referred to as hyperbola. 2-In-1 Multi Frequencies High Resolution GPR-IDS Opera Duo is manufactured by IDS Italy. Advantages of GPR-IDS Opera Duo are as followed :

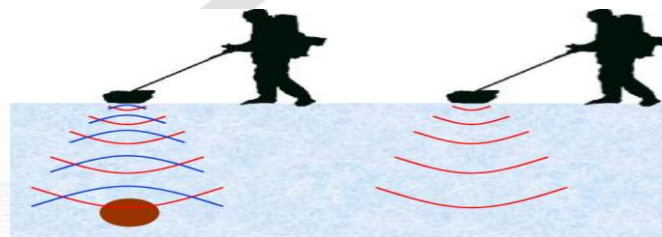
- Ability to **locate** the exact position of pipes and cables by a single scan.
- Provides simultaneous display of both deep and shallow targets.
- Pivoting head provides better contact and thus reduces signal loss.

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The following is a list of antenna frequencies their application and maximum penetration depth.

Frequency (MHz)	Sample Applications	Max. Penetration Depth(ft.)
2600	Concrete, Roadways, Bridge Decks	1
1600	Concrete, Roadways, Bridge Decks	1.5
900	Concrete, Shallow Soil, Archaeology	3
400	Shallow Geology, Utility Locating, Environmental, Archaeology	9
200	Geology, Environmental	25
100	Geology, Environmental	60

***The higher the frequency, the less depth that can be detected**



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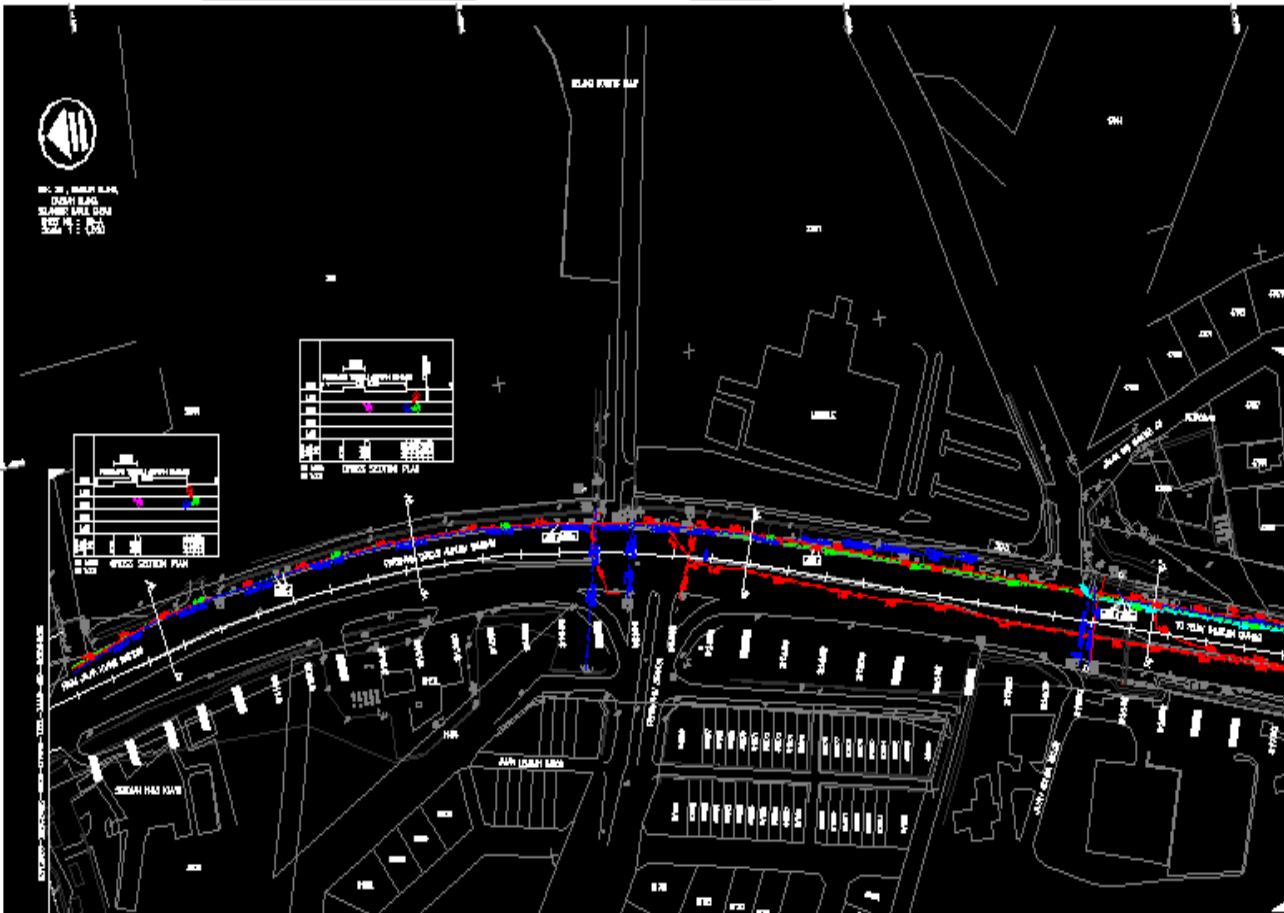
The table shows the accuracy of the equipments used.

Equipment / Utility	Accuracy
Radio detection RD Series	Horizontal Position \pm 200mm Depth \pm 5% of the depth reading up to a depth of 3.5 meters
Water And Sewerage Pipes	Horizontal Position \pm (200mm + 50% of pipe diameter)
Ground Penetrating Radar (GPR)	Limitations of detecting utilities less than 150mm diameter as well as with depths over 3m. Deeper penetration radar is usually used for compensating this depth limitation but this further decreases the resolution of the scan.

6.0 Softwares Used

1. AutoCAD

AutoCAD is a commercial computer-aided design and drafting software application. This software often use for completing and editing raw data.

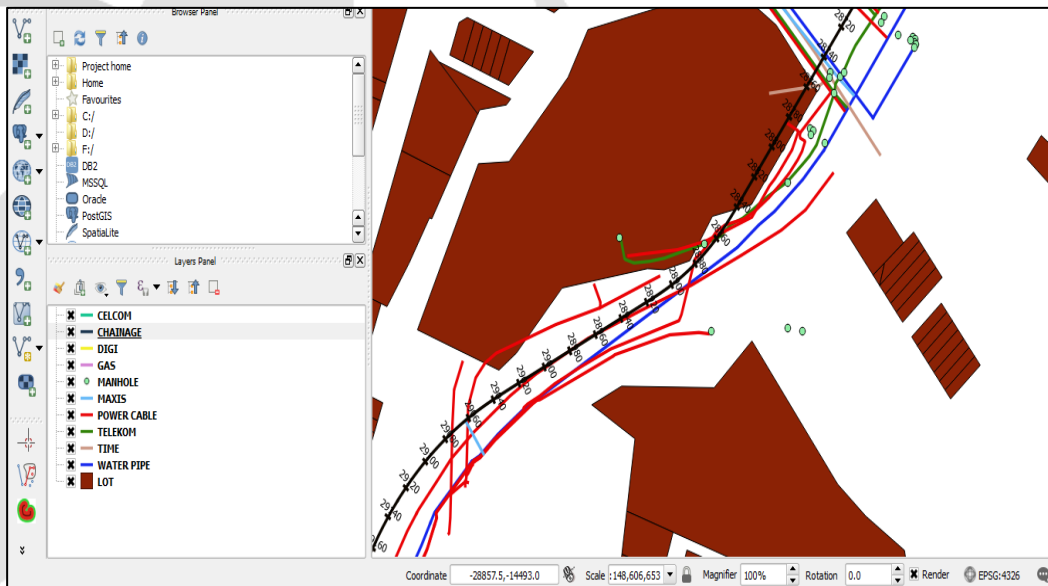


Example of utility drawing in AutoCAD software

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2. Quantum GIS (QGIS)

Designed to store, retrieve, manage, display, and analyze all types of geographic and spatial data. This software is an open source which can be download freely on the internet. It shows the data in digital format and all data such as depth, service provider and others can be saved in the database. Such data are called attributes.



Example of utility drawing in QGIS software

3. ArcGIS

It has the same function with QGIS where it can display and store geospatial data but ArcGIS is not an open source software, whereby we need to purchase its license.

*Spatial data is information that identifies the geographic location of features (e.g. where the manhole located)

*Attribute data is information appended in tabular format to spatial features (e.g. coordinate, manhole location, pipe location, service provider etc.)