

Technical Report

CJV-L06-REP-2600-0010: Water Management Plan Guidelines



outside the Gautrain rail reserve in the WMC, any activities should be checked for potential environmental authorisation / consents that may need to be obtained prior to construction.

The control of groundwater abstraction has to be applied over an area, which is likely to be much larger than the WMC as set out in Section 3.1 General Recommendations.

4. WATER MANAGEMENT APPLICATIONS

The Water Management Plan application is dealt with in two distinct areas, i.e. within the Gautrain rail reserve (where the Concessionaire is solely responsible) and outside of the Gautrain rail reserve but within the WMC (where the responsibility is shared between the Concessionaire and other stakeholders).

4.1. WITHIN THE GAUTRAIN RAIL RESERVE

The following measures are recommended to be applied by the Concessionaire within the Gautrain rail reserve:

4.1.1. Drainage

- Drains to be concrete lined with 250 µm sheeting.
- Stormwater channels to be constructed in alternate panels and joints sealed.
- Culverts and channels to be constructed at a minimum gradient of 1:100 to avoid possible ponding due to construction tolerances.
- Sub-surface drainage to be allowed in cuttings where the water table is evident. In cuttings where various types of materials are encountered and in which water bands are present, adequate sub-surface drainage is to be provided. Manholes and inspection / rodding eyes are to be provided for sub-surface drainage pipes.
- Pipe culverts to be of the spigot and socket rubber ring type.
- It is required that the concrete lining of storm water ditches is extended up to the WMC, such as in the Military Area (upstream and downstream).
- Box culvert joints to be sealed.
- Ponding to be prevented. Any feature that promotes the migration of surface water towards the Gautrain rail reserve will need to be assessed by the Concessionaire and remedial measures determined if required.
- Constructed fill and cut slopes to be top soiled and grassed to minimise erosion and slow down storm water run off.
- Stormwater pipes to be replaced with HDPE (Type PE 100, PN10) or spigot and socket rubber ring type pipes in the Gautrain rail reserve area.
- Drainage outlets to be designed to prevent erosion and promote sheet flow at the outlet.

4.1.2. Water Reticulation

- Existing water pipes to be replaced with HDPE or steel pipes and placed in HDPE sleeves or appropriate watertight containment. This is to ensure that older pipes are replaced and pressure checked to minimize any leakages.

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- Pipelines are to be designed to ensure zero leakage and shall be hydraulically tested to a pressure of 1.50 times the maximum pipe rated pressure for a minimum period of three hours.
- The sleeve systems to have designed slopes that permit drainage to predetermined inspection manholes. All manholes to be placed outside the Gautrain rail reserve to facilitate the inspections carried out by the services owners.
- Old mains are to be removed and trenches backfilled, or if not possible to be grouted and capped.

4.1.3. Sewer Reticulation

- Existing sewer pipes to be replaced with HDPE pipes and placed in HDPE sleeves or appropriate watertight containment. This is to ensure that older pipes are replaced and pressure checked to minimize and leakages.
- Pipelines are to be designed to ensure zero leakage and shall be hydraulically tested to a pressure of 1.5 times the maximum pipe rated pressure for a minimum period of three hours.
- Where HDPE sleeves are used, new HDPE water tight manholes to be constructed with minimum ring stiffness 8kN/m² and with sewer pipes welded to the manholes.
- Where precast concrete culvert sleeves are used, reinforced concrete manholes to be constructed. All access manhole rings, where utilised, to have bitumen-rubber sealant (or similar approved) between the rings.
- Old mains are to be removed and trenches backfilled, or if not possible to be grouted and capped.

4.1.4. Cable Ducts and Old Services

Dry services are to be sleeved beneath any at grade structures from the Gautrain rail reserve boundary to the Gautrain rail reserve boundary. Dry services beneath the viaducts do not need to be sleeved. All sleeves are to be watertight.

4.2. WITHIN THE WATER MANAGEMENT CORRIDOR

It is imperative to note that the measures specified in Section 4.1 above are to be implemented within the WMC too with the only exception being that the services do not need to be placed into appropriate watertight containment.

4.2.1. By The Concessionaire

During the design and construction of the GRRL, the Concessionaire has focused its attention on the Services that have a direct impact on the GRRL. To the extent that the WMC needs to be taken into consideration, the Concessionaire has undertaken a risk assessment of the Services located in the WMC.

The purpose of the risk assessment was to establish the status of the Services in the WMC. Based on the risk assessment findings a program was compiled indicating the works to be carried out as a priority, so as to prevent the risk of the formation of sinkholes and dolines.

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The remedial / replacement works and program were agreed with the CoT or relevant other wet service owners (Rand Water, Department of Public Works), as the case may be, and the Province.

As between the Concessionaire and the Province, the work undertaken by the Concessionaire within the WMC is compensated as utilities relocation and protection works in terms of relevant provisions of the Concession Agreement.

4.2.2. By Other Parties

As the land and the Services located within the WMC remain under the jurisdiction of various land and Services' owners, the Water Management Plan Guidelines should be taken into consideration by all these stakeholders to ensure that the recommended measures are implemented within the corridor. The criteria laid out in the Water Management Plan Guidelines will also be applied to future developments such as houses, businesses and complexes through the Gautrain Wayleave Manual developed by the Province in accordance with the Gauteng Transport Infrastructure Act (GTIA).

The Water Management Plan Guidelines take due considerations of the dolomite risk management system that the CoT has put in place which entails amongst others the functions of a comprehensive Audit and Risk Management System for all CoT assets and services (water bearing); Groundwater Monitoring and Extraction Control System; and Audit and Risk Management System for private property. In terms of the CoT dolomite risk management system, the CoT Water and Sanitation Division and the CoT Roads and Stormwater Division are conducting audit processes on the state and performance of services on a continual basis and are undertaking the necessary upgrade and replacement of existing services through the densification strategy and new developments.

The CoT's land development control system is dealing with all new developments, in the form of new townships or re-development within existing townships through a land-use application. Such developments are approved conditional to the compilation of an audit and implementation of a site-specific risk management plan.

According to the CoT's town planning principles, the areas along the GRRL have been delineated for higher density re-development to provide uses compatible with the GRRL as a public transport corridor. The process of re-development will present the opportunity for the CoT to ensure that these developments conform to the dolomitic standards adopted and are regularly monitored by the implementation of risk management plans.

The CoT, however, acknowledges that the execution of the risk management plans currently remains the responsibility of the private owner, Body Corporate or Managing Entity, and the feedback on the effective application of the risk management plans is provided on an ad hoc basis when private entities voluntarily provide results on the respective risk management plans.

The development of the DPW land that is referred to as the Military Area is regulated by the Appropriate Development of Infrastructure on Dolomite - Guidelines for Consultants, Department of Public Works, August 2004 as amended in June 2006 (DPW Guidelines).

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4.3. IMPLEMENTATION MATRIX

Table 4.1 below considers the implementation of the Water Management Plan Guidelines as well as the involvement of the various stakeholders which may evolve over time.

TABLE 4.1 Roles Matrix

	Gautrain rail reserve	Water Management Corridor	Comment
Development Phase Risk Assessment	N/A	The Concessionaire, Province (GMA), local authorities, Services' owners and the Council for Geoscience	The Concessionaire undertakes to carry out the risk assessment within the WMC to identify the work that is to be carried out.
Design and Construction	The Concessionaire	The Concessionaire*, Province (GMA), Services' owners and local authorities	*The Concessionaire develops the design and does the remedial / replacement works as identified during the risk assessment.
Monitoring	The Concessionaire and Services' owners	The Concessionaire and Services' owners	The Concessionaire undertakes to carry out the monitoring as stipulated in the Water Management Plan Operation and Maintenance Manual (CJV-NTH-MAN-2600-5100)
Recommendations to Services' owner	The Concessionaire	The Concessionaire, Province (GMA) and land owners	The Concessionaire will provide recommendations in accordance with the Water Management Plan Operation and Maintenance Manual (CJV-NTH-MAN-2600-5100)
Maintenance	The Concessionaire (System stormwater) and Services' owners	The Services' owners	

5. MONITORING AND MAINTENANCE

5.1. GENERAL

As set out in Sections 3 and 4 above, the Water Management Plan Guidelines recommend that all possible manmade causes of sinkholes and dolines within the Gautrain rail reserve and WMC be treated.

It is of importance to note that potentially the most dangerous situations in dolomitic areas could be created during the construction phase. Typical problem areas are trenches and excavations, left open for the installation phase, filling up with storm water during sudden high rainfall events (>20mm). Mitigation measures should be developed and applied during construction (such as immediate drainage of surplus water; executing, as far as possible, the excavations, installation and backfilling phases in one continuous operation; and construction of storm water berms where necessary).

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The dolomitic area is actually already porous below ground in places, due to the ongoing dissolution of dolomites, and that leaking water could wash ground particles down into these cavities, thereby causing sinkholes to form on the surface in a relative short time.

Monitoring and maintenance recommendations to ensure that any water leaks and groundwater table variations are detected and attended to in a relatively short time period have been developed as part of the Gautrain operation and maintenance manuals (refer to CJV-NTH-MAN-2600-5100 Dolomite Area Water Management Plan – Operations and Maintenance Manual).

5.2. MONITORING OF GROUND WATER ABSTRACTION

The groundwater abstraction in the Centurion area is under jurisdiction of and managed by the CoT which has put in place the CoT Groundwater Monitoring and Extraction Control System.

The groundwater abstraction for Municipal purposes within the CoT's area of jurisdiction is taking place at the Rietvlei Nature Reserve (RNR), (Kentron) Highveld, Valhalla and at Fountains (natural spring discharge). The CoT has been undertaking various groundwater vulnerability assessment studies of the water sources over the years which indicated that no significant water drops have occurred and that simulated water levels generally remained within 3-4m of the static water level. Also, the CoT groundwater protection measures have been adhered to by them and include reducing the abstraction rates at the RNR and decommissioning (in early 2010) of the two Kentron boreholes (ZP 13 and ZP 16) situated within the WMC.

During the design and construction of the GRRL, the Concessionaire has undertaken relevant hydrogeological investigations (including but not limited to 600 boreholes drilled in and adjacent to the GRRL) that resulted in the Hydrogeological Impact Study for Gautrain Rapid Rail Link, ARUP, February 2009 (reference CJV-NTH-REP-2600-1608).

Furthermore, the Concessionaire has installed 15 piezometers along the GRRL within the Gautrain rail reserve for the purpose of monitoring ground water variations (refer to CJV-NTH-MAN-2600-5100 Dolomite Area Water Management Plan – Operations and Maintenance Manual).

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ANNEXURE A - DRAINAGE CORRIDOR CONSIDERATIONS

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Drainage Corridor Considerations

a) General

1. Best practice drainage measurements required over the life of the project.
2. No ponding of surface water is to occur.
3. All wet services are to remain completely sealed against leakage for the duration of the project.
4. Maintenance monitoring in reserve, and partnership with services owners outside corridor, is a key issue.
5. Width of corridor for maintenance management is dependant on:
 - sensitivity of geology to ingress of water
 - potential for traumatization to encroach on rail infrastructure.
 - potential for traumatization to activate larger ground subsidence features

Items 4 and 5 are discussed in more detail below.

b) Maintenance monitoring partnerships

It is appreciated that the Concessionaire has no or only limited jurisdiction on what happens to drainage control and wet services management beyond the rail reserve. Because owners/operators outside the reserve can potentially impact on the Gautrain if they do not maintain the highest possible standards, Bombela needs to institute action that will safeguard the Gautrain against possible negligent or ignorant action from neighbours or owners of servitudes crossing the route.

If there is confidence that the party that can potentially impact on the Gautrain will act responsibly, the need to engage with such a party diminishes. Where confidence is low, Bombela needs to institute pro-active measures. This means physically taking control of monitoring and maintenance management or, less directly, by meeting with such parties to satisfy Bombela that the work is done properly.

c) Corridor width

- i) Sensitivity of the geology to ingress water. Studies and reports submitted to Bombela have highlighted the heterogeneity of the dolomite. Geological conditions vary over short distances and it is only with intensive geological mapping during construction that less sensitive areas can be isolated. These are likely to be associated with syenite intrusives, which occur largely in the Ecopark and Danie Joubert sections of the route, with some at Jean Avenue.

There is insufficient confidence on the lateral variability in the geology to indicate at this stage where corridor width can be relaxed due to stable geological conditions and in any case the syenite sections are limited in extent.

- ii) Potential for traumatization to encroach on rail reserve is a function of the depth to bedrock and the properties of the overburden. The size of sinkhole/subsidence feature is related to the bedrock. It is suggested that the corridor width is taken as twice the depth to bedrock. If bedrock dolomite is at say 60 metres, the corridor width will then be 120 metres to both sides.

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A minimum corridor of 50 metres wider than the rail reserve should always apply, which will apply to areas of shallow dolomite bedrock.

- iii) Potential for traumatization to activate larger ground subsidence features relates to the extent of the potential wetting front and the volume of ingress water. A large volume of water gaining access to the subsurface over a wide area can cause the subsidence feature and satellite sinkholes that affect areas 150 to 200 metres in diameter as can be seen on the ridge near Eeufees Road.

Where major fluid carrying services such as bulk water lines occur within 200 metres of the Gautrain route, these must form part of the monitoring and maintenance management strategy. Where they cross the route a double pipe system should be used.

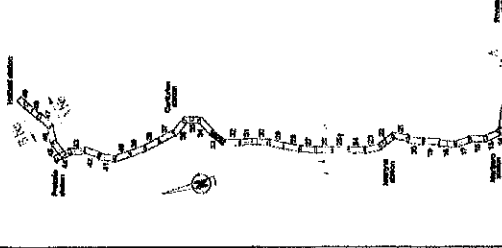
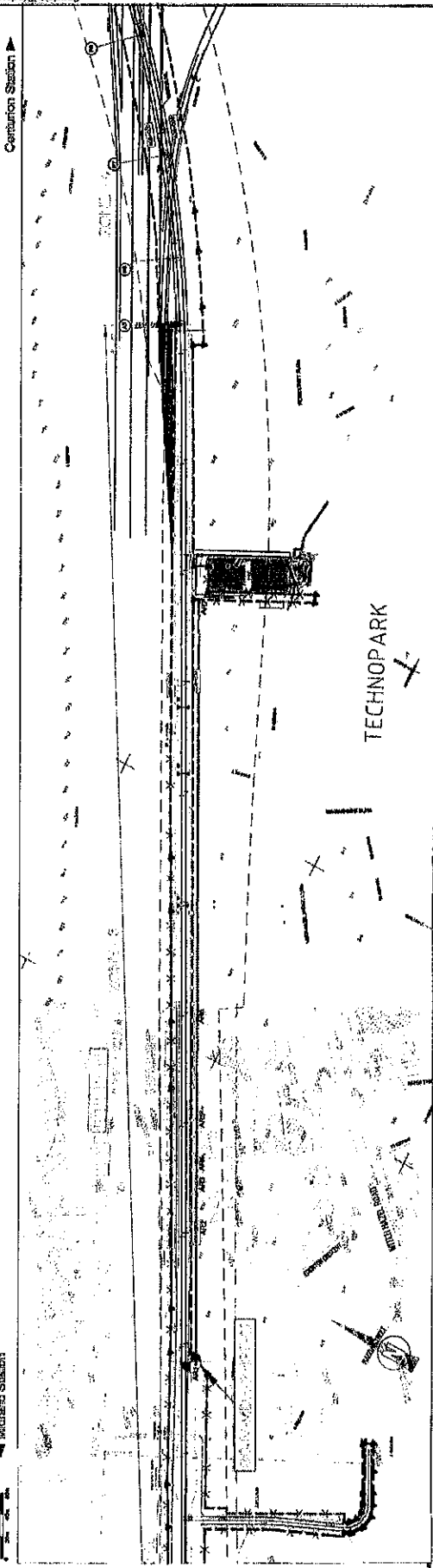
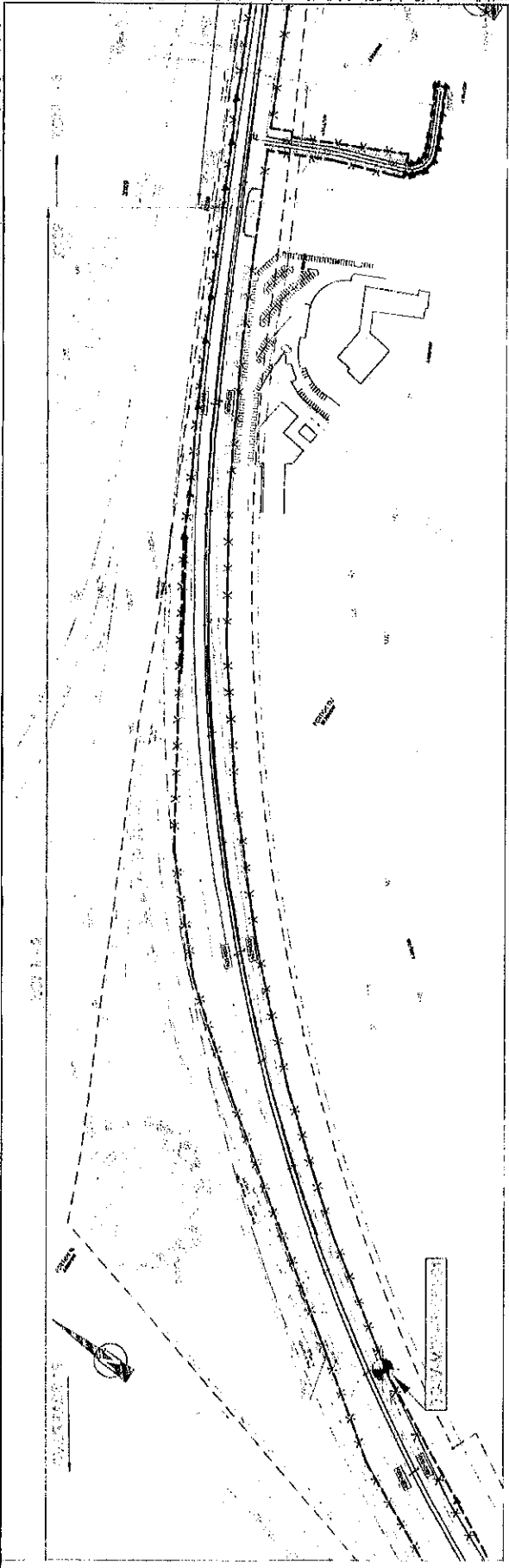
Larger areas of potential water ingress are known to exist in the Snake Valley flats area to the south of the Air Force Base. Older dams, areas of extensive stormwater accumulation and vlei and low gradient areas are suspect from a ground water ingress point of view and warrant wider corridors.

- iv) The piece of land between the Ben Schoeman and the Gautrain in the military area should be included in the corridor. In this area there is no need for the corridor to stretch beyond the highway.
- v) Releases from drains on the highways should receive particular attention. Such water is to be gathered and transferred via lined channels to where it can be safely released into existing natural drainage channels, the integrity of which must be checked by inspection/testing.

General

It is envisaged that Maintenance Monitoring Partnerships will be promoted into with the Tshwane Local Authority, Department of Public Works, Department of Transport, Rand Water Board, Petronet and other organizations that may affect Gautrain by way of their services. Together with the surveillance strategy and a maintenance schedule will have to be developed for implementation and regular revision. A specific strategy needs to be developed on how individual houses, businesses and complexes are addressed, as the water control measures of these may not fall under the control of the Local Authority, but be vested in a Body Corporate.

ANNEXURE B – WATER MANAGEMENT CORRIDOR DRAWINGS



LEGEND

—	12" - 150' DIA. PIPE
- - -	12" - 150' DIA. PIPE (PROPOSED)
---	12" - 150' DIA. PIPE (EXISTING)
---	12" - 150' DIA. PIPE (PROPOSED)
---	12" - 150' DIA. PIPE (EXISTING)
---	12" - 150' DIA. PIPE (PROPOSED)
---	12" - 150' DIA. PIPE (EXISTING)

NOTE:
 For detail drawings of all manholes & drainage structures refer to CIV-NTH-2800-5100-5100

FOR INFORMATION

DESIGN PACKAGES
 WATER MANAGEMENT ZONE DISTRIBUTION

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Scale: 1"=1000'

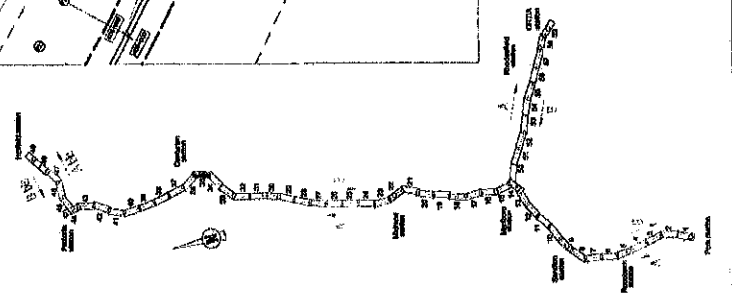
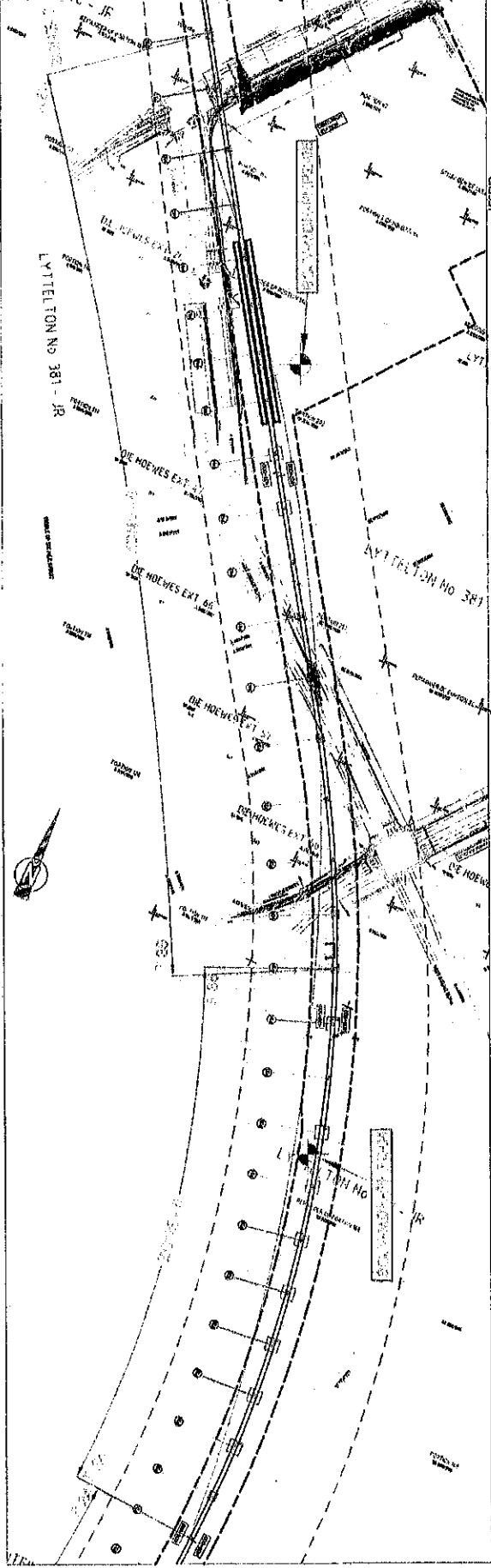
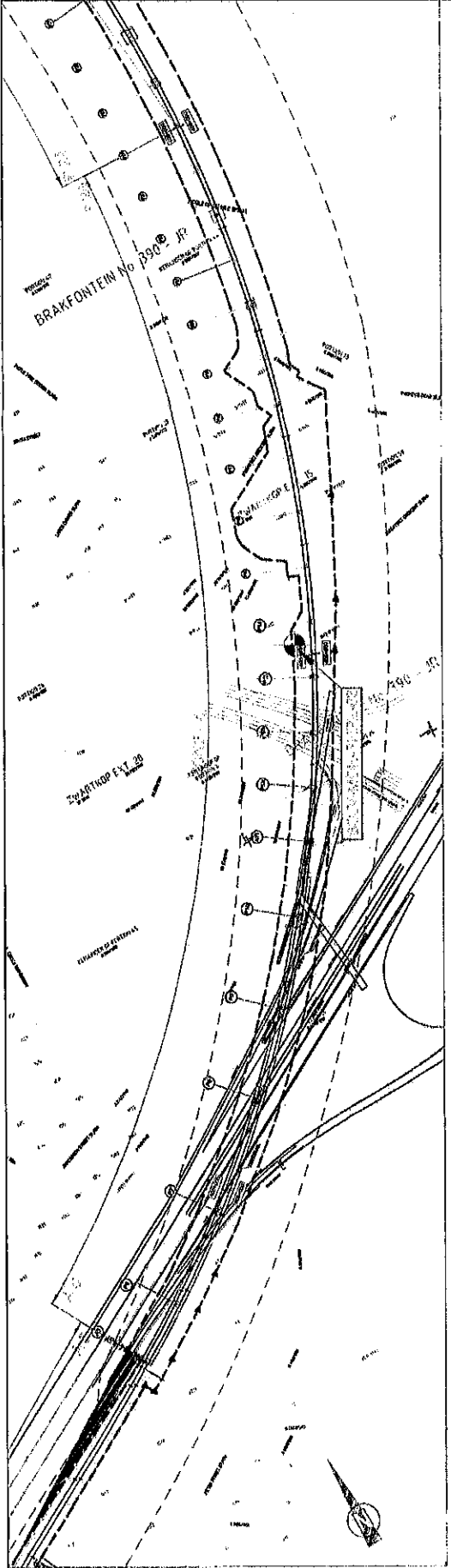
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LEGEND

- VALVE
- HYDRANT
- WATER MAIN
- WATER MAIN
- WATER MAIN

NOTE:
 For detail drawings of all services & drainage structures
 SEE 'B' DRAWING

FOR INFORMATION

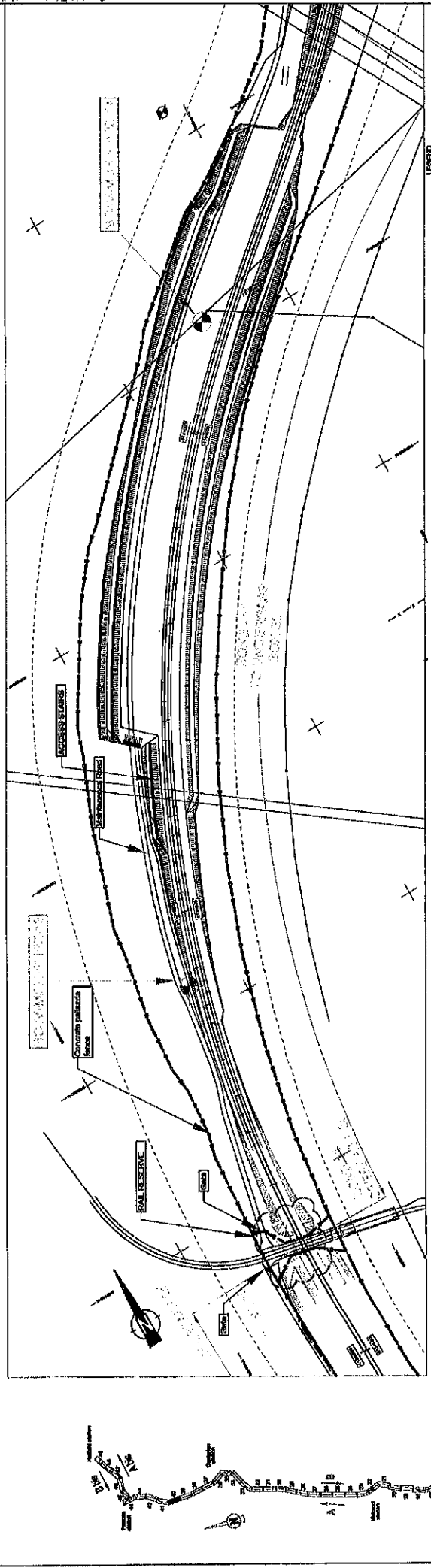
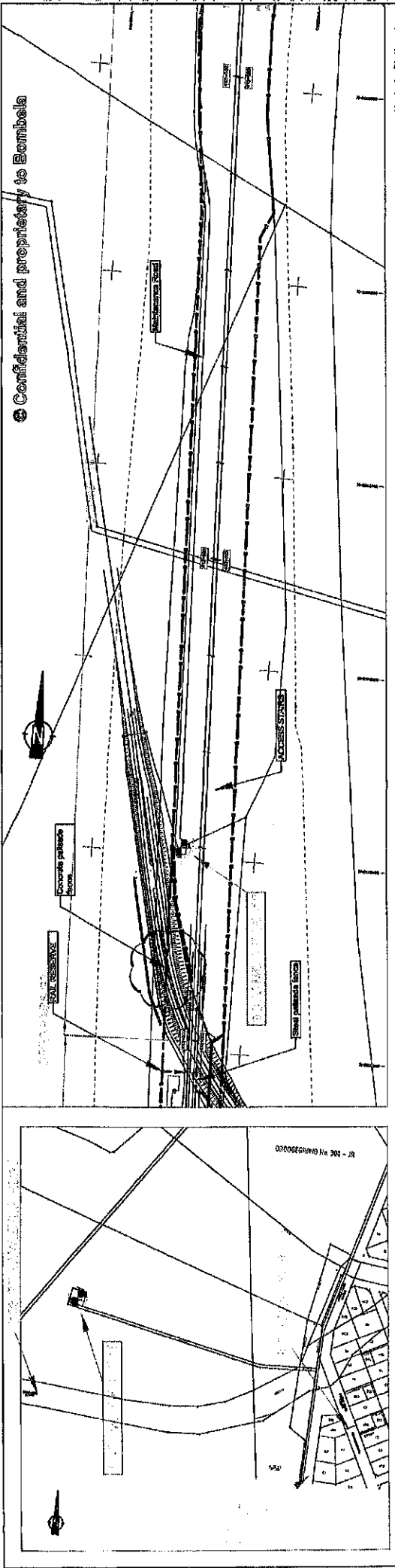
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WATER MAINS ZONE DISTRIBUTION

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Logos: GALTRAIN, MWH, and others.

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LEGEND

(Symbol)	CONCRETE RESERVE
(Symbol)	STEEL RESERVE
(Symbol)	CONCRETE PRESSURE TANK
(Symbol)	STEEL PRESSURE TANK
(Symbol)	ACCESS STAIRS
(Symbol)	SAIL RESERVE

NOTE:
 * Refer to drawings of all new lines & change structure
 LEGEND CIV-NTI-44-2020-5106

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Project No: CIV-NTI-44-2020-5106	Drawing No: DWG-2650-5106-D1
Author: [Name] Checker: [Name] Designer: [Name] Engineer: [Name]	Approved: [Signature] Date: [Date]

