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جامعة أكلي محند أولحاج
- البويرة -
معهد التكنولوجيا

**Department of Water Engineering**

**Defense Report**

Towards obtaining the Master's degree in:

**Hydraulics**

**Subject:**

# Study of the drinking water transfer from the Tichy-Haf dam to provinces: Bejaia, Setif and Bourdj Bou Arreridj, Algeria


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**Academic Year: 2023-2024**

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I also take this opportunity to thank Mr. DAHMANI Saad for the honor of being my supervisor. I am very grateful for his assistance, his listening ear, as well as for his advice and the time he devoted to my project.

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I extend my sincere thanks to the members of the jury who honored me by examining this work.

Finally, I thank all the individuals who have provided me with their support and encouragement, whether directly or indirectly, to successfully complete this work.

## *Dedication*

I dedicate this modest work:

To my father, my source of motivation, who has constantly supported and encouraged me throughout my academic journey;

To my mother, my reason for living, for her love, attention, moral support, and prayers;

To my dear sister and my dear brother;

To my dear and faithful friends;

To the entire hydraulic engineering class of 2019-2020.

**ملخص**

الهدف من هذه المذكرة هو تصميم شبكة الامداد لمياه الشرب من سد تيشي- حاف، الواقع بولاية بجاية، الى خمسة عشر (15) بلدية تابعة اداريا للولايات التالية: بجاية وبرج بوعريريج و سطيف . في هذا السياق، قمنا بتقديرعدد السكان المتوقعين بحلول عام 2060، ثم حساب معدل التدفق اليومي الأقصى. بعد ذلك، أجرينا دراسة هيدروليكية لتحديد حجم أنابيب الامداد، سواء بالجاذبية أو بالضخ، ثم اخترنا المضخات لثمانية محطات وأخيرًا، قمنا بتحجيم الخزانات لكل بلدية

**كلمات مفتاحية**: لأنابيب، الضخ، ،سد، محطة الضخ، خزان.

**Résumé:**

L'objectif de ce mémoire est de concevoir un réseau d'approvisionnement en eau potable depuis le barrage de Tichy-Haf, situé dans la wilaya de Béjaïa, vers quinze (15) communes relevant administrativement des wilayas de Béjaïa et de Bordj Bou Arréridj et Sétif. Dans ce contexte, nous avons estimé la population prévue d'ici à 2060, puis calculé le débit quotidien maximum. Ensuite, nous avons réalisé une étude hydraulique pour déterminer les dimensions des conduites d'approvisionnement, qu'elles soient par gravité ou par pompage, et avons choisi Epanet pour les pompes de huit stations. Enfin, nous avons dimensionné les réservoirs pour chaque commune.

**Mots-clés:** conduites, pompage, station de pompage, réservoir, coup de bélier, barrage.

**Abstract:**

The aim of this thesis is to design a drinking water supply network from the Tichy-Haf dam, located in the province of Béjaïa, to fifteen (15) municipalities under the administrative jurisdiction of the provinces of Béjaïa and Bordj Bou Arréridj and Setif. In this context, we estimated the expected population by 2060 and calculated the maximum daily flow rate which equal 60000 $m^3$/day. Subsequently, we conducted a hydraulic study to determine the pipe sizes for both gravity and pumped systems, selecting for pumps at eight stations. Finally, we sized the reservoirs for each municipality.

**Keywords:** pipes, pumping, pumping station, reservoir, water hammer, dam.

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## List of abbreviations

D: Diameter (m).

ND: Nominal Diameter (m).

NP: Nominal pressure (bar).

$\Delta H$: Head loss in (m).

$NGR_{UP}$: Upstream Natural ground level in (m).

$NGR_{DW}$: Downstream Natural ground level in (m).

$\lambda$:Darcy fraction coefficient.

g: acceleration due to gravity (9.81 m/s²).

$D_{inn}$ is pipe inner diameter (m).

Hg: geometric head (m).

$NPSH_d$ : Net Positive Suction Head (in, meter water column 'mwc').

$NPSH_r$: Net Positive Suction Head (in mwc).

Patm: atmospheric pressure in meters of head (mwc).

B: Maximum value of water hammer (m).

a: Wave velocity (m/s).

TDH: Total Dynamic Head (m).

CMC: Charging chambre (Chambre d Mise en Charge).

PS: Pumped Station.

# *Introduction*

# Introduction

Hydraulics studies the movements and characteristics of water, closely linked to the transfer of drinking water by conveyance, which transports this resource from sources to communities. Among these sources are dams. The transfer from dams to communities is crucial to ensure a safe and stable water supply. Dams store freshwater and regulate it to maintain a constant supply. Once captured, water is conveyed to urban and rural centers via sophisticated networks, ensuring continuous access to this vital resource.

Unfortunately, there are still areas or municipalities suffering from water scarcity nowadays. This situation is often attributed to rapid population growth in many regions. In Algeria, some areas are particularly affected, such as the provinces of Bordj Bou Arreridj, Sétif, and Béjaïa, where several municipalities face difficulties related to water supply.

As part of my professional master's program at the Institute of Applied Sciences and Techniques (ISTA-Bouira), I completed a four-month internship at AMENHYD company. During this internship, I have chosen to conduct a study aiming to transport water from the Tichy-Haf dam (Bejaia province) to the provinces of Béjaia and Bordj Bou Arreridj, Setif.

This study focuses on the following parts to achieve the given objective:

- ✔ Internship Host Company;
- ✔ Project presentation and study area;
- ✔ Assessment of water needs;
- ✔ Study of the water supply network;
- ✔ Selection of pumps for pumping stations;
- ✔ Sizing of reservoirs;

This work was finally closed by a conclusion.

# Chapter I

## Internship Host Company

## I.1 Introduction

At the end of each training cycle at the Institute of Technology (IT. Bouira), each student must complete a final project simultaneously with an internship that lasts approximately four months. The purpose of this project is to:

- Enhance the knowledge acquired during the training cycles;
- Integrate into the world of work (the professional environment);
- Understanding the duties and responsibilities of a hydraulic engineer.

As a result, I am required to exert possible effort, make observations, and remarks in order to present this work. For this reason, I had chosen **AMENHYD** company to pass the internship and carry out my final study project.

## I.2 History of AMENHYD company

AMENHYD a contraction of the words **"Aménagement, Environnement, Hydraulique"** is a leader in environmental-related professions for 25 years. It is a private Algerian company that designs solutions for water, environment, construction, deconstruction, and engineering.

The company began its activities in the field of construction and public works in 1994 under the name **"ETB/TCE Chelghoum Djamel Eddine"**. The AMENHYD group was founded in 2003 to meet the needs of the Algerian market [01].

## I.3 Presentation of the AMENHYD company

AMENHYD company includes 2300 employees, 3030 physical units, 12 billion DZD average business and 3.654 billion DZD share capital.

**General information about AMENHYD company**

Nature: Secondary establishment (Agency)

Year of establishment: 2003

Legal form: SPA

Capital: 3.654.724.000 DZD (Algerian Dinar)

Registration No: 03B0021465

Company staff: 1.000 to 4.999 employees

Kompass ID: DZ019124

Head Office: Lotissement Boushaki F. Lot No. 28 BP 21. Cité Djorf 1 6024 Bab Ezzouar

Number phone: +213 23 83 21 20

Fax: +213 23 83 29 28

Email: http://www.amenhyd.com

***Figure I.1: Logo of AMENHYD company***

### I.3.1 The AMENHYD Vision

To be the most efficient and significant company in environmental protection in Africa by 2030 [01].

### I.3.2 The mission of AMENHYD

To enhance water resources and protect the environment through reliable, Innovative, and digital solutions, facilitated by [01]:

- A high-performing team;
- Strong partnerships;
- Optimal processes.

### I.3.3 The subsidiaries of the AMENHYD

The subsidiaries of the AMENHYD group are primarily composed of the following [01]:

***AMENHYD*** **'HYDRAULIC ENVIRONMENTAL DEVELOPMENT'**: Specializes in water, waste, and civil and industrial construction and demolition.

***ALCAHYD*** **'ALGERIAN HYDRAULIC PIPEWORK'**: Prefabrication of reinforced concrete elements and hydraulic pipelines.

***GATECH*** **Electrical engineering automation control**.

***International Process***: Manufactures process and mechanical equipment.

***BIMECA***: An engineering office dedicated to mechanical equipment studies.

### I.3.4 The services and activities of AMENHYD

- ✔ System design studies;
- ✔ Installation and commissioning services;
- ✔ Repair and maintenance of facilities;
- ✔ Rehabilitation of stations;
- ✔ Operation of treatment plants;
- ✔ Training and technical assistance;
- ✔ Monitoring and supervision.

## I.4 The geographic location of AMENHYD

It is located in the Rabia Tahar neighborhood of the Bab Ezzouar municipality, in Algiers.

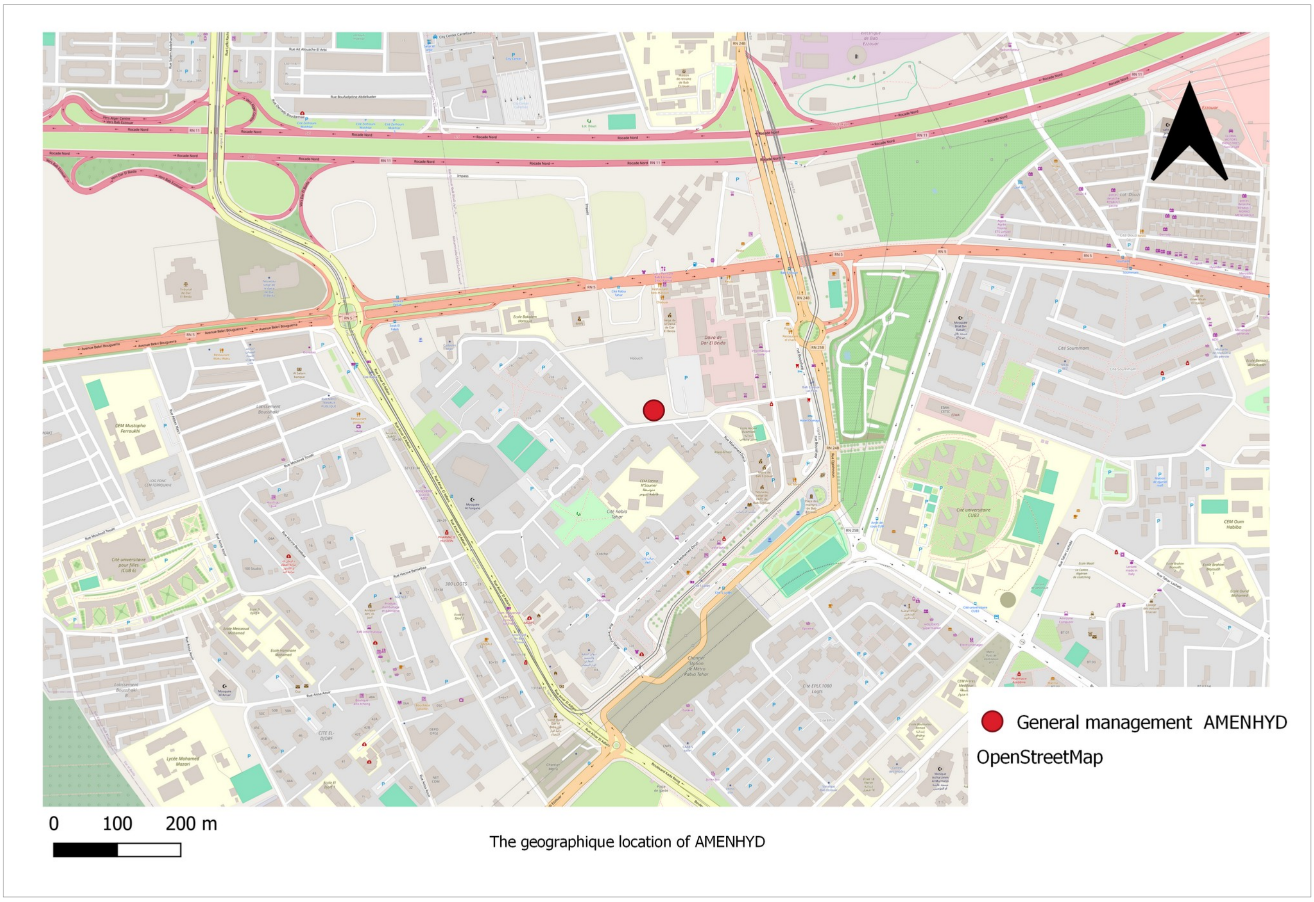
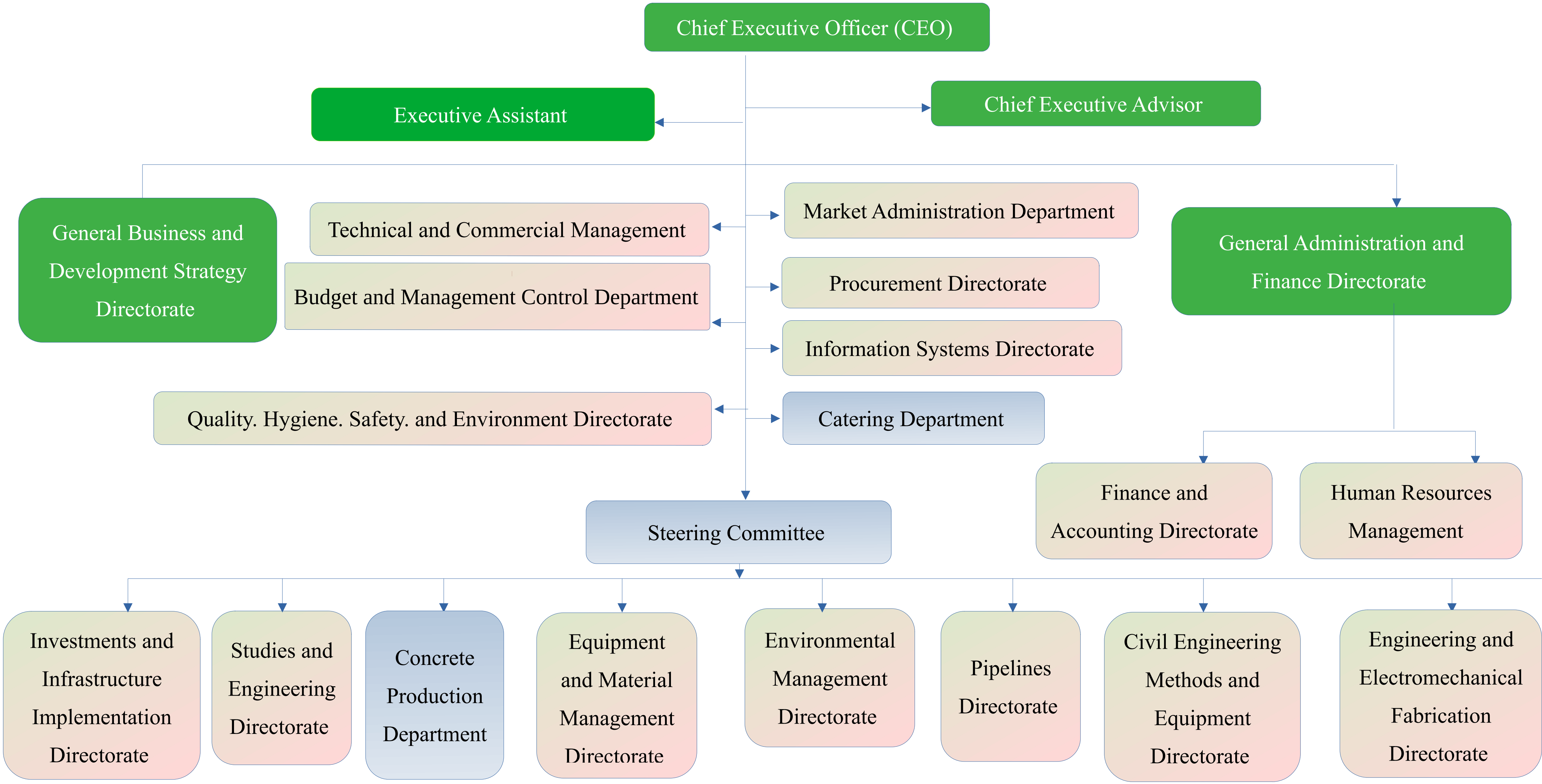
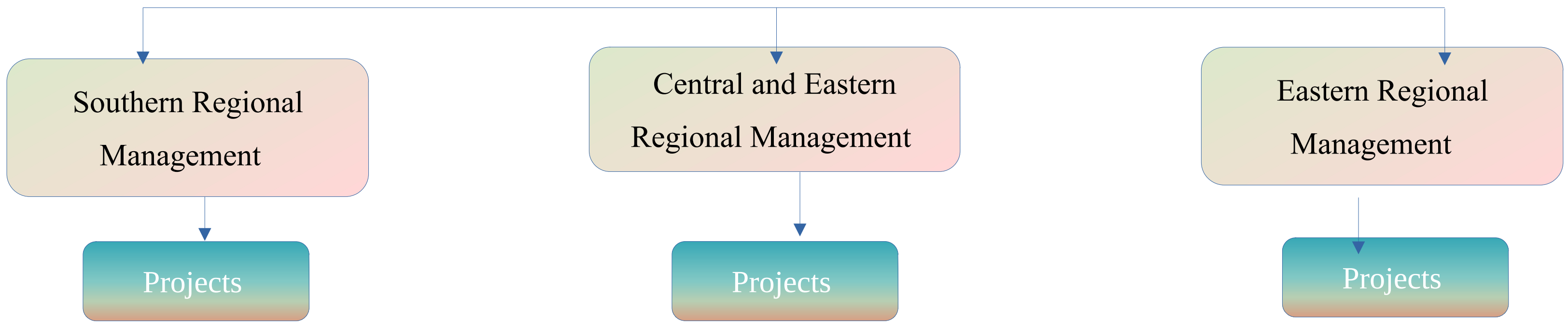



***Figure I.2: The geographic location of AMENHYD company***

## I.5 The organizational chart of the company

The organization of AMENHYD-SPA is summarized in the following organizational chart [01]:


Chief Executive Officer (CEO)
Executive Assistant
Chief Executive Advisor
General Business and Development Strategy Directorate
Technical and Commercial Management
Budget and Management Control Department
Market Administration Department
Procurement Directorate
Information Systems Directorate
General Administration and Finance Directorate
Quality. Hygiene. Safety. and Environment Directorate
Catering Department
Finance and Accounting Directorate
Human Resources Management
Steering Committee
Investments and Infrastructure Implementation Directorate
Studies and Engineering Directorate
Concrete Production Department
Equipment and Material Management Directorate
Environmental Management Directorate
Pipelines Directorate
Civil Engineering Methods and Equipment Directorate
Engineering and Electromechanical Fabrication Directorate




***Drawing I.1: Organizational chart of the company AMENHYD***

## I.6 Some projects carried out by the company

Water treatment[01]:

- Berriane Treatment Plant (Ghardaïa Province), in 2013;
- Guerrara Treatment Plant (Ghardaïa Province), in 2014.

Demineralization plants [01]:

- Touggourt Treatment Plant (Ouargla Province) (production capacity of 34.000 m3/day);
- Meghayer Treatment Plant (El Oued Province) (production capacity of 12.000 m3/day).

Wastewater treatment plants (WWTP) by lagoon treatment [01]:

- Tamanrasset WWTP, Ghardaïa WWTP, Beni Messous WWTP (Algiers Province);

Sanitation [01]:

- Development works of Oued Ouchayah (Algiers Province), in 2016;
- Beni Messous Monolith Collector (Algiers Province), in 2015;
- Sanitation of the Mzab Valley (Ghardaïa), in 2012.

## I.7 Conclusion

In conclusion, this chapter was conducted to discover the key aspects of the company AMENHYD. We have learned about its history, structure, objectives, and the values it upholds. Additionally, we have also explored professional skills such as teamwork, time management, and communication, which are important in this context.

In the next chapter, we will discuss the project presentation and the study area of this project.

# Chapter II

## Study Area and Project Presentation

## II.1 Introduction

Before implementing this project, studying the study area is necessary. This process enables us to understand the various factors that influence its design. In this chapter, we will focus on presenting the study area and its characteristics, as well as presenting the studied project.

## II.2 The project's objective

The objective of the project is providing potable water from the Tichy-Haf dam to the study area covering a total of 14 municipalities, distributed between Setif and Bordj Bou Arreridj provinces, as well as one municipality from the wilaya of Bejaïa, for the horizon of 2060.

## II.3 Project description

Providing potable water from the Tichy-Haf dam, with a capacity of 80 million cubic meters, to a study area encompassing a total of 14 municipalities distributed between the provinces of Setif and Bordj Bou Arreridj. These municipalities are situated at the western extremities of Setif province and the northwest of Bordj Bou Arreridj province, along with one municipality from Bejaïa province. This project is currently under construction.

- ✔ In Setif province: Beni Ourtilene, Beni Chebana, Ain Lagredj, Beni Mohli, Guenzet, and Harbil;
- ✔ In Bordj Bou Arreridj province: Djafraa, Teffreg, Colla, El Main, Tassamert, Ouled Dahmane, Bordj Zemmoura, and Theniet Enaser;
- ✔ In Bejaïa province: Bouhamza.

**The project will be divided into three lots:**

- ➔ **Lot number 01:** from Tichy-Haf dam to the new treatment station with a capacity of 60000 $m^3$/day (located near the Tichy-Haf dam);

- ➔ **Lot number 02:** includes 5 municipalities (Djafraa, Teffreg, Colla, El Main, Theniet Enaser), and the municipality of Bouhamza (Bejaia province) in addition. The later municipality was added to the project in 2024;
- ➔ **Lot number 03:** contains 9 municipalities, which are: Beni Ourtilene, Beni Chebana, Ain Lagredj, Beni Mohli, Guenzet, and Harbil, Tassamert, Ouled Dahmane, Bordj Zemmoura.

**Remark:**

The part of the transfer project concerned by the present study will be limited only to the lot number 2, which includes the following municipalities from the province of Bordj Bou Arreridj: Djafraa, Teffreg, Colla, El Main, and Theniet Enaser, as well as the municipality of Bouhamza from the province of Bejaïa.

## II.4 Tichy-Haf dam

The Tichy-Haf dam, located in the village of Mahfouda, Bouhamza municipality, in the province of Bejaïa, is a gravity-arch dam standing at a height of 90 meters and with a capacity of 80 million cubic meters. It is fed by the Bousellam river. This dam primarily serves for irrigation purposes in the agricultural areas of Sahel and Hight Soummam, as well as for supplying drinking and industrial water to the municipalities along the Akbou-Bejaïa corridor, in addition to flood control of the Bousellam river [02].

***Figure II.1: Tichi Haf Dam [02]***

## II.4.1 The geographical location of the Tichy-Haf dam

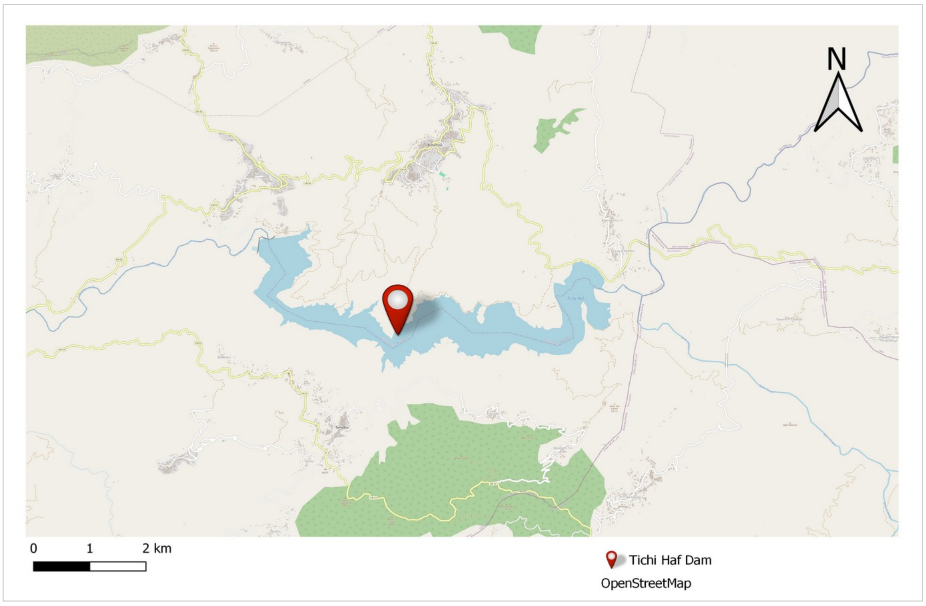



***Figure II.2: Geographical location of the Tichy-Haf dam***

## II.5 Geographical location of the study area

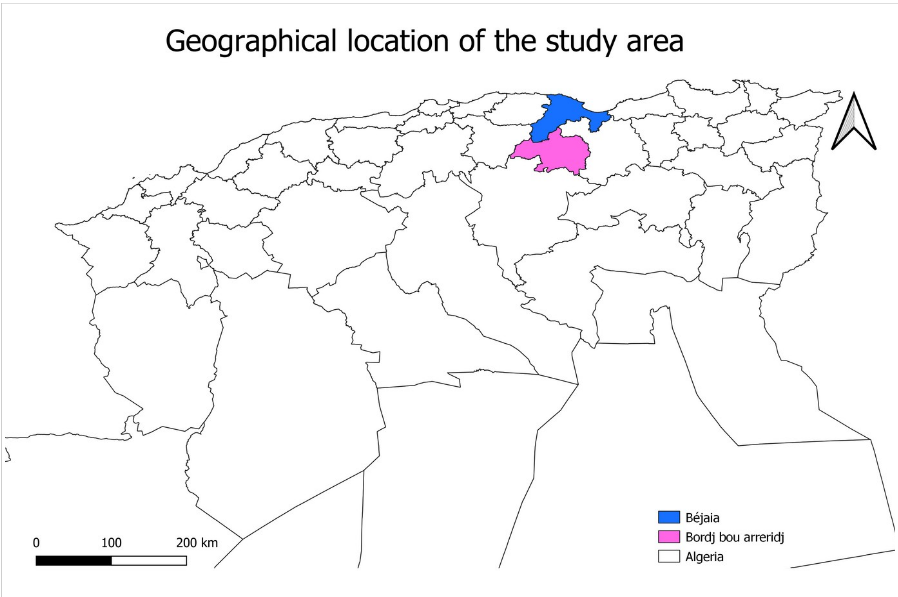



***Figure II.3: Geographical location of the study area***


***Figure II.4: Geographical location of the study area***

## II.6 General description of the study area

### II.6.1 Climate

The climate in the study area varies; in the north, it is semi-Mediterranean, while in the southwest, it is semi-arid. Summers are hot and dry, and winters are extremely cold. Rainfall is scarce and irregular in both time and location; in the Babor Mountains, precipitation averages 700 mm/year, while in the southwest, it does not exceed 300 mm. Snowfall occurs in winter in all mountains with altitudes exceeding 800 meters [02].

### II.6.2 Temperature and humidity

The temperatures are low in winter and high in summer. Moreover, the mediocre atmospheric humidity further extends the dry season [02].

### II.6.3 Winds

The winds are influenced by the mountainous topography and regional meteorological conditions. Typically, the main winds come from the west and northwest, but they can change in strength and direction depending on the season. During winter, cold and wet winds may come from the north, bringing rain or snow, especially in the mountains. In summer, hot and dry winds from the south are common, leading to hot and dry weather [02].

### II.6.4 Vegetation

The vegetation in the region of the Oued Bousellam its tributaries in the Kabylie of Akbou is diverse due to the various climates and terrains. Forests, meadows, and cultivated areas can be found there.

Forests are mainly composed of oaks, pines, and cedars, which are abundant in mountainous areas and provide important habitats for many animal and plant species.

Meadows and cultivated lands are typically located in valleys and alluvial plains, where agriculture is practiced to grow cereals, olives, fruits, and vegetables [02].

## II.7 Conclusion

In this chapter, a general overview of the project that we will be studying was provided. Additionally, the study area was presented, explaining its geographical location and characteristics.

The purpose of this study is to provide potable water from the Tichy-Haf dam to the new treatment station, and then to Lot Number 02, which concerns six (06) municipalities.

In the next chapter, assessment of water needs for all municipalities, projected up to the year 2060, will be discussed.

# *Chapter III*

## *Assessment of water needs*

## III.1 Introduction

A potable water supply network is a series of infrastructures designed to provide drinking water to a community to meet human, industrial, and public needs. Before beginning the design of pipelines and others structures, it is essential to assess the needed water flow rates.

In this chapter, we will evaluate population and water needs of each municipality in the three provinces (Bejaia, Bordj Bou Arreridj, Setif) for the future horizon (2060).

## III.2 Estimation of water needs

Distribution system must meet the needs (public, domestic, industrial) of its users. But in this study, detailed data about public and industrial needs for the considered horizon (2060) are not available. Therefore, only domestic water needs are evaluated, while the water needs for the other categories are obtained from the AMENHYD company.

### III.2.1 Population Assessment

Determining domestic water needs requires estimating the population within the study horizon n. This number of inhabitants can be calculated for future horizons using the compound interest law provided by the following formula [03]:

$$P_n = P_0(1+\tau)^n \qquad \text{(III.1)}$$

with:

- $Pn$: Population within the study horizon $n$;
- $P_0$: Current population (inhabitants);
- $n$: Number of years between the considered horizon;
- $\tau$: Average annual population growth rate. For more details, refer to annex number 01.

The results of calculation are presented in the following table:

*Table III.1: Population evolution and projection*

| Province | Municipality | Agglomerated population 2008 | Annual Population Change (%) | Agglomerated population (projection 2020) | Agglomerated population (projection 2024) | Agglomerated population (projection 2030) | Agglomerated population (projection 2040) | Agglomerated population (projection 2050) | Agglomerated population (projection 2054) | Agglomerated population (projection 2060) |
|---|---|---|---|---|---|---|---|---|---|---|
| Bordj Bou-Arreridj | Colla | 6123 | 1.3 | 7150 | 7529 | 8135 | 9257 | 10533 | 11092 | 11985 |
| | Djaafra | 7998 | 1.3 | 9339 | 9834 | 10626 | 12092 | 13759 | 14488 | 15656 |
| | El main | 6237 | 1.3 | 7283 | 7669 | 8287 | 9429 | 10729 | 11298 | 12209 |
| | Taffreg | 2164 | 1.3 | 2527 | 2660 | 2875 | 3272 | 3723 | 3920 | 4236 |
| | Ouled Dehmane | 16501 | 1.3 | 19267 | 20289 | 21924 | 24947 | 28386 | 29891 | 322100 |
| | Thassameurt | 4134 | 1.3 | 4827 | 5083 | 5493 | 6250 | 7112 | 7489 | 8092 |
| | Bordj Zemmoura | 10296 | 1.3 | 12022 | 12660 | 13680 | 15566 | 17712 | 18651 | 20154 |
| | Theniet Annesr | 5775 | 1.3 | 6743 | 7101 | 7673 | 8731 | 9935 | 10461 | 11304 |
| Setif | Ain Legredj | 14668 | 1.3 | 17127 | 18035 | 19489 | 22175 | 25233 | 26571 | 28712 |
| | Béni Chébana | 13174 | 1.3 | 153823 | 16198 | 17504 | 19916 | 22662 | 23864 | 25787 |
| | Béni Mohli | 8521 | 1.3 | 9949 | 10477 | 11321 | 12882 | 14658 | 15436 | 16679 |
| | Béni Ourtilane | 10591 | 1.3 | 12366 | 13022 | 14072 | 16011 | 18219 | 19185 | 20731 |
| | Harbil | 3675 | 1.3 | 4291 | 4519 | 4883 | 5555 | 6322 | 6657 | 7194 |
| | Guenzet | 3541 | 1.3 | 4135 | 4354 | 4703 | 5353 | 6091 | 6415 | 6931 |
| **Bejaia** | Bouhamza | 9123 | 0.64 | 9849 | 10103 | 10498 | 11189 | 11926 | 12235 | 12712 |

*Table III.2: Sparse population (projection)*

| Province | Municipality | Sparse population projection 2050 | Annual Population Change (%) | Sparse population projection 2054 | Sparse population projection 2060 |
|---|---|---|---|---|---|
| **Bordj Bou-Arreridj** | Colla | 715 | 1.3 | 753 | 814 |
| | Djaafra | 1535 | 1.3 | 1616 | 1747 |
| | El main | 796 | 1.3 | 838 | 906 |
| | Taffreg | 498 | 1.3 | 524 | 567 |
| | Ouled Dehmane | 2908 | 1.3 | 30622 | 3309 |
| | Thassameurt | 1021 | 1.3 | 1075 | 1162 |
| | Bordj Zemmoura | 1552 | 1.3 | 1634 | 1766 |
| | Theniet Annesr | 3158 | 1.3 | 3325 | 3593 |
| **Setif** | Ain Legredj | 2187 | 1.3 | 2303 | 2489 |
| | Béni Chébana | 2067 | 1.3 | 2177 | 2352 |
| | Béni Mohli | 976 | 1.3 | 1028 | 1111 |
| | Béni Ourtilane | 890 | 1.3 | 937 | 1013 |
| | Harbil | 725 | 1.3 | 7634 | 825 |
| | Guenzet | 1049 | 1.3 | 1105 | 1194 |
| **Bejaia** | Bouhamza | 0 | 0.64 | 0 | 0 |

Water endowment

The estimation of water needs for an urban area requires us to provide a fixed standard for each category of consumer (allocation)[03]:

***Table III.3: Average unit endowment***

| Population | Endowment (l/day/inhabitant) |
|---|---|
| Agglomerated population | 150 |
| Sparse areas | 95 |

## III.2.2 Consumption flow rates

➔ **Average daily flow rate:** given by the formula:

$$Q_{ave.day} = P * D \qquad \text{(III.2)}$$

Where:

- $Q_{ave.day}$: Average daily flow rate in(l/day);
- $P$: population (inhabitants);
- $D$: endowment (l/day/inhabitant).

➔ **Maximum daily flow rate:** iven by the formula:

$$Q_{max.day} = \frac{Q_{ave.day} \, x \, K_{max.day}}{1000} \qquad \text{(III.3)}$$

Where.

- $Q_{max.day}$: Maximum daily flow rate in(m$^3$/day);
- $K_{max.day}$: Maximum daily irregularity coefficient between (1.3-1.6).

**Remark:**

The following table shows the water requirements for the 2060 horizon, exclusively. The results for the other horizons are given in annex number 02.

*Table III.4: Domestic needs for the 15 municipalities*

| *Province* | Municipality | Agglomerated population (projection) | Allocation (l/d/hab) | Qave day (l/d) | K max/d | Qmax/day (l/d) | Sparse population projection 2060 | Allocation (l/d/inhab) | Qave day (l/d) | K max /d | Qmax day (l/d) | domestic need (l/d) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bordj Bou-Arreridj | Colla | 11986 | 150 | 1 797 821.94 | 1.45 | 2 606 841.82 | 814 | 95 | 77 290.14 | 1.45 | 112 070.70 | 2 718 912.52 |
| | Djaafra | 15656 | 150 | 2 348 355.37 | 1.45 | 3 405 115.28 | 1 747 | 95 | 165 930.58 | 1.45 | 240 599.35 | 3 645 714.63 |
| | El main | 12209 | 150 | 1 831 294.38 | 1.45 | 2 655 376.85 | 906 | 95 | 86 046.09 | 1.45 | 124 766.83 | 2 780 143.67 |
| | Taffreg | 4236 | 150 | 635 388.97 | 1.45 | 921314.01 | 567 | 95 | 53 832.85 | 1.45 | 78 057.64 | 999 371.65 |
| | Ouled Dehmane | 322100 | 150 | 4 844 987.74 | 1.45 | 7 025 232.22 | 3 309 | 95 | 314 349.27 | 1.45 | 455 806.45 | 7 481 038.66 |
| | Thassameurt | 8092 | 150 | 1 213 816.09 | 1.45 | 1 760 033.33 | 1 162 | 95 | 110 368.16 | 1.45 | 160 033.83 | 1 920 067.16 |
| | Bordj Zemmoura | 20153 | 150 | 3 023 089.13 | 1.6 | 4 836 942.61 | 1 766 | 95 | 167 768.25 | 1.6 | 268 429.20 | 5 105 371.81 |
| | Theniet Annesr | 11304 | 150 | 1 695 642.94 | 1.45 | 2 458 682.27 | 3 593 | 95 | 341 373.80 | 1.45 | 494 992.01 | 2 953 674.27 |
| Setif | Ain Legredj | 28712 | 150 | 4 306 786.26 | 1.45 | 6 244 840.08 | 2 489 | 95 | 236 410.54 | 1.45 | 342 795.29 | 6 587 635.37 |
| | Beni Chébana | 25788 | 150 | 3 868 121.23 | 1.45 | 5 608 775.79 | 2 352 | 95 | 223 438.77 | 1.45 | 323 986.22 | 5 932 762.00 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Beni Mohli | 16679 | 150 | 1 667 944.99 | 1.45 | 2 418 520.24 | 1 111 | 95 | 105 503.75 | 1.45 | 152 980.43 | 2 571 500.67 |
| | Beni Ourtilane | 20731 | 150 | 3 109 706.39 | 1.45 | 4 509 074.26 | 1 013 | 95 | 96 207.31 | 1.45 | 139 500.60 | 4 648 574.86 |
| | Harbil | 7194 | 150 | 1 079 045.51 | 1.45 | 1 564 615.99 | 825 | 95 | 78 371.12 | 1.45 | 113 638.13 | 1 678 254.11 |
| | Guenzet | 6931 | 150 | 1 039 700.72 | 1.45 | 1 507 566.04 | 1 194 | 95 | 113 394.91 | 1.45 | 164 422.60 | 1 671 988.66 |
| Bejaia | Bouhamza | 12712 | 150 | 1 906 784.42 | 1.45 | 2 764 837.41 | 0.00 | 95 | 0.00 | 1.45 | 0.00 | 2 764 837.41 |
| | | | | | **Total** | 50 287 768.19 l/day | | | | **Total** | 3 172 079.28 l/day | 53 459 847.47 l/day |
| | | | | | | | | | | | **Total** | 53 459.85 $m^3$/day |

**Interpretation:**

In this table, we observe that the projected population for the year 2060 ranges between 4000 and 32000, inhabitants while for sparse population, it ranges from 800 to 3000 inhabitants. Regarding the maximum daily irregularity coefficient (k), we have opted for 1.45 in normal cities and 1.6 for tourist cities. Finally, we conclude that:

- ✔ For agglomerated population: $Q_{max.day}$= 50287768.19 l/day;
- ✔ For sparse population: $Q_{max.day}$= 3172079.28 l/day;
- ✔ So domestic needs for the 15 municipalities equals 53459.85 $m^3$/day.

*Table III.5: The total water requirements for the 15 municipalities*

| Horizon of 2060 | | | | Water needs $m^3$/day | | | | |
|---|---|---|---|---|---|---|---|---|
| **Province** | **Municipality** | **Agglomerated population (projection)** | **Sparse population projection 2060** | **Domestic need ($m^3$/day)** | **Public sector (m3/day)** | **Industrial sector (m3/day)** | **Tertiary sector (m3/day)** | **TOTAL** |
| **Bordj Bou-Arreridj** | Colla | 10 533 | 715 | 2 718.91 | 215.92 | 41.52 | 83.05 | 3 059.40 |
| | Djaafra | 13 759 | 15087 | 3 645.71 | 283.73 | 54.56 | 109.13 | 4 093.13 |
| | El main | 10 729 | 11935 | 2 780.14 | 219.29 | 42.17 | 84.34 | 3 125.94 |
| | Taffreg | 3 723 | 4108 | 999.37 | 70.24 | 13.51 | 27.01 | 1 110.13 |
| | Ouled Dehmane | 28 386 | 30739 | 7 481.04 | 575.38 | 110.65 | 221.3 | 8 388.37 |
| | Thassameurt | 7 112 | 7840 | 1 920.07 | 134.91 | 25.94 | 51.89 | 2 132.81 |
| | Bordj Zemmoura | 17 712 | 18204 | 5 105.37 | 338.65 | 65.12 | 130.25 | 5 639.39 |
| | Theniet Annesr | 9 935 | 7903 | 2 953.67 | 162.29 | 31.21 | 62.42 | 3 209.59 |
| **Setif** | Ain Legredj | 25 233 | 29137 | 6 587.64 | 538.36 | 103.53 | 207.06 | 7 436.59 |
| | Beni Chébana | 22 663 | 25421 | 5 932.76 | 471.67 | 90.71 | 181.41 | 6 676.55 |
| | Beni Mohli | 14 658 | 16240 | 2 571.50 | 297.07 | 57.13 | 114.26 | 3 039.96 |
| | Beni Ourtilane | 18 219 | 22144 | 4 648.57 | 399.62 | 76.85 | 153.7 | 5 278.74 |
| | Harbil | 6 322 | 7157 | 1 678.25 | 120.6 | 23.19 | 46.39 | 1 868.43 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Guenzet | 6 092 | 6264 | 1 671.99 | 110.67 | 21.28 | 42.57 | 1 846.51 |
| **Bejaia** | Bouhamza | 11 926 | 0 | 2 764.84 | 0 | 0 | 0 | 2 764.84 |
| **TOTAL** | | 207 002 | 202894 | 53 459.85 | 3938.4 | 757.37 | 1514.78 | 59 670.40 $m^3$/day |

**Interpretation:**

In this table, it is evident that new data has been incorporated, including water requirements for the public, industrial, and tertiary sectors. So, the results are as follows:

- ✔ Public sector: $Q_{max.day}$= 3938.4 $m^3$/day;
- ✔ Industrial sector: $Q_{max.day}$= 757.37 $m^3$/day;
- ✔ Tertiary sector: $Q_{max.day}$=1514.78 $m^3$/day;

Consequently, the total sum amounts to 59670.40 $m^3$/day.

## III.3 Conclusion

In this chapter, both agglomerated population and the sparse population were assessed for each municipality projected for the year 2060. Additionally, consumption flow rates were evaluated, including average daily flow rate and maximum daily flow rate. It's crucial to incorporate the values provided for the public, industrial, and tertiary sectors obtained from the AMENHYD company. Ultimately, the comprehensive results obtained for the year 2060 are as follows:

- ✔ Domestic need: Qmax/d= 53459.85 $m^3$/day;
- ✔ Public sector: Qmax/d= 3938.4 $m^3$/day;
- ✔ Industrial sector: Qmax/d= 757.37 $m^3$/day;
- ✔ Tertiary sector: Qmax/d=1514.78 $m^3$/day;
- ✔ The total sum amounts to 59670.40 $m^3$/day, so we can consider 60.000 $m^3$/day as a value for the design of the drinking water supply network.

In the next chapter, hydraulic calculations and sizing of the pipes will be performed.

# Chapter IV

# Study of the water supply network

## IV.1 Introduction

Water supply is the process of getting and transporting potable water from its source to consumers taps. This study focuses on capturing water from the new treatment plant to the distribution reservoirs. In this chapter, we undertake a techno-economic study to select the optimal materials and diameters for various sections of the considered water supply project.

## IV.2 Type of drinking water supply

Generally, three types of drinking water supply may be implemented: pumped, gravity, and mixed, In this project, just two types are used, which are:

### IV.2.1 Gravity-fed supply

In a gravity-fed water supply system, the intake point is located at an elevation higher than the piezometric level of the receiving structure. Gravity-fed supply can be achieved either through an aqueduct utilizing the natural slope or through a conduit where the flow occurs by gravity[04].

### IV.2.2 Pumped supply

In pumped supply, the intake is situated at a lower level than that of the storage reservoir, requiring the fluid to be supplied with energy, which is provided by pumps [04].

## IV.3 Choice of materials

The choice of materials for potable water supply networks is crucial to ensure water quality and system durability. Here are some of the most commonly used materials in hydraulics, along with a few factors to consider when selecting these materials:

***Table IV.1: Advantages and disadvantages for each material in hydraulic [05]***

| Materials | Advantages | Disadvantages |
|---|---|---|
| **HDPE (High-Density Polyethylene)** | -Corrosion resistant;<br>-Flexible, lightweight, durable; Easy to install;<br>-Good impact resistance;<br>-Good hydraulic properties;<br>-Less sensitive to temperature variations than PVC. | -May be affected by UV rays if not properly protected;<br>-Initial cost slightly higher than PVC;<br>-Large diameters are made to order (not always available). |
| **Ductile iron** | -Highly resistant to corrosion;<br>-Durable;<br>-Long lifespan;<br>-Ability to withstand high pressures and loads;<br>-Good hydraulic properties;<br>-Low pressure loss. | -Heavy, requires specialized skills for installation and repair;<br>-Initial cost higher than some other materials. |
| **Steel** | - Long lifespan;<br>-Ability to withstand high pressures and loads;<br>-Suitable for aggressive environments, recyclable. | -High initial cos, requires specialized skills for installation and welding;<br>-Heavier than other materials. |

| | | |
|---|---|---|
| **PRV (Polystère Reinforced with Glass Fiber)** | -Corrosion resistance;<br>-Lightweight;<br>-Mechanical strength;<br>-Long lifespan;<br>-Electrical insulation | -PRV may have a higher initial cost;<br>-More fragile;<br>-Repair difficulty. |

For material selection, we opt for HDPE (High-Density Polyethylene) in cases where diameters are small and pressure is low, while steel material is chosen for larger diameters and for high pressure. HDPE (High-Density Polyethylene) is chosen due to its long lifespan and availability in the Algerian market. As for steel, it is preferred it for its strength, especially in diameters above 500 mm, with cathodic protection to shield the pipes from corrosion. Also, steed is chosen when HDPE is not available off-the-shelf and requires a special order.

## IV.3.1 The range of diameters for Steel

The following figure illustrates the available diameters for steel material.

| Nominal Pipe Size | | Outside Diameter (mm) | Nominal Wall Thickness Schedule | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | OD | SCH 5s | SCH l0s | SCH 10 | SCH 20 | SCH 30 | SCH 40s | SCH STD | SCH 40 | SCH 60 | SCH 80s | SCH XS | SCH 80 | SCH 100 | SCH 120 | SCH 140 | SCH 160 | SCH XXS |
| 1/8 | 6 | 10.3 | | 1.24 | | | | 1.73 | 1.73 | 1.73 | | 2.41 | 2.41 | 2.41 | | | | | |
| 1/4 | 8 | 13.7 | | 1.65 | | | | 2.24 | 2.24 | 2.24 | | 3.02 | 3.02 | 3.02 | | | | | |
| 3/8 | 10 | 17.1 | | 1.65 | | | | 2.31 | 2,31 | 2.31 | | 3.20 | 3.20 | 3.20 | | | | | |
| 1/2 | 15 | 21.3 | 1.65 | 2.11 | | | | 2.77 | 2.77 | 2.77 | | 3.73 | 3.73 | 3.73 | | | | 4.78 | 7.47 |
| 3/4 | 20 | 26.7 | 1.65 | 2.11 | | | | 2.87 | 2.87 | 2.87 | | 3.91 | 3.91 | 3.91 | | | | 5.56 | 7.82 |
| 1 | 25 | 33.4 | 1.65 | 2.77 | | | | 3.38 | 3.38 | 3.38 | | 4.55 | 4.55 | 4.55 | | | | 6.35 | 9.09 |
| 1 1/4 | 32 | 42.2 | 1.65 | 2.77 | | | | 3.56 | 3.56 | 3,56 | | 4.85 | 4.85 | 4.85 | | | | 6.35 | 9.70 |
| 1 1/2 | 40 | 48.3 | 1.65 | 2.77 | | | | 3.68 | 3.68 | 3.68 | | 5.08 | 5.08 | 5.08 | | | | 7.14 | 10.15 |
| 2 | 50 | 60.3 | 1.65 | 2.77 | | | | 3.91 | 3.91 | 3.91 | | 5.54 | 5.54 | 5.54 | | | | 8.74 | 11.07 |
| 2 1/2 | 65 | 73 | 2.11 | 3.05 | | | | 5.16 | 5.16 | 5.16 | | 7.01 | 7.01 | 7.01 | | | | 9.53 | 14.02 |
| 3 | 80 | 88.9 | 2.11 | 3.05 | | | | 5.49 | 5.49 | 5.49 | | 7.62 | 7.62 | 7.62 | | | | 11.13 | 15.24 |
| 3 1/2 | 90 | 101.6 | 2.11 | 3.05 | | | | 5.74 | 5.74 | 5.74 | | 8.08 | 8.08 | 8.08 | | | | | |
| 4 | 100 | 114.3 | 2.11 | 3.05 | | | | 6.02 | 6.02 | 6.02 | | 8.56 | 8.56 | 8.56 | | 11.13 | | 13.49 | 17.12 |
| 5 | 125 | 141.3 | 2.77 | 3.40 | | | | 6.55 | 6.55 | 6.55 | | 9.53 | 9,53 | 9.53 | | 12.70 | | 15.88 | 19.05 |
| 6 | 150 | 168.3 | 2.77 | 3.40 | | | | 7.11 | 7.11 | 7.11 | | 10.97 | 10.97 | 10.97 | | 14.27 | | 18.26 | 21.95 |
| 8 | 200 | 219.1 | 2.77 | 3.76 | | 6.35 | 7.04 | 8.18 | 8.18 | 8.18 | 10.31 | 12.70 | 12.70 | 12.70 | 15.09 | 18.26 | 20.62 | 23.01 | 22.23 |
| 10 | 250 | 273.1 | 3.40 | 4.19 | | 6.35 | 7.80 | 9.27 | 9.27 | 9.27 | 12.70 | 12.70 | 12.70 | 15.09 | 18.26 | 21.44 | 25.40 | 28.58 | 25.40 |
| 12 | 300 | 323.9 | 3.96 | 4.57 | | 6.35 | 8.38 | 9.53 | 9.53 | 10.31 | 14.27 | 12.70 | 12.70 | 17.48 | 21.44 | 25.40 | 28.58 | 33.32 | 25.40 |
| 14 | 350 | 355.6 | 3.96 | 4.78 | 6.35 | 7.92 | 9.53 | | 9.53 | 11.13 | 15.09 | | 12.70 | 19.05 | 23.83 | 27.79 | 31.75 | 35.71 | |
| 16 | 400 | 406.4 | 4.19 | 4.78 | 6.35 | 7.92 | 9.53 | | 9.53 | 12.70 | i6.66 | | 12.70 | 21.44 | 26.19 | 30.96 | 36.53 | 40.49 | |
| 18 | 450 | 457.2 | 4.19 | 4.78 | 6.35 | 7.92 | 11.13 | | 9.53 | 14.27 | 19.05 | | 12.70 | 23.83 | 29.36 | 34.93 | 39,67 | 45.24 | |
| 20 | 500 | 508 | 4.78 | 5.54 | 6.35 | 9.53 | 12.70 | | 9.53 | 15.09 | 20.62 | | 12.70 | 26.19 | 32.54 | 38.10 | 44.45 | 50.01 | |
| 22 | | 559 | 4.78 | 5.54 | 6.35 | 9.53 | 12.70 | | 9.53 | | 22.23 | | 12.70 | 28.58 | 34.93 | 41.28 | 47.63 | 53.98 | |
| 24 | 600 | 610 | 5.54 | 6.35 | 6.35 | 9.53 | 14.27 | | 9.53 | 17.48 | 24.61 | | 12.70 | 30.96 | 38.89 | 46.02 | 52.37 | 59.54 | |
| 26 | | 660 | | | 7.92 | 12.70 | | | 9.53 | | | | 12.70 | | | | | | |
| 28 | 700 | 711 | | | 7.92 | 12.70 | 15.88 | | 9.53 | | | | 12.70 | | | | | | |
| 30 | | 762 | 6.35 | 7.92 | 7.92 | 12.70 | 15.88 | | 9.53 | | | | 12.70 | | | | | | |
| 32 | 800 | 813 | | | 7.92 | 12.70 | 15.88 | | 9.53 | 17.48 | | | 12.70 | | | | | | |
| 34 | | 884 | | | 7.92 | 12.70 | 15.88 | | 9.53 | 17.48 | | | 12.70 | | | | | | |
| 36 | 900 | 914 | | | 7.92 | 12.70 | 15.88 | | 9.53 | 19.05 | | | 12.70 | | | | | | |
| 38 | | 965 | | | | | | | 9.53 | | | | 12.70 | | | | | | |
| 40 | 1000 | 1016 | | | | | | 9.53 | | 12.70 | | | | | | | | | |
| 42 | | 1067 | | | | 12.70 | 15.88 | | 9.53 | 19.05 | | | 12.70 | | | | | | |
| 44 | 1100 | 1118 | | | | | | | 9.53 | | | | 12.70 | | | | | | |
| 46 | | 1168 | | | | | | | 9.53 | | | | 12.70 | | | | | | |
| 48 | 1200 | 1219 | | | | | | | 9.53 | | | 12.70 | | | | | | | |

*Figure IV.1: Range of diameters for Steel [06]*

## IV.3.2 The range of diameters for HDPE (High-Density Polyethylene)

***Table IV.2: Range of diameters for HDPE [07]***

| Diameter | NP10 | | NP16 | | NP20 | | NP25 | |
|---|---|---|---|---|---|---|---|---|
| | EP (mm) | Price TTC (DA) | EP (mm) | Price TTC (DA) | EP (mm) | Price TTC (DA) | EP (mm) | Price TTC (DA) |
| 20 | 1.9 | 32 | 2.0 | 41 | 2.3 | 47 | 3 | 48 |
| 25 | 2.0 | 41 | 2.3 | 53.5 | 3 | 64 | 3.5 | 68 |
| 32 | 2.0 | 59 | 3.0 | 82 | 3.6 | 93 | 4.4 | 111 |
| 40 | 2.4 | 89.5 | 3.7 | 125 | 4.5 | 144 | 5.5 | 166 |
| 50 | 3 | 128 | 4.6 | 185 | 5.6 | 220 | 6.9 | 270 |
| 63 | 3.8 | 210 | 5.8 | 299 | 7.1 | 355 | 8.6 | 420 |
| 75 | 4.5 | 297 | 6.8 | 420 | 8.4 | 500 | 10.3 | 590 |
| 90 | 5.4 | 422 | 8.2 | 580 | 10.1 | 720 | 12.3 | 850 |
| 110 | 6.6 | 615 | 10 | 875 | 12.3 | 1096 | 15.1 | 1280 |
| 125 | 7.4 | 790 | 11.4 | 1120 | 14.0 | 1350 | 17.1 | 1620 |
| 160 | 9.5 | 1260 | 14.6 | 1820 | 17.9 | 2250 | 21.9 | 2650 |
| 200 | 11.9 | 1900 | 18.2 | 2900 | 22.4 | 3370 | 27.4 | 4100 |
| 250 | 14.8 | 3050 | 22.7 | 4350 | 27.9 | 5400 | 34.2 | 6400 |
| 315 | 18.7 | 4850 | 28.6 | 7200 | 35.2 | 8750 | 43.1 | 10300 |
| 400 | 23.7 | 7500 | 36.3 | 11450 | 44.7 | 14000 | 54.7 | 17250 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 500 | 29.7 | 11900 | 45.4 | 17500 | 55.8 | 21500 | | 26400 |
| 630 | 37.4 | / | 57.2 | / | / | / | / | / |
| 710 | 42.1 | / | 64.5 | / | / | / | / | / |
| 800 | 47.4 | / | 72.6 | / | / | / | / | / |

## IV.4 The project layout

Google Earth Pro software was used to create the project layout, making sure to follow certain conditions. For example, it was crucial to keep the route as short as possible for economic reasons. The image below shows the layout for lot number 2, For more details and clarity, please refer to annex number 03.

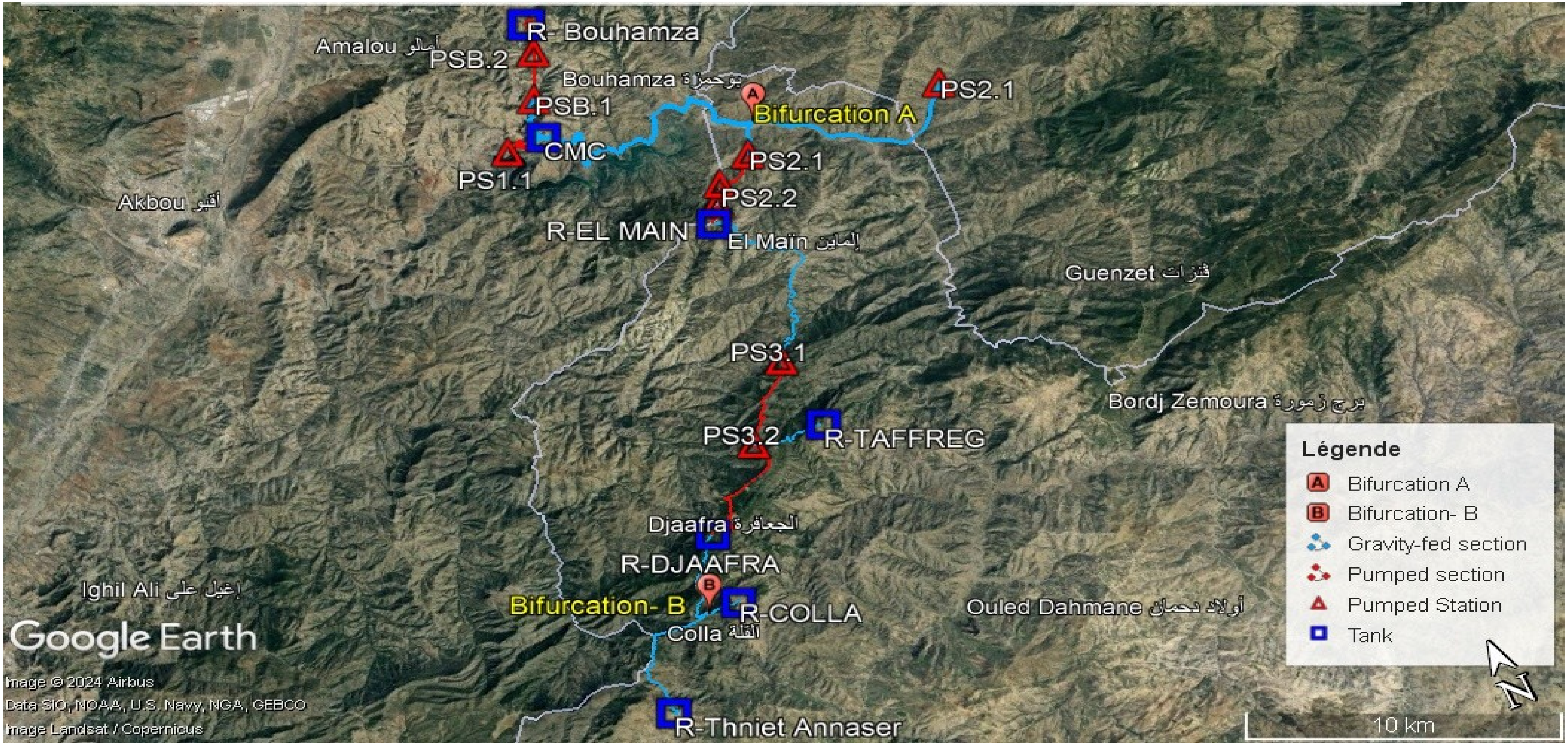



*Figure IV.2: The project layout from the Tichi-Haf dam to the distribution network tanks*

## IV.5 The water supply network diagram

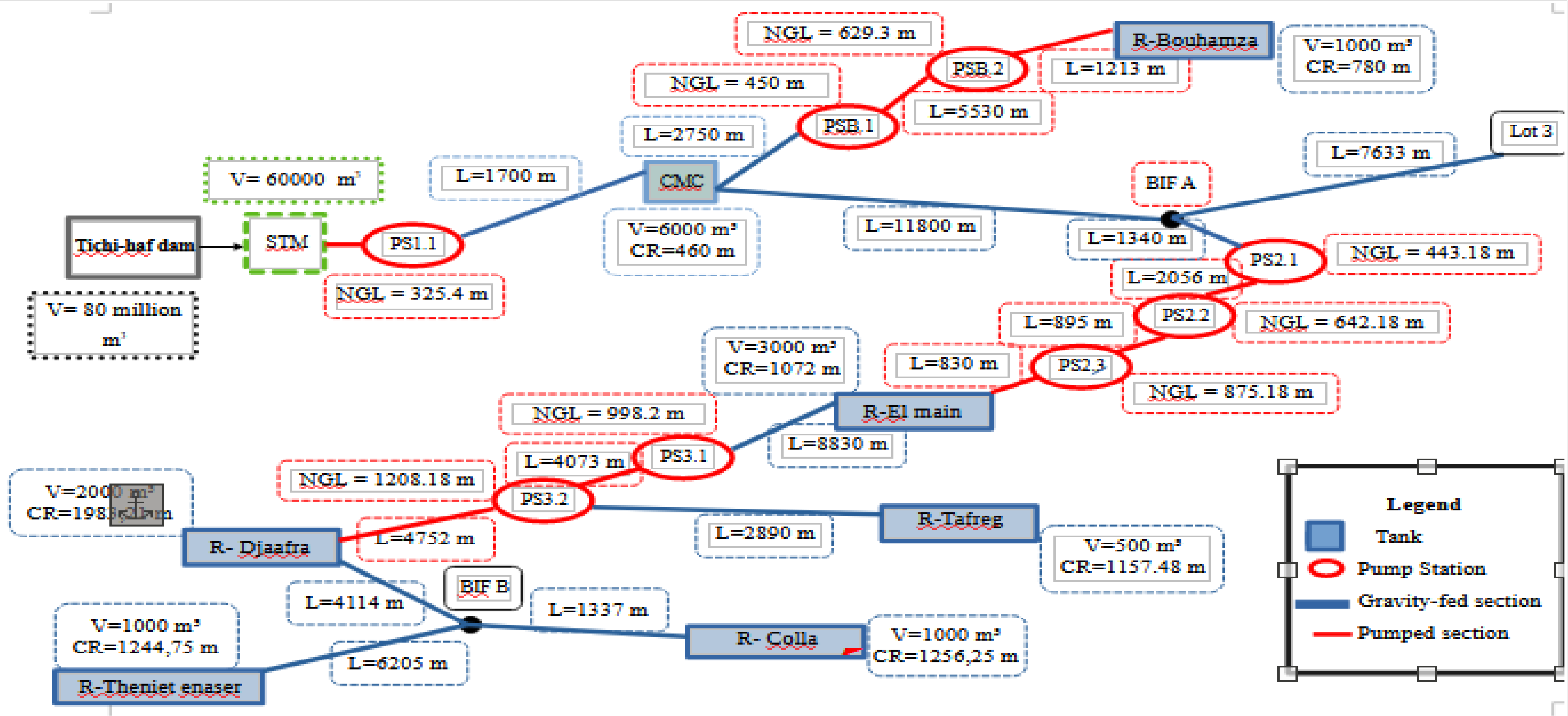



*Figure IV.3: The water supply network diagram*

## IV.6 The values of the flow rates in the pipes

So, from the previous figures, we understand that the project includes 8 pumped pipes and 10 gravity-fed pipes. The flow will be calculated as follows:

➔ pupmed pipes: $Q(l/s) = \frac{Q(m^3/day) * 10^3}{Tp * 3600}$ (IV.1)

➔ gravity-fed pipes: $Q(l/s) = \frac{Q(m^3/day) * 10^3}{24 * 3600}$ (IV.2)

Where:

*Q (l/s):* Maximum dialy flow rate in l/s;

*Q ($m^3$/day):* Maximum daily flow rate in ($m^3$/day);

*Tp:* Time of pumping in h.

**Table IV.4: The flow rates in the pipes for lot number 02**

| Stretch | | Type | Flow m³/day | Flow l/s |
|---|---|---|---|---|
| STM | PS1.1 | Gravity | 60000 | 694.44 |
| PS1.1 | CMC | Pumped | 60000 | 757.58 |
| CMC | PSB.1 | Gravity | 2786.83 | 32.25 |
| PSB.1 | PSB.2 | Pumped | 2786.83 | 38.71 |
| PSB.2 | R-BOUHAMZA | Pumped | 2786.83 | 38.71 |
| CMC | Bif-A | Gravity | 57213.17 | 662.19 |
| Bif-A | LOT-03 | Gravity | 42505.02 | 491.96 |
| Bif-A | PS2.1 | Gravity | 14708.15 | 170.23 |
| PS2.1 | PS2.2 | Pumped | 14708.15 | 204.28 |
| PS2.2 | PS2.3 | Pumped | 14708.15 | 204.28 |
| PS2.3 | R-ELmain | Pumped | 14708.15 | 204.28 |
| R-ELmain | PS3.1 | Gravity | 11560.22 | 133.80 |
| PS3.1 | PS3.2 | Pumped | 11560.22 | 160.56 |
| PS3.2 | R-TAFREG | Gravity | 1132.12 | 13.10 |
| PS3.2 | R-DJAAFRA | Pumped | 10428.1 | 144.83 |
| R-DJAAFRA | Bif-B | Gravity | 6312.98 | 73.07 |
| Bif-B | R-COLLA | Gravity | 3081.39 | 35.66 |
| Bif-B | R-THENIET.ENASER | Gravity | 3231.58 | 37.40 |

## IV.6.1 The schematic network in the EPANET software

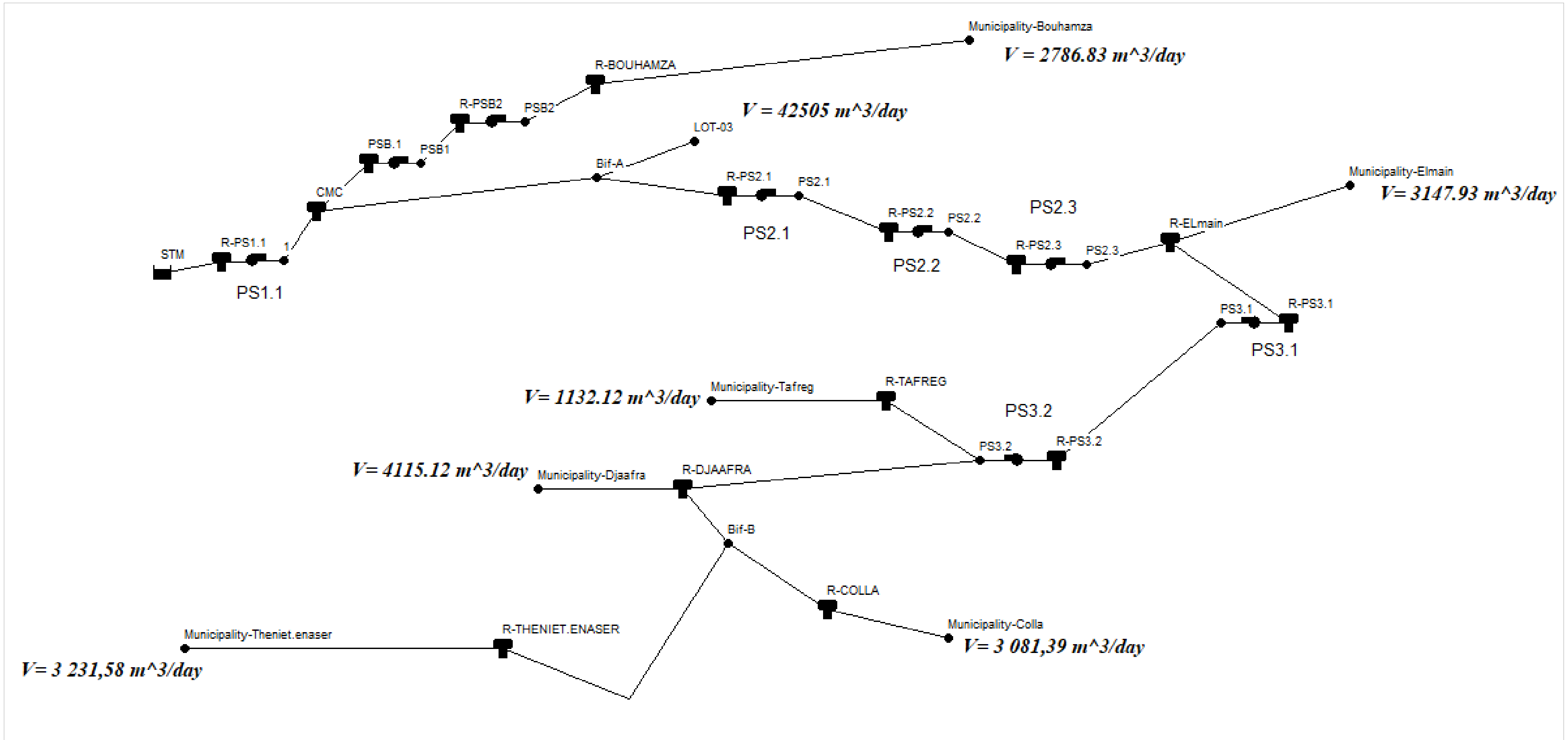



*Figure IV.4a: The schematic diagram in the EPANET software*

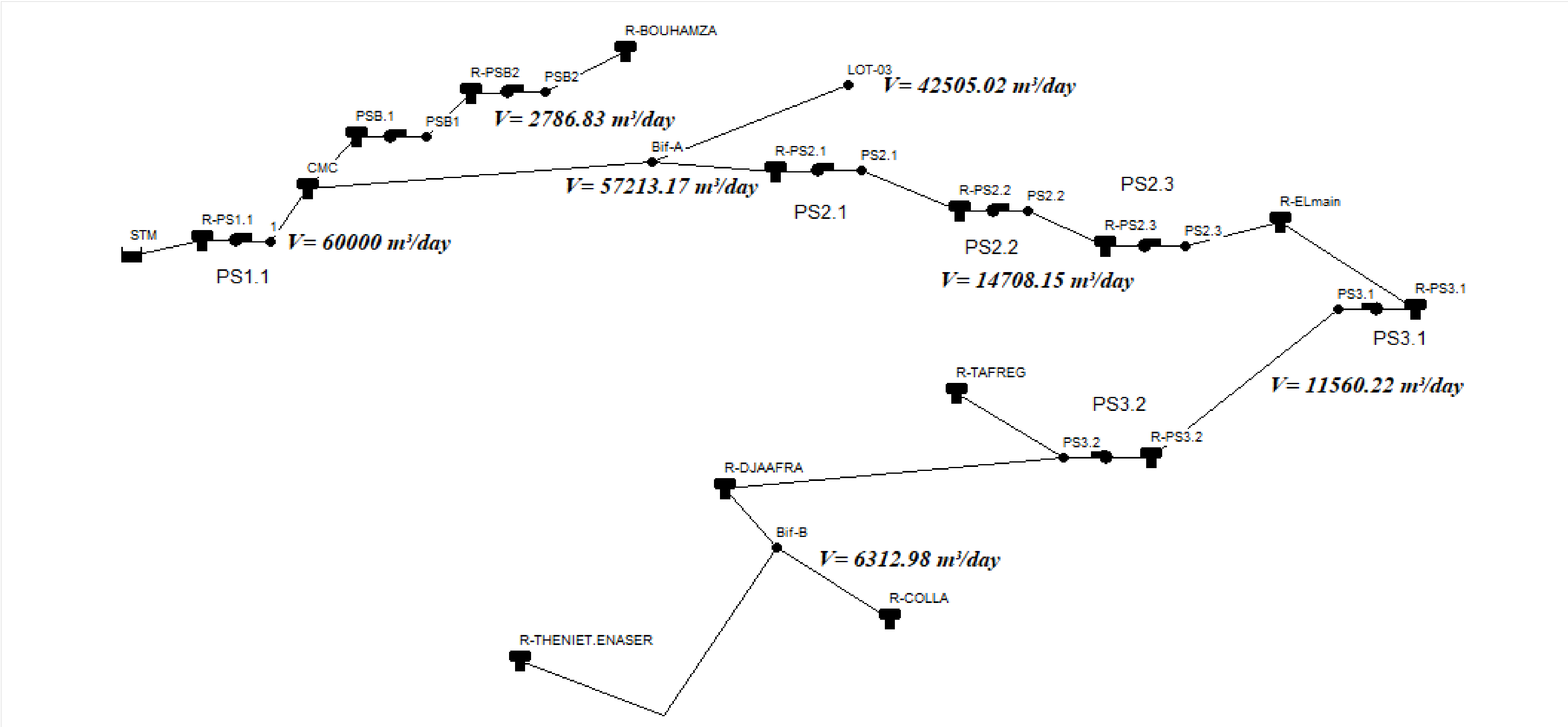



*Figure IV.5b: The schematic diagram in the EPANET software*

# IV.7 Gravity-fed section

## IV.7.1 The design laws

### IV.7.1.1 Flow rate calculation

The flow (*Q*) in ($m^3/s$) is calculated using:

$$Q(m^3/s)=Q(l/s)*10^{-3} \quad \text{(IV.3)}$$

### IV.7.1.2 Head loss (m)

$$\Delta H=NGL_{UP}-(NGL_{DW}+h) \quad \text{(IV.4)}$$

Where:

- *ΔH:* Head loss in (m);
- $NGR_{UP}$: Upstream Natural ground level in (m);
- $NGR_{DW}$: Downstream Natural ground level in (m);
- *h:* The head of the tank, which is equal to 4m.

### IV.7.1.3 Diameter (m)

Diameter is calculated with[04]:

$$D=\frac{\lambda*L*v^2}{2*\Delta H*g} \quad \text{(IV.5)}$$

Where:

- $\lambda$: Darcy fraction coefficient;
- *L*: length of the pipeline (m);
- *v*: velocity in a pipe in (m/s);
- *ΔH:* Head loss in (m);
- *g:* acceleration due to gravity (9.81 $m/s^2$).

Then the nominal diameter $D_N$ is chosen among commercial available ones.

Pipeline cross-section

The cross-section *A* of a pipe is calculated as follows [04]:

$$A=\frac{\pi*D_{inn}^2}{4} \quad \text{(IV.6)}$$

With:

- $D_{inn}$ is pipe inner diameter (m);
- A is cross-section in ($m^2$).

### IV.7.1.4 Velocity

The velocity is calculated as follows [04]:

$$v(m/s)=\frac{Q(m^3/s)}{A(m^2)} \quad \text{(IV.7)}$$

The velocity should be between two values: 0.5 m/s to avoid the deposition of sand and other minerals, and 1.5 m/s, It can go up to 2 m/s to avoid pipe vibration.

### IV.7.1.5 The linear head losses

The linear head losses are determined using the Darcy-Weisbach formula[04]:

$$\Delta H l = j*L=\frac{\lambda*L*v^2}{2*D*g} \quad \text{(IV.8)}$$

with:

- *j*: linear head losses in m/ml;
- *g:* acceleration due to gravity (9.81 m/s²);
- *L*: length of the pipeline (m);
- $\lambda$: Darcy fraction coefficient.

The calculation of the Darcy coefficient is determined by the following formula:

COLBROOK formula:

$$\frac{1}{\sqrt{\lambda}}=-2\log\left(\frac{\varepsilon}{3{,}71*D}+\frac{2{,}51}{\Re*\sqrt{\lambda 0}}\right) \quad \text{(IV.9)}$$

with:

- ε: pipe roughness coefficient, equal 0.02 mm for HDPE material and 0.1 mm for Steel material;
- *Re*: Reynolds number.

### IV.7.1.6 Singular pressure losses

Singular pressure losses are caused by equipment (valves, air vents, etc...) and are estimated to be 15% of the linear pressure losses.

$\Delta H_s = \Delta H_l * 0.15$ (IV.10)

### IV.7.1.7 Total head losses

The sum of the two pressure losses $\Delta H_S$ and $\Delta H_L$:

$$\Delta H_t = \Delta H_s + \Delta H_l \quad \text{(IV.11)}$$

$$\Delta H_t = 1.15 * \Delta H_l \quad \text{(IV.11)}$$

### IV.7.1.8 The nominal pressure NP

It was calculated using the profile of each pipeline (please refer to the annex number 04 for more details).

## Stretch number 01:

| Stretch | natural ground level (m) | | Hydraulic head (m) | | length (m) | Flow m³/s | ΔH (m) | Diameter (m) | ND (mm) | Matrerial | Inner diameter (mm) | velocity (m/s) | Lambda λ | Head loss total (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upstream | downstream | upstream | downstream | | | | | | | | | | | |
| STM – PS1.1 | 332.23 | 325.4 | 337.99 | 331.16 | 47 | 0.69 | 2.83 | 0.39 | 500 | HDPE | 440.6 | 4.55 | 0.0136 | 1.76 | **NP16** |
| | | | | | 47 | 0.69 | 2.83 | 0.39 | 700 | Steel | 700 | 1.80 | 0.0138 | 0.18 | **NP16** |

**Disscusion :** For stretch number 01, extending from the treatment plant station to pumped station 1.1, a nominal diameter of 500 mm with HDPE material has been chosen. The velocity within this pipeline is set to 4.55 m/s. This value was accepted due to the small length of 47 m and to minimize pressure losses. The nominal pressure rating is NP16.

## Stretch number 02:

| Stretch | | natural ground level (m) | | Hydraulic head (m) | | length (m) | Flow m³/s | ΔH (m) | Diameter (m) | ND (mm) | Matrerial | Inner diameter (mm) | velocity (m/s) | Lambda λ | Head loss total (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | upstream | downstream | upstream | downstream | | | | | | | | | | | |
| CMC | PSB.1 | 460 | 450 | 469.46 | 459.46 | 2750 | 0.03 | 6 | 0.23 | 250 | Steel | 250 | 0.66 | 0.0196 | 5.46 | **NP10** |

**Disscusion :** For stretch number 02, from the charging chamber to the Bouhamza 1 pumped station, a nominal diameter of 250 mm with Steel material has been chosen. The velocity within this pipeline will be 0.66 m/s, and the nominal pressure rating is NP10.

## Stretch number 03:

| Stretch | natural ground level (m) | | Hydraulic head (m) | | length (m) | Flow m³/s | ΔH (m) | Diameter (m) | ND (mm) | Matrerial | Inner diameter (mm) | velocity (m/s) | Lambda λ | Total Head loss (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upstream | downstream | upstream | downstream | | | | | | | | | | | |
| CMC – Bif A | 460 | 450 | 469.46 | 459.86 | 11800 | 0.66 | 6 | 1.00 | 900 | Steel | 900 | 1.04 | 0.0137 | 9.92 | **NP25** |
| | | | | | | | | | 1000 | Steel | 1000 | 0.84 | 0.0137 | 5.86 | **NP25** |

**Disscusion :** For stretch number 03, from the charging chamber to the bifurcation point A, a nominal diameter of 1000 mm with Steel material has been chosen. The velocity within this pipeline will be 0.84 m/s, and the nominal pressure rating is NP25.

## Stretch number 04:

| Stretch | natural ground level (m) | | Hydraulic head (m) | | length (m) | Flow m³/s | ΔH (m) | Diameter (m) | ND (mm) | Matrerial | Inner diameter (mm) | velocity (m/s) | Lambda λ | Head loss total (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upstream | downstream | upstream | downstream | | | | | | | | | | | |
| Bif-A – LOT 03 | 450 | 434.35 | 459.86 | 445.84 | 7633 | 0.49 | 11.65 | 0.71 | 700 | Steel | 700 | 1.28 | 0.0141 | 14.73 | **NP16** |
| | | | | | 7633 | 0.49 | 11.65 | 0.71 | 800 | Steel | 800 | 0.97 | 0.0141 | 7.49 | **NP16** |
| | | | | | 7633 | 0.49 | 11.65 | 0.71 | 900 | Steel | 900 | 0.77 | 0.0141 | 4.16 | **NP16** |

**Disscusion :** For stretch number 04, from bifurcation point A to the Lot number 03, a nominal diameter of 800 mm with Steel material has been selected. The velocity within this pipeline will be 0.97 m/s, and the nominal pressure rating is NP16.

## Stretch number 05:

| Stretch | | natural ground level (m) | | Hydraulic head (m) | | length (m) | Flow m³/s | ΔH (m) | Diameter (m) | ND (mm) | Matrerial | Inner diameter (mm) | velocity (m/s) | Lambda λ | Head loss total (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | upstream | downstream | upstream | downstream | | | | | | | | | | | |
| Bif-A | PS2.1 | 450 | 443.18 | 459.86 | 450.32 | 1340 | 0.17 | 3.82 | 0.42 | 450 | Steel | 450 | 1.07 | 0.0157 | 3.14 | **NP16** |

**Disscusion :** For stretch number 05, from point A to the pumped station PS2.1, a nominal diameter of 450 mm with Steel material has been selected. The velocity within this pipeline will be 1.07 m/s, and the nominal pressure rating is NP16.

## Stretch number 06:

| Stretch | | natural ground level (m) | | Hydraulic head (m) | | length (m) | Flow m³/s | ΔH (m) | Diameter (m) | ND (mm) | Matrerial | Inner diameter (mm) | velocity (m/s) | Lambda λ | Head loss total (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | upstream | downstream | upstream | downstream | | | | | | | | | | | |
| R-ELmain | PS3.1 | 1072 | 998.2 | 1,099.62 | 1,025.82 | 8830 | 0.13 | 69.8 | 0.31 | 300 | Steel | 300 | 1.89 | 0.0164 | 101.37 | |
| | | | | | | 8830 | 0.13 | 69.8 | 0.31 | 400 | Steel | 400 | 1.06 | 0.0161 | 23.62 | **NP25** |

**Disscusion :** For stretch number 06, from the El-main reservoir to the pumped station PS3.1, a nominal diameter of 400 mm with Steel material has been selected. The velocity within this pipeline will be 1.06 m/s, and the nominal pressure rating is NP25.

## Stretch number 07:

| Stretch | | natural ground level (m) | | Hydraulic head (m) | | length (m) | Flow m³/s | ΔH (m) | Diameter (m) | ND (mm) | Matrerial | Inner diameter (mm) | velocity (m/s) | Lambda λ | Head loss total (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | upstream | downstream | upstream | downstream | | | | | | | | | | | |
| SP3.2 | R-TAFREG | 1208.18 | 1157.48 | 1,234.35 | 1,183.65 | 2890 | 0.01 | 46.7 | 0.11 | 125 | HDPE | 102.2 | 1.60 | 0.0176 | 74.43 | |
| | | | | | | 2890 | 0.01 | 46.7 | 0.11 | 160 | HDPE | 130.8 | 0.98 | 0.018 | 22.17 | **NP16** |

**Disscusion :** For stretch number 07, from the pumped station PS3.2 to the Tafreg reservoir, a nominal diameter of 160 mm with HDPE material has been selected. The velocity within this pipeline will be 0.98 m/s, and the nominal pressure rating is NP16.

## Stretch number 08:

| Stretch | | natural ground level (m) | | Hydraulic head (m) | | length (m) | Flow m³/s | ΔH (m) | Diameter (m) | ND (mm) | Matrerial | Inner diameter (mm) | velocity (m/s) | Lambda λ | Linear Head loss (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | upstream | downstream | upstream | downstream | | | | | | | | | | | |
| R-DJAAFRA | Bif-B | 1383.21 | 1300 | 1,482.79 | 1,399.58 | 4114 | 0.07 | 83.21 | 0.20 | 200 | Steel | 200 | 2.33 | 0.0148 | 83.11 | **NP20** |

**Disscusion :** For stretch number 08, from the Djaafra reservoir to the bifurcation point B, a nominal diameter of 200 mm with steel material. The velocity within this pipeline will be 2.33 m/s, and the nominal pressure rating is NP20.

## Stretch number 09:

| Stretch | | natural ground level (m) | | Hydraulic head (m) | | length (m) | Flow m³/s | ΔH (m) | Diameter (m) | ND (mm) | Matrerial | Inner diameter (mm) | velocity (m/s) | Lambda λ | Total Head loss (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | upstream | downstream | upstream | downstream | | | | | | | | | | | |
| Bif-B | R-COLLA | 1300 | 1256.25 | 1,399.58 | 1,300.89 | 1337 | 0.04 | 39.75 | 0.14 | 150 | Steel | 150 | 2.02 | 0.0191 | 35.34 | **NP10** |

**Disscusion :** For stretch number 09, from the bifurcation point B to the Colla Tank, a nominal diameter of 150 mm with steel material has been selected. The velocity within this pipeline will be 2.02 m/s, and the nominal pressure rating is NP10.

## Stretch number 10:

| Stretch | | natural ground level (m) | | Hydraulic head (m) | | length (m) | Flow m³/s | ΔH (m) | Diameter (m) | ND (mm) | Matrerial | Inner diameter (mm) | velocity (m/s) | Lambda λ | Head loss total | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | upstream | downstream | upstream | downstream | | | | | | | | | | | |
| Bif-B | 'HENIET.ENAS | 1300 | 1244.75 | 1,399.58 | 1,296.44 | 6205 | 0.04 | 51.25 | 0.19 | 200 | Steel | 200 | 1.19 | 0.0185 | 47.69 | **NP16** |

**Disscusion :** For stretch number 10, from the bifurcation B to the Theniet enaser reservoir, a nominal diameter of 200 mm with steel material. The velocity within this pipeline will be 1.19 m/s, and the nominal pressure rating is NP16.

# IV.8 Pumped section

## IV.8.1 The design laws

### IV.8.1.1 Economic diameter

The economic diameter was calculated using the following formula [08]:

- ✔ BOUNIN formula (m): $D(BOUNIN)=\sqrt{Q}$ (IV.13)
- ✔ BRESS formula (m): $D(BRESS)=1,5*\sqrt{Q}$ (IV.14)

with:

- $D_{BOUNIN.}$ $D_{BRESS}$: Pipeline diameter (m);
- $Q$: Flow rate passing through the section ($m^3/s$).

These two formulas provide two values for the diameter. Then we choose the best one based on velocity and other hydraulic parameters.

### IV.8.1.2 Geometric head

Represented by the following formula[04]:

$$Hg=NGL_{UP}-NGL_{DW} \quad \text{(IV.15)}$$

### IV.8.1.3 Total dynamic head

Represented by the following formula[04]:

$$TDH(m)=Hg+\Delta H_t \quad \text{(IV.16)}$$

with:

- $Hg$: geometric head (m);
- $\Delta H_t$: total head losses (m).

### IV.8.1.4 The nominal pressure NP

It was calculated using the profile of each conduit, for more details please refer to the annex number 04.

**Stretch number 01:** PS1.1 - CMC

| Stretch | natural ground level (m) | | length (m) | Flow m³/s | Diameter BOUNIN (m) | ND (mm) | Diameter BRESS (m) | ND (mm) | ND (mm) | Matrerial | Inner diameter (mm) | Cross section (m²) | velocity (m/s) | Hg (m) | Lambda λ | Linear Head loss (m) | Head loss total | TDH (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upstream | downstream | | | | | | | | | | | | | | | | | |
| PS1.1 – CMC | 325.4 | 460 | 1700 | 0.76 | 0.87 | 900 | 1.31 | 1300 | 800 | Steel | 800 | 0.50 | 1.51 | 134.6 | 0.0136 | 3.35 | 3.85 | 138.45 | NP40 |
| | | | | | | | | | 900 | Steel | 900 | 0.64 | 1.19 | 135.6 | 0.0135 | 1.84 | 2.12 | 137.72 | |
| | | | | | | | | | 1000 | Steel | 1000 | 0.79 | 0.96 | 134.6 | 0.0135 | 1.09 | 1.25 | 135.85 | |
| | | | | | | | | | 1100 | Steel | 1100 | 0.95 | 0.80 | 134.6 | 0.0135 | 0.68 | 0.78 | 135.38 | |
| | | | | | | | | | 1200 | Steel | 1200 | 1.13 | 0.67 | 134.6 | 0.0135 | 0.44 | 0.50 | 135.10 | |
| | | | | | | | | | 1300 | Steel | 1300 | 1.33 | 0.57 | 134.6 | 0.0135 | 0.29 | 0.34 | 134.94 | |

For stretch number 01, from the pumped station PS1.1 to the charging chamber, the nominal diameter of 800 mm is chosen with Steel material. The velocity within this pipeline will be 1.51 m/s, and the nominal pressure rating is NP40.

**Stretch number 02:** PSB.1 – PSB.2

| Stretch | natural ground level (m) | | length (m) | Flow m³/s | Diameter BOUNIN (m) | ND (mm) | Diameter BRESS (m) | ND (mm) | ND (mm) | Matrerial | Inner diameter (mm) | Cross section (m²) | velocity (m/s) | Hg (m) | Lambda λ | Linear Head loss (m) | Head loss total | TDH (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upstream | downstream | | | | | | | | | | | | | | | | | |
| PSB.1 – PSB.2 | 458.25 | 629.3 | 5530 | 0.04 | 0.20 | 200 | 0.30 | 300 | 200 | Steel | 200 | 0.03 | 1.23 | 171.05 | 0.0155 | 33.16 | 38.13 | 209.18 | NP40 |
| | | | | | | | | | 250 | Steel | 250 | 0.05 | 0.79 | 171.05 | 0.0157 | 11.01 | 12.66 | 183.71 | |
| | | | | | | | | | 300 | Steel | 300 | 0.07 | 0.55 | 171.05 | 0.0161 | 4.54 | 5.22 | 176.27 | |

For stretch number 02, from Bouhamza Pumped Station 1 to Bouhamza Pumped Station 2, the nominal diameter of 200 mm is chosen with Steel material. The velocity within this pipeline will be 1.23 m/s, resulting in a total dynamic head of 209.18 m. The nominal pressure rating is NP40.

**Stretch number 03:** PSB.2 – R-Bouhamza

| Stretch | natural ground level (m) | | length (m) | Flow m³/s | Diameter BOUNIN (m) | ND (mm) | Diameter BRESS (m) | ND (mm) | ND (mm) | Matrerial | Inner diameter (mm) | Cross section (m²) | velocity (m/s) | Hg (m) | Lambda λ | Linear Head loss (m) | Head loss total | TDH (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upstream | downstream | | | | | | | | | | | | | | | | | |
| PSB.2 – R-BOUHAMZA | 629.3 | 780 | 1213 | 0.04 | 0.20 | 200 | 0.30 | 300 | 200 | Steel | 200 | 0.03 | 1.23 | 150.7 | 0.0155 | 7.27 | 8.36 | 159.06 | NP40 |
| | | | | | | | | | 250 | Steel | 250 | 0.05 | 0.79 | 150.7 | 0.0157 | 2.41 | 2.78 | 153.48 | |
| | | | | | | | | | 300 | Steel | 300 | 0.07 | 0.55 | 150.7 | 0.0161 | 0.99 | 1.14 | 151.84 | |

For stretch number 03, from Bouhamza Pumped Station 2 to Bouhamza reservoir, the nominal diameter of 200 mm is chosen with Steel material. The velocity within this pipeline will be 1.23 m/s, resulting in a total dynamic head of 159.06 m. The nominal pressure rating is NP40.

**Stretch number 04:** PS2.1 – PS2.2

| Stretch | natural ground level (m) | | length (m) | Flow m³/s | Diameter BOUNIN (m) | ND (mm) | Diameter BRESS (m) | ND (mm) | ND (mm) | Matrerial | Inner diameter (mm) | Cross section (m²) | velocity (m/s) | Hg (m) | Lambda λ | Linear Head loss (m) | Head loss total | TDH (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upstream | downstream | | | | | | | | | | | | | | | | | |
| PS2.1 –PS2.2 | 443.18 | 642.18 | 2056 | 0.20 | 0.45 | 450 | 0.68 | 700 | 450 | Steel | 450 | 0.16 | 1.28 | 199 | 0.0155 | 5.95 | 6.85 | 205.85 | NP40 |
| | | | | | | | | | 500 | Steel | 500 | 0.20 | 1.04 | 199 | 0.0154 | 3.49 | 4.02 | 203.02 | |
| | | | | | | | | | 600 | Steel | 600 | 0.28 | 0.72 | 199 | 0.0153 | 1.39 | 1.60 | 200.60 | |
| | | | | | | | | | 700 | Steel | 700 | 0.38 | 0.53 | 199 | 0.0154 | 0.65 | 0.75 | 199.75 | |

For stretch number 04, from pumped station 2.1 to the pumped station 2.2, the nominal diameter of 450 mm is chosen with Steel material. The velocity within this pipeline will be 1.28 m/s, resulting in a total dynamic head of 205.85 m. The nominal pressure rating is NP40.

**Stretch number 05:** PS2.2 – PS2.3

| Stretch | natural ground level (m) | | length (m) | Flow m³/s | Diameter BOUNIN (m) | ND (mm) | Diameter BRESS (m) | ND (mm) | ND (mm) | Matrerial | Inner diameter (mm) | Cross section (m²) | velocity (m/s) | Hg (m) | Lambda λ | Linear Head loss (m) | Head loss total | TDH (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upstream | downstream | | | | | | | | | | | | | | | | | |
| PS2.2 – PS2.3 | 642.18 | 875.18 | 895 | 0.20 | 0.45 | 450 | 0.68 | 700 | 450 | Steel | 450 | 0.16 | 1.28 | 233 | 0.0155 | 2.59 | 2.98 | 235.98 | NP40 |
| | | | | | | | | | 500 | Steel | 500 | 0.20 | 1.04 | 233 | 0.0154 | 1.52 | 1.75 | 234.75 | |
| | | | | | | | | | 600 | Steel | 600 | 0.28 | 0.72 | 233 | 0.0153 | 0.61 | 0.70 | 233.70 | |
| | | | | | | | | | 700 | Steel | 700 | 0.38 | 0.53 | 233 | 0.0154 | 0.28 | 0.33 | 233.33 | |

For stretch number 05, from pumped station 2.2 to the pumped station 2.3, the nominal diameter of 450 mm is chosen with Steel material. The velocity within this pipeline will be 1.28 m/s, resulting in a total dynamic head of 235.98 m. The nominal pressure rating is NP40.

**Stretch number 06:** PS2.3 – R-E lmain

| Stretch | natural ground level (m) | | length (m) | Flow m³/s | Diameter BOUNIN (m) | ND (mm) | Diameter BRESS (m) | ND (mm) | ND (mm) | Matrerial | Inner diameter (mm) | Cross section (m²) | velocity (m/s) | Hg (m) | Lambda λ | Linear Head loss (m) | Head loss total | TDH (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upstream | downstream | | | | | | | | | | | | | | | | | |
| PS2.3 – R-Elmain | 875.18 | 1072 | 830 | 0.20 | 0.45 | 450 | 0.68 | 700 | 450 | Steel | 450 | 0.16 | 1.28 | 196.82 | 0.0155 | 2.40 | 2.76 | 199.58 | NP40 |
| | | | | | | | | | 500 | Steel | 500 | 0.20 | 1.04 | 196.82 | 0.0154 | 1.41 | 1.62 | 198.44 | |
| | | | | | | | | | 600 | Steel | 600 | 0.28 | 0.72 | 196.82 | 0.0153 | 0.56 | 0.65 | 197.47 | |
| | | | | | | | | | 700 | Steel | 700 | 0.38 | 0.53 | 196.82 | 0.0154 | 0.26 | 0.30 | 197.12 | |

For stretch number 06, from pumped station 2.3 to Elmain reservoir, the nominal diameter of 450 mm is chosen with Steel material. The velocity within this pipeline will be 1.28 m/s, resulting in a total dynamic head of 199.58 m. The nominal pressure rating is NP40.

**Stretch number 07:** PS3.1 – PS3.2

| Stretch | natural ground level (m) | | length (m) | Flow m³/s | Diameter BOUNIN (m) | ND (mm) | Diameter BRESS (m) | ND (mm) | ND (mm) | Matrerial | Inner diameter (mm) | Cross section (m²) | velocity (m/s) | Hg (m) | Lambda λ | Linear Head loss (m) | Head loss total | TDH (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upstream | downstream | | | | | | | | | | | | | | | | | |
| PS3.1 – PS3.2 | 998.2 | 1208.18 | 4073 | 0.16 | 0.40 | 400 | 0.60 | 600 | 350 | Steel | 350 | 0.10 | 1.67 | 209.98 | 0.0138 | 22.80 | 26.21 | 236.19 | |
| | | | | | | | | | 400 | Steel | 400 | 0.13 | 1.28 | 209.98 | 0.0158 | 13.39 | 15.39 | 225.37 | NP40 |
| | | | | | | | | | 450 | Steel | 450 | 0.16 | 1.01 | 209.98 | 0.0157 | 7.38 | 8.49 | 218.47 | |
| | | | | | | | | | 500 | Steel | 500 | 0.20 | 0.82 | 209.98 | 0.0157 | 4.36 | 5.01 | 214.99 | |
| | | | | | | | | | 600 | Steel | 600 | 0.28 | 0.57 | 209.98 | 0.0158 | 1.76 | 2.03 | 212.01 | |

For stretch number 07, from the pumped station 3.1 to pumped station 3.2, the nominal diameter of 400 mm is chosen with Steel material. The velocity within this pipeline will be 1.28 m/s, resulting in a total dynamic head of 225.37 m. The nominal pressure rating is NP40.

**Stretch number 08:** PS3.2 - R-Djaafra

| Stretch | natural ground level (m) | | length (m) | Flow m³/s | Diameter BOUNIN (m) | ND (mm) | Diameter BRESS (m) | ND (mm) | ND (mm) | Matrerial | Inner diameter (mm) | Cross section (m²) | velocity (m/s) | Hg (m) | Lambda λ | Linear Head loss (m) | Head loss total | TDH (m) | PN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upstream | downstream | | | | | | | | | | | | | | | | | |
| PS3.2 – R-DJAAFRA | 1208.18 | 1383.21 | 4752 | 0.14 | 0.38 | 400 | 0.57 | 600 | 350 | HDPE | 350 | 0.10 | 1.51 | 175.03 | 0.0164 | 25.72 | 29.58 | 204.61 | |
| | | | | | | | | | 400 | Steel | 400 | 0.13 | 1.15 | 175.03 | 0.016 | 12.87 | 14.80 | 189.83 | NP40 |
| | | | | | | | | | 450 | Steel | 450 | 0.16 | 0.91 | 175.03 | 0.0159 | 7.10 | 8.16 | 183.19 | |
| | | | | | | | | | 500 | Steel | 500 | 0.20 | 0.74 | 175.03 | 0.0159 | 4.19 | 4.82 | 179.85 | |
| | | | | | | | | | 600 | Steel | 600 | 0.28 | 0.51 | 175.03 | 0.0159 | 1.68 | 1.94 | 176.97 | |

For stretch number 08, from the pumped station 3.2 to Djaafra reservoir, the nominal diameter of 400 mm is chosen with Steel material. The velocity within this pipeline will be 1.15 m/s, resulting in a total dynamic head of 189.83 m. The nominal pressure rating is NP40.

*Tableau IV.5: Summary of the results for LOT number 02*

## IV.9 Summary of the results

| Stretch | | Length (m) | Type of supply | Flow m³/s | ND (mm) | Material | Velocity (m/s) | NP |
|---|---|---|---|---|---|---|---|---|
| STM | PS1.1 | 4312 | gravity | 0.694 | 500 | HDPE | 4.55 | NP16 |
| PS1.1 | CMC | 1700 | Pumped | 0.757 | 800 | Steel | 1.15 | NP40 |
| CMC | PSB.1 | 2750 | gravity | 0.032 | 250 | Steel | 0.66 | NP10 |
| PSB.1 | PSB.2 | 5530 | Pumped | 0.039 | 200 | Steel | 1.23 | NP40 |
| PSB.2 | R-BOUHAMZA | 1213 | Pumped | 0.039 | 200 | Steel | 1.23 | NP40 |
| CMC | Bif-A | 11800 | gravity | 0.663 | 100 | Steel | 0.84 | NP25 |
| Bif-A | LOT-03 | 7633 | gravity | 0.492 | 800 | Steel | 0.97 | NP16 |
| Bif-A | PS2.1 | 1340 | gravity | 0.17 | 450 | Steel | 1.07 | NP16 |
| PS2.1 | PS2.2 | 2056 | Pumped | 0.204 | 450 | Steel | 1.28 | NP40 |
| PS2.2 | PS2.3 | 895 | Pumped | 0.204 | 450 | Steel | 1.28 | NP40 |
| PS2.3 | R-ELmain | 830 | Pumped | 0.204 | 450 | Steel | 1.28 | NP40 |
| R-ELmain | PS3.1 | 8830 | gravity | 0.134 | 400 | Steel | 1.06 | NP25 |
| PS3.1 | PS3.2 | 4073 | Pumped | 0.161 | 400 | Steel | 1.28 | NP40 |
| PS3.2 | R-TAFREG | 2890 | gravity | 0.013 | 160 | HDPE | 0.98 | NP16 |
| PS3.2 | R-DJAAFRA | 4752 | Pumped | 0.145 | 400 | Steel | 1.48 | NP40 |
| R-DJAAFRA | Bif-B | 4114 | gravity | 0.073 | 200 | Steel | 1.15 | PN20 |
| Bif-B | R-COLLA | 1337 | gravity | 0.036 | 150 | Steel | 2.02 | PN10 |
| Bif-B | R-THENIET.ENASER | 6205 | gravity | 0.037 | 200 | Steel | 1.19 | NP16 |

## IV.10 Conclusion

To summarize, this chapter covers the following points:

- ✔ The choice of materials, where steel was preferred over HDPE in certain cases, despite the smaller diameter, to optimize other hydraulic parameters;
- ✔ Presentation of the project layout using Google Earth Pro and Epanet software;
- ✔ Detailed study of the water supply network, including calculations of hydraulic parameters such as diameter, velocity, nominal pressure, total head loss, and total dynamic head for both gravity-fed and pumped sections;
- ✔ Following to the pipeline study, a pump selection study for the pumping section is required.

# *Chapter V*
# *Pump Selection and Water Hammer Effect*

## V.1 Introduction

Pumps are essential mechanical devices in hydraulics. Their crucial role is to transfer water from one place to another. In this chapter, we will examine the different types of pumps and how we made the selection for the various pumping stations.

## V.2 What is a pump?

A pump is a mechanical device that is used to give energy to a flowing liquid such that the liquid can overcome the resistance in the hydraulic system. Simply the pump converts mechanical energy into hydraulic energy given to the flow [09].

## V.3 Types of pumps

### V.3.1 Reciprocation Pumps

The pressure energy of fluid increase due to positive displacement of its piston or plunger. These are used to the handle low increase the rate at high pressure [09].

### V.3.2 Rotary Displacement pumps

Combine the advantages of reciprocating and centrifugal pump. They are positive in action, compact, produce an even flow, have no valves and run at high speeds. These pumps are suitable for handling oils but they are unsuitable for gritty (sandy) liquid [09].

### V.3.3 Centrifugal pump

It is by far the commonest type of dynamic pump also called as velocity pump. These are classified as roto-dynamic pumps since the rotating impeller of pump impresses a centrifugal head or pressure on the liquid which leaves the impeller at a high velocity. This pressure allows the liquid to rise to a higher level [09].

## V.4 Pump coupling

In this study, it was found that one pump is not sufficient; thus, coupled pumps are required, either in parallel or in series, according to the needs identified.

### V.4.1 Series coupling

Significantly increasing the Pumped head, which is the total dynamic head.

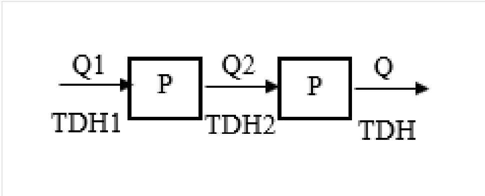



***Figure V.1: Mounting two (02) pumps in series***

### V.4.2 Parallel coupling

Significantly increasing the pumped flow rate in a network.

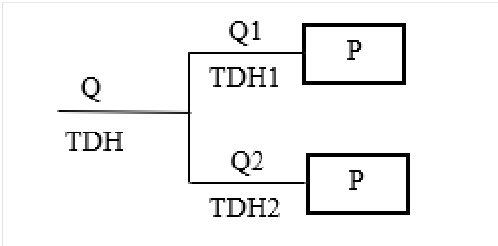



***Figure V.2: Mounting two (02) pumps in parallel***

## V.5 The pump characteristic

- The operating point (flow and total dynamic head);
- Optimal efficiency;
- Non-cavitation condition verified $NPSHr < NPSHd$;
- Low electricity or energy consumption.

## V.6 The absorbed power of the pumps

Calculated following this formula [10]:

$$Pab = \frac{Psh}{\eta} = \frac{Q * TDH * g}{\eta} \quad \text{(V.1)}$$

where:

- $TDH$: Total Dynamic Head (m);
- $Pab$: absorbed power of the pumps (KW);
- $Psh$: shafet power (KW);

- *Q*: pump flow rate ($m^3/s$);
- *g*: acceleration due to gravity ( $m/s^2$);
- $\eta$: pump efficiency (%).

## V.7 Energy consumed by a pump for one year of operation

Calculated following this formula [10]:

$$E = Pab * T * 365 \quad (V.2)$$

with

- *E:* energy consumed by the pump for one year of operation (kw.h);
- *Pab:* absorbed power of the pumps (KW);
- *T:* time pumping (h).

## V.8 Checking pump cavitation

The NPSH (Net Positive Suction Head) is a criterion used to define the pressure required for pump suction. The condition of no cavitation is verified if [10]:

$NPSHd > NPSHr$

where:

- $NPSH_d$ : Net Positive Suction Head (in, meter water column 'mwc');
- $NPSH_r$: Net Positive Suction Head (in mwc).

NPSH in pumping stations is calculated as follows:

$NPSHd = Patm - Pv - \Delta H\,asp + Hasp$ (V.3) (Suction under load)

Where:

- *Patm:* atmospheric pressure in meters of head (mwc);
- *Pv:* absolute vaporization pressure of the fluid (0.24 mwc);

*Δhasp:* suction pipe head losses in meters of head (mwc);

$$\Delta H_{asp} = \frac{\lambda * L_{asp} * V^2}{2 * D * g} \quad (V.4)$$

with:

- $L_{asp}$ : the length of aspiration (mwc);
- *Hasp:* Suction head (mwc).

**Remark:**

We opted for the LOWARA and GOULDS water technologie a Xylem brand (https://www.xylem.com/fr-fr/support/outils-et-calculateurs-interactifs/xylect/). The brand offers an easy-to-use web portal for pump selection. In most pumping stations, we choose to couple pumps in series because we have not found pumps that meet the required specifications (the operating point). Of course, we always have another pump in reserve in case of breakdown or for repair work.

## V.9 Pump selection

### PS1.1 pumping station

At this station, 2 pumps were chosen for a parallel circuit, with one pump serving as a reserve. The type found is e-XC350-690/8000W/W45ADS4AG, and cavitation is monitored due to $NPSHd > NPSHr$.

***Tableau V.1: Characteristics of pumping station 1.1***

| PS 1.1 | Naturel ground level | ND (mm) | Time of pumping | Flow m³/h | TDH(m) | Hg (m) | ΔH as (m) | NPSHd (m) | Effeciency (%) | NPSHr (m) | shaft power (kw) | Pab (kw) | E (kw,h) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 325.4 | 800 | 22 | 2500 | 138.45 | 134.6 | 0.002 | 11.77 | 76.5 | 4.36 | 1246.2 | 1,232.93 | 9900419.24 |

### PSB.1 pumping station

At this station, 2 pumps were chosen for a serial circuit, with one pump serving as a reserve. The type found is IXPC125-100-315D750L25BDN4S1G, and cavitation is monitored due to $NPSHd > NPSHr$.

***Tableau V.2: Characteristics of pumping station B.1***

| PSB.1 | Naturel ground level (m) | ND (mm) | Time of pumping | Flow m³/h | TDH(m) | Hg (m) | ΔH as (m) | NPSHd (m) | Effeciency (%) | NPSHr (m) | shaft power (kw) | Pab (kw) | E (kw,h) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 450 | 200 | 20 | 116.12 | 209.18 | 171.05 | 0.006 | 11.77 | 57.6 | 3.45 | 115.2 | 114.913541 | 838868.852 |

## PSB.2 pumping station

At this station, 3 pumps were chosen for a parallel circuit, with one pump serving as reserve. The type found is MPA100A/08A/BD750/L45VCCC4, and cavitation is monitored due to $NPSHd > NPSHr$.

***Tableau V.3: Characteristics of pumping station B.2***

| PSB.2 | Naturel ground level (m) | ND (mm) | Time of pumping | Flow m³/h | TDH(m) | Hg (m) | ΔH as (m) | NPSHd (m) | Effeciency (%) | NPSHr (m) | shaft power (kw) | Pab (kw) | E (kw,h) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 629.3 | 200 | 20 | 116.12 | 159.06 | 150.7 | 0.006 | 11.77 | 67.8 | 1.09 | 76.9 | 74.23 | 541.91 |

## SP2.1 pumping station

At this station, 4 pumps were chosen for a parallel circuit, with one pump serving as reserve. The type found is MPA125A/02A/BD1600/L25VCCC4, and cavitation is monitored due to $NPSHd > NPSHr$.

***Tableau V.4: Characteristics of pumping station 2.1***

| PS2.1 | Naturel ground level (m) | ND (mm) | Time of pumping | Flow m³/h | TDH(m) | Hg (m) | ΔH as (m) | NPSHd (m) | Effeciency (%) | NPSHr (m) | shaft power (kw) | Pab (kw) | E (kw,h) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 443.18 | 450 | 20 | 612.84 | 205.85 | 199 | 0.003 | 11.77 | 76.4 | 4.47 | 449.3 | 449.96 | 3284687 |

## SP2.2 pumping station

At this station, 3 pumps were chosen for a parallel circuit, with one pump serving as reserve. The type found is MPA150A/02C/BD3150/L25VDNC4, and cavitation is monitored due to $NPSHd > NPSHr$.

***Tableau V.5: Characteristics of pumping station 2.2***

| PS2.2 | Naturel ground level (m) | ND (mm) | Time of pumping | Flow m³/h | TDH(m) | Hg (m) | ΔH as (m) | NPSHd (m) | Effeciency (%) | NPSHr (m) | shaft power (kw) | Pab (kw) | E (kw,h) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 642.18 | 450 | 20 | 612.84 | 235.85 | 233 | 0.003 | 11.77 | 72.3 | 6.66 | 536.3 | 544.77 | 3976803 |

## SP2.3 pumping station

At this station, 4 pumps were chosen for a parallel circuit, with one pump serving as reserve. The type found is MPA125B/02C/BD1600/L25VCCC4, and cavitation is monitored due to $NPSHd > NPSHr$.

***Tableau V.6: Characteristics of pumping station 2.3***

| PS2.3 | Naturel ground level (m) | ND (mm) | Time of pumping | Flow m³/h | TDH(m) | Hg (m) | ΔH as (m) | NPSHd (m) | Effeciency (%) | NPSHr (m) | shaft power (kw) | Pab (kw) | E (kw,h) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 875.18 | 450 | 20 | 612.84 | 199.58 | 196.82 | 0.003 | 11.77 | 72.6 | 4.84 | 461 | 459.09 | 3351327 |

## SP3.1 pumping station

At this station, 4 pumps were chosen for a serial circuit, with one pump serving as reserve. The type found is PA 154/2-SA111-16004, and cavitation is monitored due to $NPSHd > NPSHr$.

***Tableau V.7: Characteristics of pumping station 3.1***

| PS3.1 | Naturel ground level (m) | ND (mm) | Time of pumping | Flow m³/h | TDH(m) | Hg (m) | ΔH as (m) | NPSHd (m) | Effeciency (%) | NPSHr (m) | shaft power (kw) | Pab (kw) | E (kw,h) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 998.2 | 400 | 20 | 481.68 | 225.37 | 209.98 | 0.003 | 11.77 | 79 | 6.12 | 386.4 | 374.45 | 2733487 |

## SP3.2 pumping station

At this station, 5 pumps were chosen for a parallel circuit, with one pump serving as reserve. The type found is MPA65B/04A/BD750/L25VCCC4, and cavitation is monitored due to $NPSHd > NPSHr$.

***Tableau V.8: Characteristics of pumping station 3.2***

| PS3.2 | Naturel ground level (m) | ND (mm) | Time of pumping | Flow m³/h | TDH(m) | Hg (m) | ΔH as (m) | NPSHd (m) | Effeciency (%) | NPSHr (m) | shaft power (kw) | Pab (kw) | E (kw,h) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1208.18 | 400 | 20 | 434.5 | 189.93 | 175.03 | 0.003 | 11.77 | 79.1 | 4.1 | 279.5 | 284.30 | 2075373 |

**Remark:**

Please refer to the annex number 05, for more details about pump curves for each pumping station.

## V.10 Water hammer effect

The water hammer effect refers to the sudden stoppage of flow in a pipe system, typically caused by the abrupt closing of a valve, faucet, or the starting or stopping of a pump, leading to a change in liquid velocity [11].

### V.10.1 The wave velocity

The wave velocity, given by the following value [09]:

$$a = \frac{9900}{\sqrt{48.3 + \frac{K * D}{e}}} \qquad (V.5)$$

with

- *a:* Wave velocity in m/s;
- *k*: Coefficient dependent on the material of the conduit;
- *D*: Inner diameter of the conduit, in m;
- *e*: Thickness of the pipe, in m.

***Table V.9: The ranges of wave velocity and the values of coefficient K for the two materials[09].***

| Material | K | Range of wave velocity (m/s) |
|---|---|---|
| Steel | 0.5 | 900-1250 |
| HDPE | 83 | 230-430 |

### V.10.2 Value of water hammer

**Stop time of the pump**

Given by the following formula [12]:

$$T_A(s) = \frac{L.V_0}{[9,81.(HMT + P_{atm} - 3)]} \quad (V.6)$$

<u>If $T < \frac{2L}{a}$ case of sudden closer:</u>

The value of water hammer Given by the following value [09]:

$$B = \frac{a * V_0}{g} \quad (V.7)$$

with:

- $B$: Maximum value of water hammer in m;
- $V_0$: Flow velocity (m/s);
- $g$: acceleration due to gravity (9.81 m/s²).

<u>If $T > \frac{2L}{a}$ Case of slow closer:</u>

The value of water hammer Given by the following value [09]:

$$B = \frac{2LV_0}{gT} \quad (V.8)$$

with:

- $B$: Maximum value of water hammer in m;
- $V_0$: Flow velocity (m/s);
- $g$: acceleration due to gravity (9.81 m/s²);
- $L$: length of the pipeline (m);
- $T$: Stop time of the pump (s).

### V.10.3 Surges and depressions in the Pumped pipeline

We use the following formulas for calculation:

$$Pmax = H_g + B \quad (V.9)$$

$$Pmin = H_g - B \quad (V.10)$$

with:

- $Pmax$: Surge value (m);
- $Pmin$: Depression value (m);

- *Hg*: geometric head (m).

### V.10.4 Atmospheric pressure

Given by the following formula [08]:

$$P_{atm}(m) = 10,21 - 0,001.\,Altitude(m) \qquad (V.10)$$

### V.10.5 Calculation results of surge and depression for each pipeline

***Tableau V.10: Surge and depression for each pipeline***

| Stretch | | Hg (m) | ND (m) | Material | L (m) | Inner diameter (mm) | e (mm) | K | a (m/s) | Patm | T (s) | 2L/a (s) | Type | V0 (m/s) | B (m) | Pmax (m) | Pmin (m) | NP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PS1.1 | CMC | 134.6 | 900 | Steel | 1700 | 800 | 7.1 | 0.5 | 967.81 | 9.88 | 1.44 | 3.51 | Sudden closure | 1.51 | 148.97 | 283.57 | -14.37 | NP40 |
| PSB.1 | PSB.2 | 171.05 | 250 | Steel | 5530 | 200 | 3.2 | 0.5 | 1,109.98 | 9.76 | 4.81 | 9.96 | Sudden closure | 1.23 | 139.17 | 310.22 | 31.88 | |
| PSB.2 | R-BOUHAMZA | 150.7 | 250 | Steel | 1213 | 200 | 3.2 | 0.5 | 1,109.98 | 9.58 | 1.48 | 2.19 | Sudden closure | 1.23 | 139.17 | 289.87 | 11.53 | |
| PS2.1 | PS2.2 | 199 | 450 | Steel | 2056 | 450 | 4.5 | 0.5 | 998.52 | 9.77 | 1.03 | 4.12 | Sudden closure | 1.28 | 130.29 | 329.29 | 68.71 | |
| PS2.2 | PS2.3 | 233 | 450 | Steel | 895 | 450 | 4.5 | 0.5 | 998.52 | 9.57 | 0.39 | 1.79 | Sudden closure | 1.28 | 130.29 | 363.29 | 102.71 | |
| PS2.3 | R-ELmain | 196.82 | 450 | Steel | 830 | 450 | 4.5 | 0.5 | 998.52 | 9.33 | 0.17 | 1.66 | Sudden closure | 1.28 | 130.29 | 327.11 | 66.53 | |
| PS3.1 | PS3.2 | 209.98 | 400 | Steel | 4073 | 400 | 4 | 0.5 | 998.52 | 9.21 | 1.47 | 8.16 | Sudden closure | 1.28 | 130.29 | 340.27 | 79.69 | |
| PS3.2 | R-DJAAFRA | 175.03 | 400 | Steel | 4752 | 400 | 4 | 0.5 | 998.52 | 9.00 | 5.39 | 9.52 | Sudden closure | 1.15 | 117.05 | 292.08 | 57.98 | |

**Discussion:**

In this table, we observe that the wave velocity, for steel, fall within the expected range.

The *Pmax* values reveal that all pipelines are under the nominal pressure value, indicating no risk of water hammer phenomenon.

However, the *Pmin* values do not exceed the nominal pressure value. Additionally, the depression values obtained are mostly positive, except for the first pipeline which is -1.44bar. Therefore, there is no risk of pipeline destruction due to the water hammer phenomenon.

## V.11 Water hammer analysis using the envelope method

This method allows for determining precisely the areas prone to flattening due to depressions and areas susceptible to bursting as a result of dangerous overpressures [08].

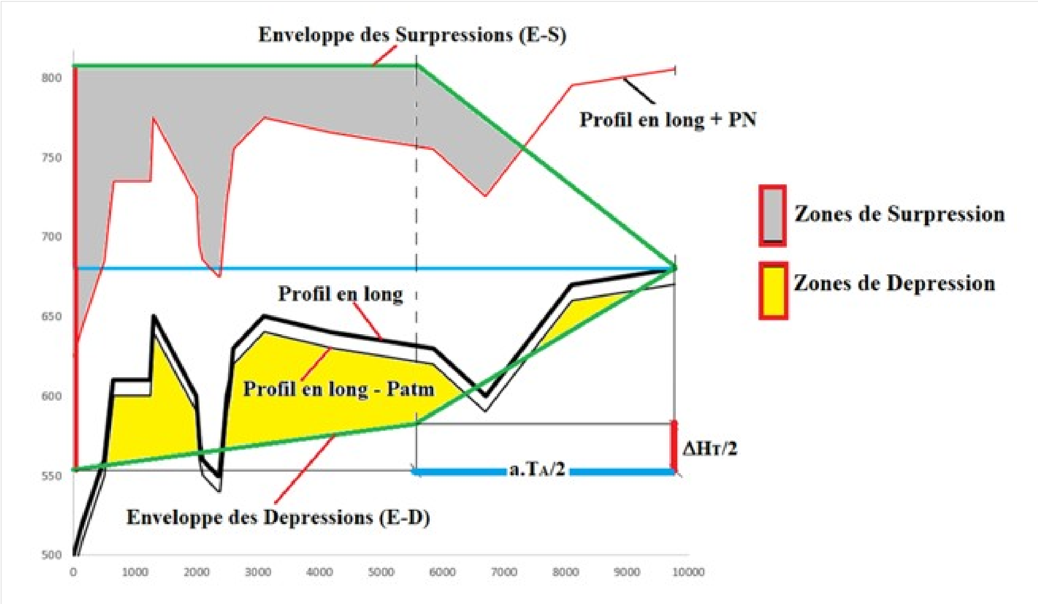



***Figure V.3: The ENVELOPE method for pump flow analysis in sudden water hammer case [08]***

## V.12 Application of the envelope method

**Stretch number 01:** PS1.1- CMC

***Tableau V.11: Water hammer analysis for the first stretch PS1.1 - CMC***

| x | y | Pro - Patm | PN16 | PN20 | PN25 | PN40 |
|---|---|---|---|---|---|---|
| 0 | 325,4 | 315,52 | 485,4 | 525,4 | 575,4 | 725,4 |
| 292 | 301 | 291,12 | 461 | 501 | 551 | 701 |
| 584 | 320 | 310,12 | 480 | 520 | 570 | 720 |
| 788 | 302 | 292,12 | 462 | 502 | 552 | 702 |
| 983 | 327 | 317,12 | 487 | 527 | 577 | 727 |
| 1080 | 317 | 307,12 | 477 | 517 | 567 | 717 |
| 1700 | 460 | 450,12 | 620 | 660 | 710 | 860 |
| | | | | | | |
| **Envloppe - surpression** | | | | **Envloppe - dépression** | | |
| 0 | 608,91 | | | 0 | 311,09 | |
| 696,82 | 608,91 | | | 696,82 | 313,015 | |
| 1700 | 460 | | | 1700 | 460 | |

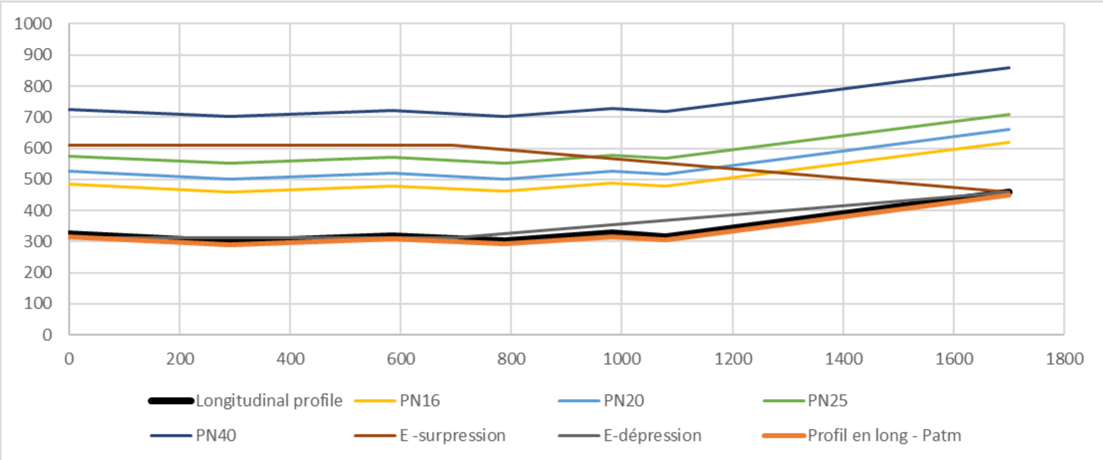



***Figure V.4: Graph stretch PS1.1 - CMC***

**Discussion:**

The previous graph shows that the NP40 curve is above the overpressure envelope, indicating that there is no risk of water hammer phenomenon. In other hand, the curve of the pipeline profile is below the depression envelope so there is no risk of water hammer phenomenon.

**Stretch number 02:** PSB,1- PSB,2

***Tableau V.12: Water hammer analysis for the stretch 02 PSB.1-PSB.2***

| x | y | Pro-Patm | PN16 | PN20 | PN25 | PN40 |
|---|---|---|---|---|---|---|
| 0 | 450 | 440,24 | 610 | 650 | 700 | 850 |
| 597 | 525 | 515,24 | 685 | 725 | 775 | 925 |
| 731 | 518 | 508,24 | 678 | 718 | 768 | 918 |
| 906 | 555 | 545,24 | 715 | 755 | 805 | 955 |
| 1100 | 510 | 500,24 | 670 | 710 | 760 | 910 |
| 4430 | 629,3 | 619,54 | 789,3 | 829,3 | 879,3 | 1029,3 |
| | | | | | | |
| **Envloppe - surpression** | | | **Envloppe - dépression** | | | |
| 0 | 768,47 | | 0 | 490,13 | | |
| 2669,5 | 768,47 | | 2669,5 | 509,195 | | |
| 4430 | 629,3 | | 4430 | 629,3 | | |

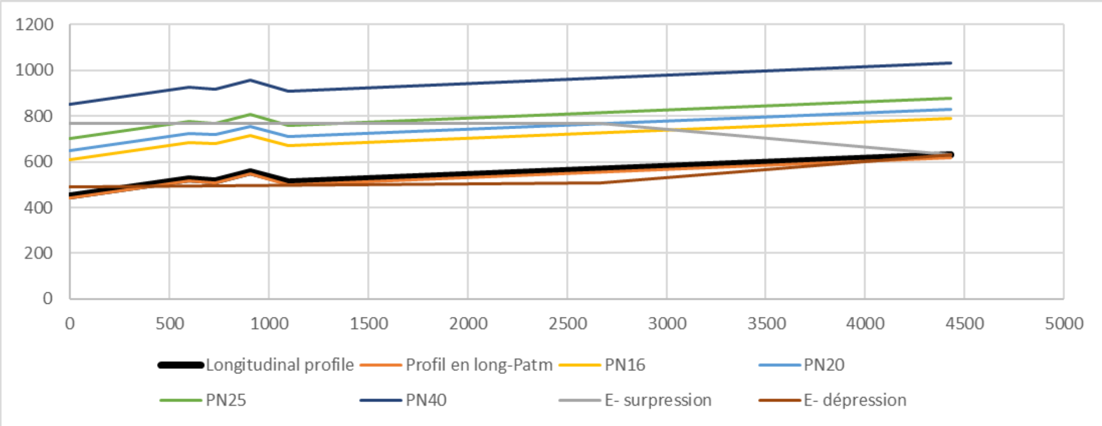



***Figure V.5: Graph stretch PSB.1-PSB.2***

**Discussion:**

This graph shows that the NP40 curve is above the overpressure envelope, indicating that there is no risk of water hammer phenomenon. In the other side, the curve of the pipeline profile is below than the depression envelope from 0m to 300m, so there is no risk of water hammer phenomenon. Then, from 300 to 4430m the curve of pipeline profile is above the depression envelope. So, there will be water hammer phenomenon.

**Stretch number 03:** PSB.2 - R Bouhamza

***Tableau V.13: Water hammer anlysis for the stretch 03 PSB.2 - R Bouhamza***

| x | y | Pro-Patm | PN16 | PN20 | PN25 | PN40 |
|---|---|---|---|---|---|---|
| 0 | 629,3 | 619,72 | 789,3 | 829,3 | 879,3 | 1029,3 |
| 189 | 646 | 636,42 | 806 | 846 | 896 | 1046 |
| 286 | 623 | 613,42 | 783 | 823 | 873 | 1023 |
| 448 | 675 | 665,42 | 835 | 875 | 925 | 1075 |
| 518 | 659 | 649,42 | 819 | 859 | 909 | 1059 |
| 793 | 718 | 708,42 | 878 | 918 | 968 | 1118 |
| 1106 | 726 | 716,42 | 886 | 926 | 976 | 1126 |
| 1213 | 743 | 733,42 | 903 | 943 | 993 | 1143 |

| Envloppe - surpression | | | Envloppe - dépression | |
|---|---|---|---|---|
| 0 | 882,17 | | 0 | 603,83 |
| 821,39 | 882,17 | | 821,39 | 608,01 |
| 1213 | 743 | | 1213 | 743 |

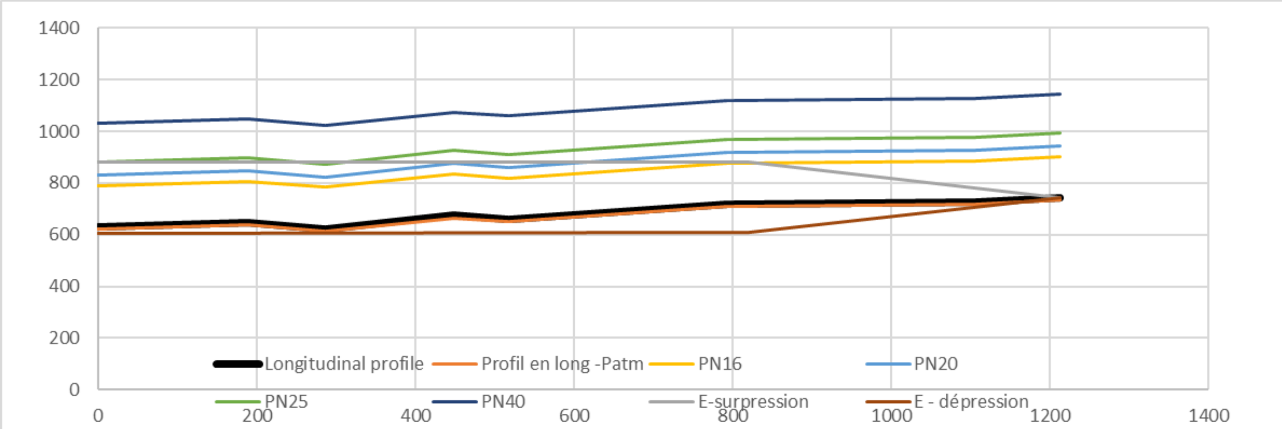



***Figure V.6: Graph stretch PSB.2 - R Bouhamza***

**Discussion:**

This graph shows that the PN40 curve is above the overpressure envelope, indicating that there is no risk of water hammer phenomenon. And, the curve of pipeline profile is greater than the depression envelope. Thus, there is a risk of water hammer phenomenon.

**Stretch number 04:** PS2.1 -PS2.2

***Tableau V.14: Water hammer analysis for the stretch 04 PS2.1- PS2.2***

| x | y | Pro-Patm | PN16 | PN20 | PN25 | PN40 |
|---|---|---|---|---|---|---|
| 0 | 443,18 | 433,41 | 603,18 | 643,18 | 693,18 | 843,18 |
| 898 | 630 | 620,23 | 790 | 830 | 880 | 1030 |
| 1390 | 588 | 578,23 | 748 | 788 | 838 | 988 |
| 2056 | 642,18 | 632,41 | 802,18 | 842,18 | 892,18 | 1042,18 |

| Envloppe - surpression | | | Envloppe - dépression | |
|---|---|---|---|---|
| 0 | 772,47 | | 0 | 511,89 |
| 514,24 | 772,42 | | 514,24 | 515,315 |
| 2056 | 642,18 | | 2056 | 642,18 |

**Discussion:**

This graph shows that the NP40 curve is above the over pressure envelope, indicating that there is no risk of water hammer phenomenon. In the other side, the profile of the pipeline is greater than the depression envelope from 300 m to 2056 m. Thus, there is a risk of water hammer phenomenon.

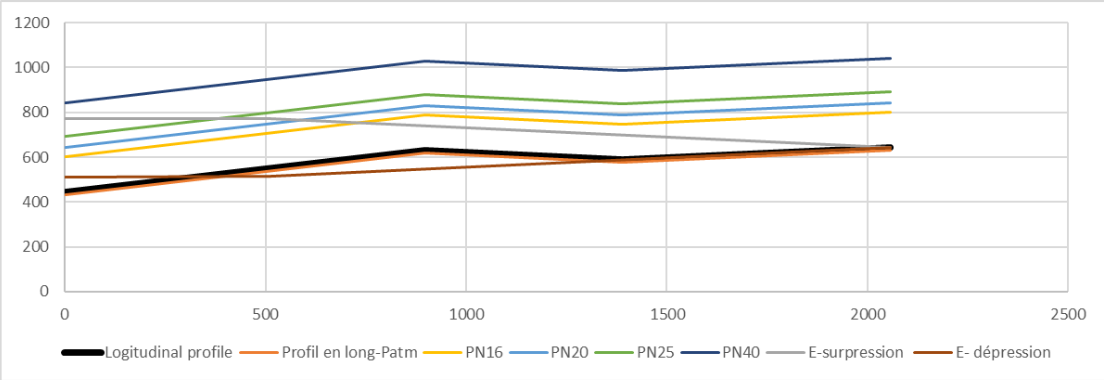



***Figure V.7: Graph stretch PS2.1-PS2.2***

**Stretch number 05:** PS2.2 – PS2.3

***Tableau V.15: Water hammer analysis for the stretch 05 PS2.2-PS2.3***

| x | y | Pro-Patm | PN16 | PN20 | PN25 | PN40 |
|---|---|---|---|---|---|---|
| 0 | 642,18 | 632,61 | 802,18 | 842,18 | 892,18 | 1042,18 |
| 603 | 791 | 781,43 | 951 | 991 | 1041 | 1191 |
| 895 | 875,18 | 865,61 | 1035,18 | 1075,18 | 1125,18 | 1275,18 |
| | | | | | | |
| **Envloppe - surpression** | | | **Envloppe - dépression** | | | |
| 0 | 1005,47 | | 0 | 744,89 | | |
| 194,71 | 1005,47 | | 194,71 | 746,38 | | |
| 895 | 875,18 | | 895 | 875,18 | | |

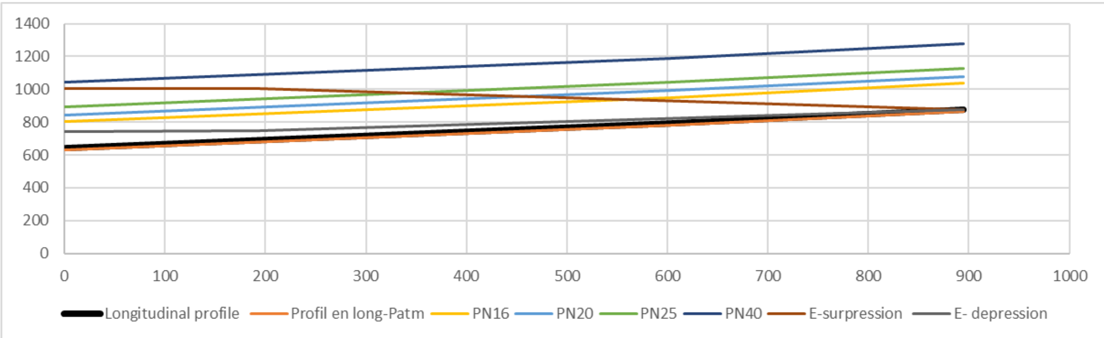



***Figure V.8: Graph stretch PS2.2-PS2.3***

**Discussion:**

This graph shows that the NP40 curve is above the overpressure envelope, indicating that there is no risk of water hammer phenomenon. In the other hand, the depression envelope is greater than the pipeline profile. Therefore, there is no risk of water hammer phenomenon.

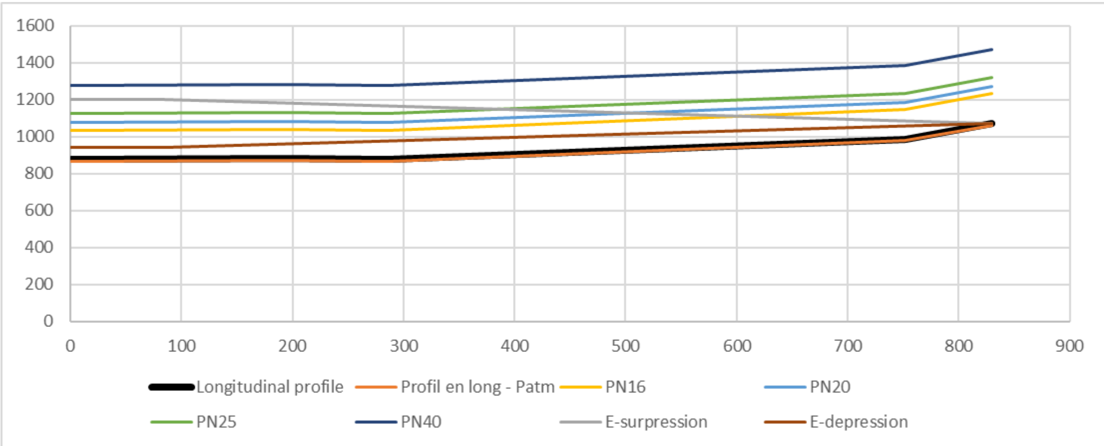
**Stretch number 06:** PS2.3 – R-Elmain

***Tableau V.16: Water hammer analysis for the stretch 06 PS2.3- R Elmain***

| x | y | Pro-Patm | PN16 | PN20 | PN25 | PN40 |
|---|---|---|---|---|---|---|
| 0 | 875,18 | 865,85 | 1035,18 | 1075,18 | 1125,18 | 1275,18 |
| 192 | 881 | 871,67 | 1041 | 1081 | 1131 | 1281 |
| 285 | 875 | 865,67 | 1035 | 1075 | 1125 | 1275 |
| 752 | 986 | 976,67 | 1146 | 1186 | 1236 | 1386 |
| 830 | 1072 | 1062,67 | 1232 | 1272 | 1322 | 1472 |

| Envloppe - surpression | |
|---|---|
| 0 | 1202,29 |
| 84,87 | 1202,29 |
| 830 | 1072 |

| Envloppe - dépression | |
|---|---|
| 0 | 941,71 |
| 84,87 | 943,09 |
| 830 | 1072 |




***FigureV.9: Graph stretch PS2.3- R Elmain***

**Discussion:**

Firstly, the previous graph shows that the NP40 curve is above the overpressure envelope, indicating that there is no risk of water hammer phenomenon. Secondly, the pipeline profile is below than the depression envelope. Thus, there is no risk of water hammer phenomenon.

**Stretch number 07:** PS3.1 – PS3.2

***Tableau V.17: Water hammer analysis for the stretch 07 PS3.1 -PS3.2***

| x | y | Pro-Patm | PN16 | PN20 | PN25 | PN40 |
|---|---|---|---|---|---|---|
| 0 | 998,2 | 988,99 | 1158,2 | 1198,2 | 1248,2 | 1398,2 |
| 40,9 | 1052 | 1042,79 | 1212 | 1252 | 1302 | 1452 |
| 136 | 1049 | 1039,79 | 1209 | 1249 | 1299 | 1449 |
| 304,1 | 1065 | 1055,79 | 1225 | 1265 | 1315 | 1465 |
| 813 | 1145 | 1135,79 | 1305 | 1345 | 1395 | 1545 |
| 876 | 1135 | 1125,79 | 1295 | 1335 | 1385 | 1535 |
| 1130 | 1173 | 1163,79 | 1333 | 1373 | 1423 | 1573 |
| 1440 | 1126 | 1116,79 | 1286 | 1326 | 1376 | 1526 |
| 2250 | 1176 | 1166,79 | 1336 | 1376 | 1426 | 1576 |
| 2350 | 1156 | 1146,79 | 1316 | 1356 | 1406 | 1556 |
| 2500 | 1165 | 1155,79 | 1325 | 1365 | 1415 | 1565 |
| 2780 | 1140 | 1130,79 | 1300 | 1340 | 1390 | 1540 |
| 2970 | 1151 | 1141,79 | 1311 | 1351 | 1401 | 1551 |
| 4073 | 1208,18 | 1198,97 | 1368,18 | 1408,18 | 1458,18 | 1608,18 |

| Envloppe - surpression | |
|---|---|
| 0 | 1338,47 |
| 733,91 | 1338,47 |
| 4073 | 1208,18 |

| Envloppe - dépression | |
|---|---|
| 0 | 1077,89 |
| 733,91 | 1085,59 |
| 4073 | 1208,18 |

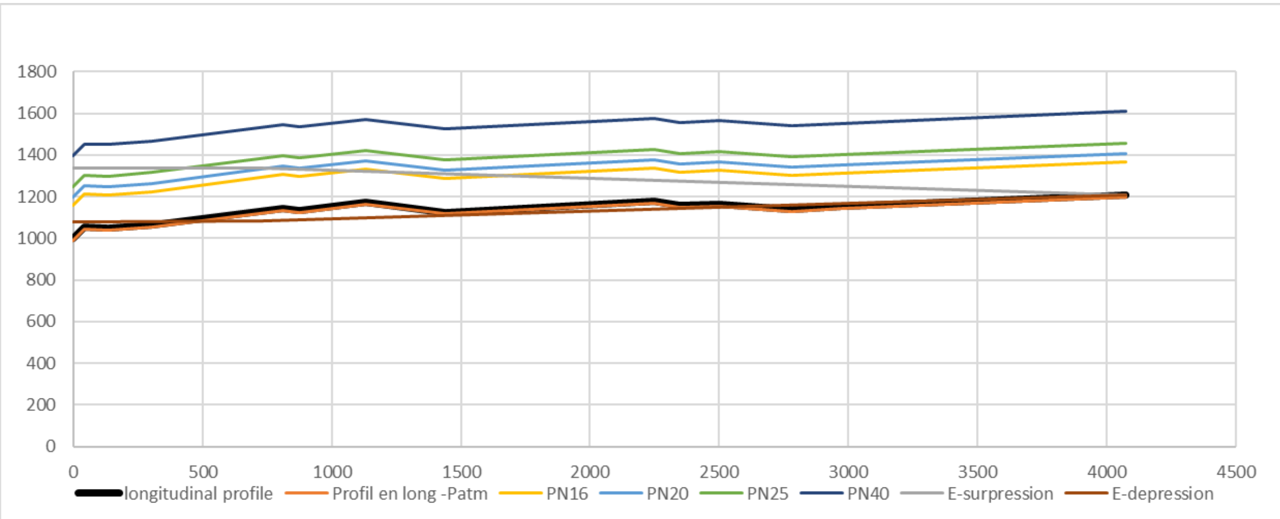



***Figure V.10: Graph stretch PS3.1 -PS3.2***

**Discussion:**

Firstly, the previous graph shows that the NP40 curve is above the overpressuenvelope, indicating that there is no risk of water hammer phenomenon. Secondly, the profile of the pipeline is obove than the depression envelope from 400 m to 2700 m. In conclusion, there is risk of water hammer phenomenon in this part of the pipeline.

**Stretch number 07:** PS3.2– R-DJAAFRA

***Tableau V.18: Water hammer analysis for the stretch 08 PS3.2- R Djaafra***

| x | y | Pro-Patm | PN16 | PN20 | PN25 | PN40 |
|---|---|---|---|---|---|---|
| 0 | 1208,18 | 1199,18 | 1368,18 | 1408,18 | 1458,18 | 1608,18 |
| 749 | 1299 | 1290 | 1459 | 1499 | 1549 | 1699 |
| 1550 | 1237 | 1228 | 1397 | 1437 | 1487 | 1637 |
| 2070 | 1255 | 1246 | 1415 | 1455 | 1505 | 1655 |
| 3020 | 1179 | 1170 | 1339 | 1379 | 1429 | 1579 |
| 4470 | 1329 | 1320 | 1489 | 1529 | 1579 | 1729 |
| 4752 | 1383,21 | 1374,21 | 1543,21 | 1583,21 | 1633,21 | 1783,21 |

| Envloppe - surpression | | Envloppe - dé pression | |
|---|---|---|---|
| 0 | 1500,26 | 0 | 1266,16 |
| 2691,01 | 1500,26 | 2691,01 | 1273,56 |
| 4752 | 1383,21 | 4752 | 1383,21 |

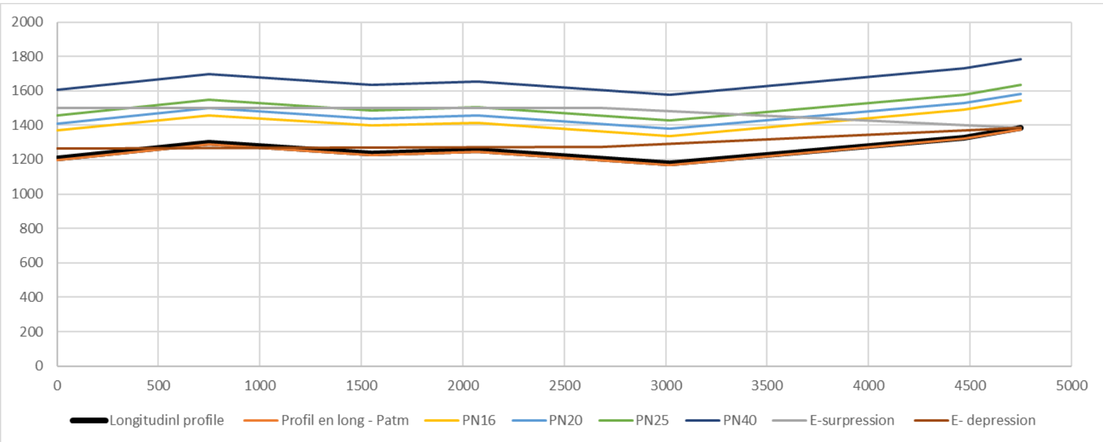



***Figure V.11: Graph stretch PS3.2 -R Djaafra***

**Discussion:**

This graph shows that the NP40 curve is above the overpressure envelope, indicating that there is no risk of water hammer phenomenon. Secondly, the profile of the pipeline is greater than the depression envelope from 600 m to 1100 m so there is risk of water hammer phenomenon in this part of the pipeline.

## V.13 Means of protection against water hammer

When water hammer is dangerous due to overpressure alone, the following measures can be used [08]:

- Selecting a higher NP rating for the pipeline and hydraulic components;
- Sizing relief valves;
- Sizing dual-function air valves with high air Pumped capacity;
- Sizing an anti-water hammer tanks.

When water hammer is dangerous due to depression alone, the following measures can be taken [08]:

- Calculating the allowable depression in the pipeline and conducting necessary checks;
- Sizing inertia wheels;
- Sizing dual-function air valves with high air intake capacity;
- Sizing an anti-water hammer tanks.

When water hammer is dangerous simultaneously due to overpressure and depression, the following measures can be taken [08]:

- Selecting a higher PN rating for the pipeline and hydraulic components + calculating the allowable depression in the pipeline;
- Sizing triple-function air valves;
- Sizing an anti-water hammer tanks;
- Sizing a hybrid protection system composed of relief valves and dual-function air valves with high air intake capacity.

## V.14 Conclusion

An analysis regarding the choice of the pump was conducted in this chapter. Firstly, a general idea about pumps was presented. Then, the decision was made to select the LOWARA and GOULDS brands from Xylem. Also, Parallel and serial coupling of pumps was established for each case as required, and the condition of no-cavitation was checked for each pumping station. Finally, calculations were conducted to determine surges and depressions in the Pumped pipes, revealing that maximal pressure (Pmax) values indicate all sections of the pipelines are under nominal pressure. Consequently, a water hammer analysis was performed on the Pumped pipes using the envelope method.

In the next chapter, we will talk about tanks and their sizing.

# Chapter VI

## *Sizing of Tanks*

## VI.1 Introduction

The municipalities of the two provinces of Bejaia and Bordj Bou Arreridj will be supplied with drinking water from the Tichy-Haf dam. The purpose of this chapter is to determine the necessary storage volumes for the reservoirs in each municipality to ensure optimal functioning of the distribution networks.

## VI.2 Tank presentation

### VI.2.1 Definition

Water tanks are generally necessary to adequately supply a community with drinking water. They are primarily dictated by the difference between the water intake or Pumped flow rate and the water consumption rate by the community (which varies depending on the time of day)[13].

### VI.2.2 Types of reservoirs

- ✔ Reservoirs are classified based on their position relative to the ground [13]:
  - Underground reservoirs;
  - Semi-buried reservoirs;
  - Elevated reservoirs.
- ✔ In terms of their connection to the supply network, they can also be grouped into two types [13]:
  - Passage reservoirs (located between the intake and the water distribution network);
  - Balancing reservoirs (located at the end of the distribution network).

### VI.2.3 Function and utility of reservoirs

The presence of a reservoir between water abstraction, and the distribution network serves several functions [13]:

- ✗ Flow regulation;
- ✗ Pressure regulation;
- ✗ Safety element;

- ✗ Ensuring firefighting reserve;
- ✗ Surge protection;
- ✗ Acting as a relay (buffer reservoir);
- ✗ Ensuring continuity of distribution during pump shutdown.

### VI.2.4 Site Selection for Water Supply Reservoirs

The location of water supply reservoirs is determined based on the topography of the study area, taking into account the following considerations [13]:

- ✗ The distribution network must be gravity-fed, so the reservoir should be built at a higher elevation than the community it serves;
- ✗ When multiple reservoirs are necessary, they should preferably be located either at the end of the distribution network or near a significant consumption center;
- ✗ For elevated reservoirs (water towers), the site selection should follow a simple rule: find the minimum elevation ensuring sufficient service to the highest houses.

## VI.3 Evaluation of hourly consumption based on the number of inhabitants

“The hourly flow of a city varies according to its size. The variation in daily hourly flows is represented according to the number of inhabitants in the table below”[03].

***Tableau VI.1: Adjustment of hourly flow rates based on the number of inhabitants [14]***

| Heures | Nombre d'habitants | | | | |
|---|---|---|---|---|---|
| (h) | < 10000 | 10001à 50000 | 50001 à100000 | > 100000 | Agglomération de type rural |
| 0-1 | 01 | 1.5 | 03 | 3.35 | 0.75 |
| 1-2 | 01 | 1.5 | 3.2 | 3.25 | 0.75 |
| 2-3 | 01 | 1.5 | 2.5 | 3.3 | 01 |
| 3-4 | 01 | 1.5 | 2.6 | 3.2 | 01 |
| 4-5 | 02 | 2.5 | 3.5 | 3.25 | 03 |
| 5-6 | 03 | 3.5 | 4.1 | 3.4 | 5.5 |
| 6-7 | 05 | 4.5 | 4.5 | 3.85 | 5.5 |
| 7-8 | 6.5 | 5.5 | 4.9 | 4.45 | 5.5 |
| 8-9 | 6.5 | 6.25 | 4.9 | 5.2 | 3.5 |
| 9-10 | 5.5 | 6.25 | 4.6 | 5.05 | 3.5 |
| 10-11 | 4.5 | 6.25 | 4.8 | 4.85 | 06 |
| 11-12 | 5.5 | 6.25 | 4.7 | 4.6 | 8.5 |
| 12-13 | 07 | 05 | 4.4 | 4.6 | 8.5 |
| 13-14 | 07 | 05 | 4.1 | 4.55 | 06 |
| 14-15 | 5.5 | 5.5 | 4.2 | 4.75 | 05 |
| 15-16 | 4.5 | 06 | 4.4 | 4.7 | 05 |
| 16-17 | 05 | 06 | 4.3 | 4.65 | 3.5 |
| 17-18 | 6.5 | 5.5 | 4.1 | 4.35 | 3.5 |
| 18-19 | 6.5 | 05 | 4.5 | 4.4 | 06 |
| 19-20 | 5.0 | 4.5 | 4.5 | 4.3 | 06 |
| 20-21 | 4.5 | 04 | 4.5 | 4.3 | 06 |
| 21-22 | 03 | 03 | 4.8 | 3.75 | 03 |
| 22-23 | 02 | 02 | 4.6 | 3.75 | 02 |
| 23-24 | 01 | 1.5 | 3.3 | 3.7 | 01 |
| Somme | 100 | 100 | 100 | 100 | 100 |

## VI.4 Tank capacity

Most often, the reservoir capacity is calculated to meet daily variations in consumption flow, taking into account, of course the day of highest consumption. The reservoir capacity is determined based on the input flow rate and the output flow rate, possibly increased by the fire reserve. Two methods can be applied to determine it [14]:

- The analytical method;
- The graphical method.

### VI.4.1 Analytical Method

The analytical method is based on the maximum daily consumption rate and the pump operation time. The total volume Vt is determined by the following formula [14]:

$$\boxed{Vt = Vr + Vinc} \quad \text{(VI.1)}$$

Where, the regulating volume *Vr* is calculated using the following formula [14]:

$$\boxed{Vr = \frac{Qmax\,day * Pmax\,\%}{100}} \quad \text{(VI.2)}$$

and,

$$\boxed{Pmax = V+(\%) + V-\%} \quad \text{(VI.3)}$$

Given that:

- *V -:* The largest negative value of the difference between the incoming volume and the outgoing volume;
- *V +:* The largest positive value of the difference between the incoming volume and the outgoing volume;
- *Qmax.day:* Maximum daily inflow into the reservoir ($m^3$/day);
- *Vinc:* Fire volume $\boxed{Vinc = 120\,m^3/s}$

## VI.5 Sizing of tanks

If the tank is circular (assuming a height h = 4 m), then:

$$D(m)=\left(\frac{5*Vt}{h*\pi}\right)^{(1/2)} \qquad \text{(VI.4)}$$

**Remark:**

The future tanks will be of the semi-buried type, circular in shape for low-capacity reservoirs, and rectangular or square for larger capacities. A height of 4 meters has been chosen for each tank.

## VI.5.1 Tank sizing for CMC

The arrival at the reservoir is done by pumping, where the pumping time $T_p$ = 22 hours.

*Tableau VI.2: Tank sizing for CMC*

| T(h) | | Contribution % | Distribution departure (Gravitational) % | Volume for 2786.83 ($m^3$/day) | Distribution departure (Gravitational ) % | Volume for 57213.17 $m^3$/day | Sum ($m^3$/day) | Sum % | Water distributed from the reservoir % | Water stored in the reservoir % | Remaining % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 4.55 | 4.16 | 115.93 | 4.16 | 2380.07 | 2496.00 | 4.17 | | 0.38 | 0.38 |
| 1 | 2 | 4.55 | 4.16 | 115.93 | 4.16 | 2380.07 | 2496.00 | 4.17 | | 0.38 | 0.77 |
| 2 | 3 | 4.55 | 4.16 | 115.93 | 4.16 | 2380.07 | 2496.00 | 4.17 | | 0.38 | 1.15 |
| 3 | 4 | 4.55 | 4.16 | 115.93 | 4.16 | 2380.07 | 2496.00 | 4.17 | | 0.38 | 1.54 |
| 4 | 5 | 4.55 | 4.16 | 115.93 | 4.16 | 2380.07 | 2496.00 | 4.17 | | 0.38 | 1.92 |
| 5 | 6 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.38 | 2.30 |
| 6 | 7 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.38 | 2.69 |
| 7 | 8 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.38 | 3.07 |
| 8 | 9 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.38 | 3.46 |
| 9 | 10 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.38 | 3.84 |
| 10 | 11 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.38 | 4.22 |
| 11 | 12 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.38 | 4.61 |
| 12 | 13 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.37 | 4.98 |
| 13 | 14 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.37 | 5.36 |
| 14 | 15 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.37 | 5.73 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 16 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.37 | 6.10 |
| 16 | 17 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.17 | | 0.37 | 6.48 |
| 17 | 18 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.166 | | 0.37 | 6.85 |
| 18 | 19 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.166 | | 0.37 | 7.23 |
| 19 | 20 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.166 | 0.37 | | 7.60 |
| 20 | 21 | 4.55 | 4.17 | 116.21 | 4.17 | 2385.79 | 2502.00 | 4.170 | 0.37 | | 7.97 |
| 21 | 22 | 0 | 4.16 | 115.93 | 4.16 | 2380.07 | 2496.00 | 4.170 | -4.17 | | 3.80 |
| 22 | 23 | 0 | 4.16 | 115.93 | 4.16 | 2380.07 | 2496.00 | 4.170 | -4.17 | | -0.37 |
| 23 | 24 | 4.55 | 4.16 | 115.93 | 4.16 | 2380.07 | 2496.00 | 4.170 | | 0.37 | 0.00 |
| Total | | 100 | 100 | 2786.83 | 100 | 5721..17 | 60000 | 100 | -7.60 | 7.60 | |

| | |
|---|---|
| **Pmax (%)** | 9.08 |
| **Vr** | 5450.40 |
| **Vr+ Vinc = Vt** | 5570.40 |
| **Vt ($m^3$)** | 6000 |
| **h (m)** | 4 |
| **S ($m^2$)** | 1500 |
| **D (m)** | 43.71 |

**Remark**: It is preferred to build 2 tanks of 3000 $m^3$ each, with a diameter of 30.9 meters.

## VI.5.2 Tank sizing for the municipality of Bouhamza, Bejaia province

*Tableau VI.3: Tank sizing for the municipality of Bouhamza*

| T(h) | | Hourly consumption of (Q max/day) | Contribution % | Water distributed from the reservoir % | Water stored in the reservoir % | Remaining % |
|---|---|---|---|---|---|---|
| 0 | 1 | 1.5 | 5 | | 3.5 | 3.5 |
| 1 | 2 | 1.5 | 5 | | 3.5 | 7 |
| 2 | 3 | 1.5 | 5 | | 3.5 | 10.5 |
| 3 | 4 | 1.5 | 5 | | 3.5 | 14 |
| 4 | 5 | 2.5 | 5 | | 2.5 | 16.5 |
| 5 | 6 | 3.5 | 5 | | 1.5 | 18 |
| 6 | 7 | 4.5 | 5 | | 0.5 | 18.5 |
| 7 | 8 | 5.5 | 5 | -0.5 | | 18 |
| 8 | 9 | 6.25 | 5 | -1.25 | | 16.75 |
| 9 | 10 | 6.25 | 5 | -1.25 | | 15.5 |
| 10 | 11 | 6.25 | 5 | -1.25 | | 14.25 |
| 11 | 12 | 6.25 | 5 | -1.25 | | 13 |
| 12 | 13 | 5 | 5 | 0 | | 13 |
| 13 | 14 | 5 | 5 | 0 | | 13 |
| 14 | 15 | 5.5 | 5 | -0.5 | | 12.5 |
| 15 | 16 | 6 | 5 | -1 | | 11.5 |
| 16 | 17 | 6 | 5 | -1 | | 10.5 |
| 17 | 18 | 5.5 | 5 | -0.5 | | 10 |
| 18 | 19 | 5 | 5 | 0 | | 10 |
| 19 | 20 | 4.5 | 0 | -4.5 | | 5.5 |
| 20 | 21 | 4 | 0 | -4 | | 1.5 |
| 21 | 22 | 3 | 0 | -3 | | -1.5 |
| 22 | 23 | 2 | 0 | -2 | | -3.5 |
| 23 | 24 | 1.5 | 5 | | 3.5 | 0 |
| Total | | 100 | 100 | -22 | 22 | |

| | |
|---|---|
| **Pmax (%)** | 22 |
| **Vr** | 613.10 |
| **Vr+ Vinc = Vt** | 733.10 |
| **Vt (m³)** | 1000 |
| **h (m)** | 4 |
| **S (m²)** | 250 |
| **D (m)** | 17.85 |

The arrival at the tank is done by pumping, with a pumping time of Tp= 20h.

### VI.5.3 Tank sizing for the municipality of El main, Bordj Bou-Arreridj province

The arrival at the tank is done by pumping, with a pumping time of Tp= 20h.

***Tableau VI.4: Tank sizing for the municipality of El main***

| T(h) | | Contribution % | Hourly consumption of Q (max/day) | Volume for 3147.93 ($m^3$/day) | Distribution departure (Gravitational) % | Volume for 11560.22 ($m^3$/day) | Sum ($m^3$/day) | Sum % | Water distributed from the reservoir % | Water stored in the reservoir % | Remaining % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 5 | 1.5 | 47.22 | 4.16 | 480.91 | 528.12 | 3.59 | | 1.41 | 1.41 |
| 1 | 2 | 5 | 1.5 | 47.22 | 4.16 | 480.91 | 528.12 | 3.59 | | 1.41 | 2.82 |
| 2 | 3 | 5 | 1.5 | 47.22 | 4.16 | 480.91 | 528.12 | 3.59 | | 1.41 | 4.23 |
| 3 | 4 | 5 | 1.5 | 47.22 | 4.16 | 480.91 | 528.12 | 3.59 | | 1.41 | 5.64 |
| 4 | 5 | 5 | 2.5 | 78.70 | 4.16 | 480.91 | 559.60 | 3.80 | | 1.20 | 6.83 |
| 5 | 6 | 5 | 3.5 | 110.18 | 4.17 | 482.06 | 592.24 | 4.03 | | 0.97 | 7.81 |
| 6 | 7 | 5 | 4.5 | 141.66 | 4.17 | 482.06 | 623.72 | 4.24 | | 0.76 | 8.57 |
| 7 | 8 | 5 | 5.5 | 173.14 | 4.17 | 482.06 | 655.20 | 4.45 | | 0.55 | 9.11 |
| 8 | 9 | 5 | 6.25 | 196.75 | 4.17 | 482.06 | 678.81 | 4.62 | | 0.38 | 9.50 |
| 9 | 10 | 5 | 6.25 | 196.75 | 4.17 | 482.06 | 678.81 | 4.62 | | 0.38 | 9.88 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 11 | 5 | 6.25 | 196.75 | 4.17 | 482.06 | 678.81 | 4.62 | | 0.38 | 10.27 |
| 11 | 12 | 5 | 6.25 | 196.75 | 4.17 | 482.06 | 678.81 | 4.62 | | 0.38 | 10.65 |
| 12 | 13 | 5 | 5 | 157.40 | 4.17 | 482.06 | 639.46 | 4.35 | | 0.65 | 11.30 |
| 13 | 14 | 5 | 5 | 157.40 | 4.17 | 482.06 | 639.46 | 4.35 | | 0.65 | 11.95 |
| 14 | 15 | 5 | 5.5 | 173.14 | 4.17 | 482.06 | 655.20 | 4.45 | | 0.55 | 12.50 |
| 15 | 16 | 5 | 6 | 188.88 | 4.17 | 482.06 | 670.94 | 4.56 | | 0.44 | 12.94 |
| 16 | 17 | 5 | 6 | 188.88 | 4.17 | 482.06 | 670.94 | 4.56 | | 0.44 | 13.38 |
| 17 | 18 | 5 | 5.5 | 173.14 | 4.17 | 482.06 | 655.20 | 4.45 | | 0.55 | 13.92 |
| 18 | 19 | 5 | 5 | 157.40 | 4.17 | 482.06 | 639.46 | 4.35 | | 0.65 | 14.57 |
| 19 | 20 | 0 | 4.5 | 141.66 | 4.17 | 482.06 | 623.72 | 4.24 | -4.24 | | 10.33 |
| 20 | 21 | 0 | 4 | 125.92 | 4.17 | 482.06 | 607.98 | 4.13 | -4.13 | | 6.20 |
| 21 | 22 | 0 | 3 | 94.44 | 4.16 | 480.91 | 575.34 | 3.91 | -3.91 | | 2.29 |
| 22 | 23 | 0 | 2 | 62.96 | 4.16 | 480.91 | 543.86 | 3.70 | -3.70 | | -1.41 |
| 23 | 24 | 5 | 1.5 | 47.22 | 4.16 | 480.91 | 528.12 | 3.59 | | 1.41 | 0.00 |
| Total | | 100 | 100 | 3147.93 | 100 | 11560.22 | 14708.15 | 100 | -15.98 | 15.98 | |

| | |
|---|---|
| **Pmax(%)** | 15.98 |
| **Vr** | 2350.90 |
| **Vr+ Vinc = Vt** | 2470.90 |
| **Vt ($m^3$)** | 3000 |
| **h (m)** | 4 |
| **S ($m^2$)** | 750 |
| **D (m)** | 30.91 |

### VI.5.4 Tank sizing for the municipality of Tafreg, Bordj Bou-Arreridj province

The arrival at the reservoir is done by pumping, with a pumping time of Tp= 20h.

**Tableau VI.5: Tank sizing for the municipality of Tafreg**

| T(h) | | Hourly consumption of (Q max/day) | Contribution % | Water distributed from the reservoir % | Water stored in the reservoir % | Remaining % |
|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 5 | | 4 | 4 |
| 1 | 2 | 1 | 5 | | 4 | 8 |
| 2 | 3 | 1 | 5 | | 4 | 12 |
| 3 | 4 | 1 | 5 | | 4 | 16 |
| 4 | 5 | 2 | 5 | | 3 | 19 |
| 5 | 6 | 3 | 5 | | 2 | 21 |
| 6 | 7 | 5 | 5 | 0 | | 21 |
| 7 | 8 | 6.5 | 5 | -1.5 | | 19.5 |
| 8 | 9 | 6.5 | 5 | -1.5 | | 18 |
| 9 | 10 | 5.5 | 5 | -0.5 | | 17.5 |
| 10 | 11 | 4.5 | 5 | | 0.5 | 18 |
| 11 | 12 | 5.5 | 5 | -0.5 | | 17.5 |
| 12 | 13 | 7 | 5 | -2 | | 15.5 |
| 13 | 14 | 7 | 5 | -2 | | 13.5 |
| 14 | 15 | 5.5 | 5 | -0.5 | | 13 |
| 15 | 16 | 4.5 | 5 | | 0.5 | 13.5 |
| 16 | 17 | 5 | 5 | 0 | | 13.5 |
| 17 | 18 | 6.5 | 5 | -1.5 | | 12 |
| 18 | 19 | 6.5 | 5 | -1.5 | | 10.5 |
| 19 | 20 | 5 | 0 | -5 | | 5.5 |
| 20 | 21 | 4.5 | 0 | -4.5 | | 1 |
| 21 | 22 | 3 | 0 | -3 | | -2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 22 | 23 | 2 | 0 | -2 | | -4 |
| 23 | 24 | 1 | 5 | | 4 | 0 |
| Total | | 100 | 100 | -26 | 26 | |

| | |
|---|---|
| **Pmax (%)** | 25 |
| **Vr** | 283.03 |
| **Vr+ Vinc = Vt** | 403.03 |
| **Vt (m³)** | 500 |
| **h (m)** | 4 |
| **S (m²)** | 125 |
| **D (m)** | 12.62 |

### VI.5.5 Tank sizing for the municipality of Djaafra, Bordj Bou-Arreridj province

The arrival at the reservoir is done by pumping, with a pumping time of Tp= 20h.

*Tableau VI.6: Tank sizing for the municipality of Djaafra*

| T(h) | | Contribution % | Hourly consumption of (Q max/day) | Volume for 4115.12 ($m^3$/day) | Distribution departure (Gravitational) % | Volume for 6312.98 ($m^3$/day) | Sum ($m^3$/day) | Sum % | Water distributed from the reservoir % | Water stored in the reservoir % | Remaining % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 5 | 1.5 | 61.73 | 4.16 | 262.62 | 324.35 | 3.11 | | 1.89 | 1.89 |
| 1 | 2 | 5 | 1.5 | 61.73 | 4.16 | 262.62 | 324.35 | 3.11 | | 1.89 | 3.78 |
| 2 | 3 | 5 | 1.5 | 61.73 | 4.16 | 262.62 | 324.35 | 3.11 | | 1.89 | 5.67 |
| 3 | 4 | 5 | 1.5 | 61.73 | 4.16 | 262.62 | 324.35 | 3.11 | | 1.89 | 7.56 |
| 4 | 5 | 5 | 2.5 | 102.88 | 4.16 | 262.62 | 365.50 | 3.50 | | 1.50 | 9.05 |
| 5 | 6 | 5 | 3.5 | 144.03 | 4.17 | 263.25 | 407.28 | 3.91 | | 1.09 | 10.15 |
| 6 | 7 | 5 | 4.5 | 185.18 | 4.17 | 263.25 | 448.43 | 4.30 | | 0.70 | 10.85 |
| 7 | 8 | 5 | 5.5 | 226.33 | 4.17 | 263.25 | 489.58 | 4.69 | | 0.31 | 11.15 |
| 8 | 9 | 5 | 6.25 | 257.20 | 4.17 | 263.25 | 520.45 | 4.99 | | 0.01 | 11.16 |
| 9 | 10 | 5 | 6.25 | 257.20 | 4.17 | 263.25 | 520.45 | 4.99 | | 0.01 | 11.17 |
| 10 | 11 | 5 | 6.25 | 257.20 | 4.17 | 263.25 | 520.45 | 4.99 | | 0.01 | 11.18 |
| 11 | 12 | 5 | 6.25 | 257.20 | 4.17 | 263.25 | 520.45 | 4.99 | | 0.01 | 11.19 |
| 12 | 13 | 5 | 5 | 205.76 | 4.17 | 263.25 | 469.01 | 4.50 | | 0.50 | 11.69 |
| 13 | 14 | 5 | 5 | 205.76 | 4.17 | 263.25 | 469.01 | 4.50 | | 0.50 | 12.19 |
| 14 | 15 | 5 | 5.5 | 226.33 | 4.17 | 263.25 | 489.58 | 4.69 | | 0.31 | 12.50 |
| 15 | 16 | 5 | 6 | 246.91 | 4.17 | 263.25 | 510.16 | 4.89 | | 0.11 | 12.61 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 17 | 5 | 6 | 246.91 | 4.17 | 263.25 | 510.16 | 4.89 | | 0.11 | 12.72 |
| 17 | 18 | 5 | 5.5 | 226.33 | 4.17 | 263.25 | 489.58 | 4.69 | | 0.31 | 13.02 |
| 18 | 19 | 5 | 5 | 205.76 | 4.17 | 263.25 | 469.01 | 4.50 | | 0.50 | 13.52 |
| 19 | 20 | 0 | 4.5 | 185.18 | 4.17 | 263.25 | 448.43 | 4.30 | -4.30 | | 9.22 |
| 20 | 21 | 0 | 4 | 164.60 | 4.17 | 263.25 | 427.86 | 4.10 | -4.10 | | 5.12 |
| 21 | 22 | 0 | 3 | 123.45 | 4.16 | 262.62 | 386.07 | 3.70 | -3.70 | | 1.42 |
| 22 | 23 | 0 | 2 | 82.30 | 4.16 | 262.62 | 344.92 | 3.31 | -3.31 | | -1.89 |
| 23 | 24 | 5 | 1.5 | 61.73 | 4.16 | 262.62 | 324.35 | 3.11 | | 1.89 | 0.00 |
| Total | | 100 | 100 | 4115.12 | 100 | 6312.98 | 10428.1 | 100 | -15.41 | 15.41 | |

| | |
|---|---|
| **Pmax (%)** | 15.41 |
| **Vr** | 1607.28 |
| **Vr+ Vinc = Vt** | 1727.28 |
| **Vt ($m^3$)** | 2000 |
| **h (m)** | 4 |
| **S ($m^2$)** | 500 |
| **D (m)** | 25.24 |

## VI.5.6 Tank sizing for the municipality of Colla, Bordj Bou-Arreridj province

The water flows into the reservoir due to gravity.

***Tableau VI.7: Tank sizing for the municipality of Colla***

| T(h) | | Hourly consumption of (Q max/day) | Contribution % | Water distributed from the reservoir % | Water stored in the reservoir % | Remaining % |
|---|---|---|---|---|---|---|
| 0 | 1 | 1.5 | 4.16 | | 2.66 | 2.66 |
| 1 | 2 | 1.5 | 4.16 | | 2.66 | 5.32 |
| 2 | 3 | 1.5 | 4.16 | | 2.66 | 7.98 |
| 3 | 4 | 1.5 | 4.16 | | 2.66 | 10.64 |
| 4 | 5 | 2.5 | 4.16 | | 1.66 | 12.3 |
| 5 | 6 | 3.5 | 4.17 | | 0.67 | 12.97 |
| 6 | 7 | 4.5 | 4.17 | -0.33 | | 12.64 |
| 7 | 8 | 5.5 | 4.17 | -1.33 | | 11.31 |
| 8 | 9 | 6.25 | 4.17 | -2.08 | | 9.23 |
| 9 | 10 | 6.25 | 4.17 | -2.08 | | 7.15 |
| 10 | 11 | 6.25 | 4.17 | -2.08 | | 5.07 |
| 11 | 12 | 6.25 | 4.17 | -2.08 | | 2.99 |
| 12 | 13 | 5 | 4.17 | -0.83 | | 2.16 |
| 13 | 14 | 5 | 4.17 | -0.83 | | 1.33 |
| 14 | 15 | 5.5 | 4.17 | -1.33 | | 0 |
| 15 | 16 | 6 | 4.17 | -1.83 | | -1.83 |
| 16 | 17 | 6 | 4.17 | -1.83 | | -3.66 |
| 17 | 18 | 5.5 | 4.17 | -1.33 | | -4.99 |
| 18 | 19 | 5 | 4.17 | -0.83 | | -5.82 |
| 19 | 20 | 4.5 | 4.17 | -0.33 | | -6.15 |
| 20 | 21 | 4 | 4.17 | | 0.17 | -5.98 |
| 21 | 22 | 3 | 4.16 | | 1.16 | -4.82 |
| 22 | 23 | 2 | 4.16 | | 2.16 | -2.66 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 23 | 24 | 1.5 | 4.16 | | 2.66 | 0 |
| Total | | 100 | 100 | -19.12 | 19.12 | |

| | |
|---|---|
| **Pmax (%)** | 19.12 |
| **Vr** | 589.16 |
| **Vr+ Vinc = Vt** | 709.16 |
| **Vt (m³)** | 1000 |
| **h (m)** | 4 |
| **S (m²)** | 250 |
| **D (m)** | 17.85 |

## VI.5.7 Tank sizing for the municipality of Theniet enaser, Bordj Bou-Arreridj province

The water flows into the reservoir due to gravity.

**Tableau VI.8: Tank sizing for the municipality of Theniet enaser**

| T(h) | | Hourly consumption of (Q max/day) | Contribution % | Water distributed from the reservoir % | Water stored in the reservoir % | Remaining % |
|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 4.16 | | 3.16 | 3.16 |
| 1 | 2 | 1 | 4.16 | | 3.16 | 6.32 |
| 2 | 3 | 1 | 4.16 | | 3.16 | 9.48 |
| 3 | 4 | 1 | 4.16 | | 3.16 | 12.64 |
| 4 | 5 | 2 | 4.16 | | 2.16 | 14.8 |
| 5 | 6 | 3 | 4.17 | | 1.17 | 15.97 |
| 6 | 7 | 5 | 4.17 | -0.83 | | 15.14 |
| 7 | 8 | 6.5 | 4.17 | -2.33 | | 12.81 |
| 8 | 9 | 6.5 | 4.17 | -2.33 | | 10.48 |
| 9 | 10 | 5.5 | 4.17 | -1.33 | | 9.15 |
| 10 | 11 | 4.5 | 4.17 | -0.33 | | 8.82 |
| 11 | 12 | 5.5 | 4.17 | -1.33 | | 7.49 |
| 12 | 13 | 7 | 4.17 | -2.83 | | 4.66 |
| 13 | 14 | 7 | 4.17 | -2.83 | | 1.83 |
| 14 | 15 | 5.5 | 4.17 | -1.33 | | 0.5 |
| 15 | 16 | 4.5 | 4.17 | -0.33 | | 0.17 |
| 16 | 17 | 5 | 4.17 | -0.83 | | -0.66 |
| 17 | 18 | 6.5 | 4.17 | -2.33 | | -2.99 |
| 18 | 19 | 6.5 | 4.17 | -2.33 | | -5.32 |
| 19 | 20 | 5 | 4.17 | -0.83 | | -6.15 |
| 20 | 21 | 4.5 | 4.17 | -0.33 | | -6.48 |
| 21 | 22 | 3 | 4.16 | | 1.16 | -5.32 |
| 22 | 23 | 2 | 4.16 | | 2.16 | -3.16 |
| 23 | 24 | 1 | 4.16 | | 3.16 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Total | | 100 | 100 | -22.45 | 22.45 | |

| | |
|---|---|
| **Pmax (%)** | 22.45 |
| **Vr** | 725.49 |
| **Vr+ Vinc = Vt** | 845.49 |
| **Vt ($m^3$)** | 1000 |
| **h (m)** | 4 |
| **S ($m^2$)** | 250 |
| **D (m)** | 17.85 |

## VI.6 Conclusion

In this chapter, the sizing and capacity calculations of potable water supply tanks were examined in detail.

Firstly, the current drinking water needs of the population were analyzed, alongside demographic growth forecasts for the coming years (chapter number 03). Next, tank capacity calculations were approached using the analytical method. It was determined that the first tank would have a capacity of 6000 $m^3$, filled by pumping over a duration of 22 hours. However, this volume has been divided into two tanks, each with a capacity of 3000 $m^3$. The tank designated for the municipality of Bouhamza has a capacity of 1000 $m^3$. Regarding the municipalities of the Bordj Bou Arreridj province, their capacities are as follows: El Maine with 3000 $m^3$, Tafreg with 500 $m^3$, Djaafra with 2000 $m^3$, Colla and Theniet Enaser with 1000 $m^3$ each.

# *Conclusion*

## *Conclusion*

Through this work, we have studied the project of transferring drinking water from the Tichy-Haf dam to two provinces which are Béjaia and Bordj-Bou-Arréridj, to meet the needs of 6 municipalities as follows:

- In the province of Bordj Bou Arreridj: Djafraa, Teffreg, Colla, El Main, and Theniet Enaser;
- In the province of Béjaïa: Bouhamza.

This study on drinking water supply is projected for the year 2060, by which time the population of the entire study area is expected to reach 4,096,896 inhabitants. Consumption flow rates were assessed, with the total sum of the maximum daily flow rate amounting to 59,670.40 $m^3$/day. We have opted for a value of 60,000 $m^3$/day for the design of the drinking water supply network.

For material choice, HDPE and steel were selected. Then we illustrated the project layout using Google Earth and Epanet softwares. Following this, we conducted a comprehensive study of the water supply network, considering both the gravity-fed and pumped sections. This involved calculating various hydraulic parameters such as diameter, velocity, nominal pressure, total head loss, and total dynamic head for each segment. Additionally, we conducted a basic study on water hammer phenomena.

For pump selection, we opted for two brands: LOWARA and GOULDS from Xylem, ensuring that the pumps meet the necessary specifications. These specifications include total dynamic head, efficiency, flow rate, and available net positive suction head (NPSH). The available NPSH should exceed the required NPSH of the pump to prevent cavitation phenomena.

Each municipality necessitates a storage reservoir. We conducted detailed sizing and capacity calculations for potable water supply reservoirs. The initial reservoir, designated as a charging station, would hold a capacity of 6000 $m^3$. Furthermore, the reservoir for the municipality of Bouhamza is sized at 1000 $m^3$. Concerning the municipalities within the Bordj Bou Arreridj province, their respective capacities are as follows: El Main with 3000 $m^3$, Teffreg with 500 $m^3$, Djafraa with

2000 $m^3$, while Colla and Theniet Enaser each require a reservoir with a capacity of 1000 $m^3$.

Ultimately, this internship provided a transition from theory to practical application in the professional world. It enabled me to acquire new knowledge, particularly in using Google Earth and Epanet software. Lastly, we trust that this modest effort will serve as a valuable reference for students.

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# *Annexes*

**Population résidente des ménages ordinaires et collectifs (MOC)**
**selon la wilaya de résidence et le sexe et le taux d'accroissement annuel moyen (1998-2008)**

| Wilayas | الذكور<br>Masculin | الإناث<br>Féminin | المجموع<br>Total | معدل النمو<br>Taux d'accroissement | الولاية |
|---|---|---|---|---|---|
| Adrar | 203836 | 195878 | 399714 | **2.6** | أدرار |
| Chlef | 502470 | 499618 | 1002088 | **1.6** | الشلف |
| Laghouat | 232517 | 223085 | 455602 | **3.8** | الأغواط |
| Oum El Bouaghi | 314084 | 307527 | 621612 | **1.9** | أم البواقي |
| Batna | 565320 | 554472 | 1119791 | **1.6** | باتنة |
| Bejaia | 465612 | 446965 | 912577 | **0.6** | بجاية |
| Biskra | 365040 | 356317 | 721356 | **2.3** | بسكرة |
| Bechar | 135436 | 134626 | 270061 | **1.9** | بشار |
| Blida | 509602 | 493335 | 1002937 | **2.5** | البليدة |
| Bouira | 353195 | 342387 | 695583 | **1.0** | البويرة |
| Tamanrasset | 90820 | 85816 | 176637 | **2.6** | تامنغست |
| Tébessa | 326086 | 322617 | 648703 | **1.7** | تبسة |
| Tlemcen | 482364 | 466771 | 949135 | **1.2** | تلمسان |
| Tiaret | 427358 | 419465 | 846823 | **1.6** | تيارت |
| Tizi Ouzou | 564974 | 562633 | 1127607 | **0.2** | تيزي وزو |
| Alger | 1499800 | 1488345 | 2988145 | **1.6** | الجزائر |
| Djelfa | 562207 | 529977 | 1092184 | **3.3** | الجلفة |
| Jijel | 320820 | 316128 | 636948 | **1.1** | جيجل |
| Sétif | 756434 | 733545 | 1489979 | **1.3** | سطيف |
| Saida | 166717 | 163925 | 330641 | **1.7** | سعيدة |
| Skikda | 452392 | 446288 | 898680 | **1.4** | سكيكدة |
| Sidi Bel Abbes | 305130 | 299614 | 604744 | **1.4** | سيدي بلعباس |
| Annaba | 305030 | 304469 | 609499 | **0.9** | عنابة |
| Guelma | 242430 | 240001 | 482430 | **1.2** | قالمة |

السكان المقيمين من الأسر العادية والجماعية حسب ولاية الإقامة والجنس ومعدل النمو السنوي (**1998-2008**)

**Population résidente des ménages ordinaires et collectifs (MOC)selon la wilaya de résidence et le sexe et le taux d'accroissement annuel moyen (1998-2008) (Suite)**

| Wilaya | الذكور Masculin | الإناث Féminin | المجموع Total | معدل النمو Taux d'accroissement | الولاية |
|---|---|---|---|---|---|
| Constantine | 470262 | 468213 | 938475 | **1.5** | قسنطينة |
| Médéa | 417559 | 402373 | 819932 | **0.2** | المدية |
| Mostaganem | 370018 | 367100 | 737118 | **1.6** | مستغانم |
| M'sila | 504684 | 485907 | 990591 | **2.1** | المسيلة |
| Mascara | 398767 | 385306 | 784073 | **1.5** | معسكر |
| Ouargla | 283389 | 275169 | 558558 | **2.3** | ورقلة |
| Oran | 728221 | 725857 | 1454078 | **1.9** | وهران |
| El Bayadh | 115449 | 113175 | 228624 | **3.1** | البيض |
| Illizi | 28244 | 24088 | 52333 | **4.5** | ايليزى |
| Bordj Bou Arreridj | 320786 | 307689 | 628475 | **1.3** | برج بوعريرج |
| Boumerdes | 411650 | 390433 | 802083 | **2.2** | بومرداس |
| El Tarf | 203933 | 204480 | 408414 | **1.5** | الطارف |
| Tindouf | 24996 | 24153 | 49149 | **6.3** | تندوف |
| Tissemsilt | 149434 | 145042 | 294476 | **1.1** | تيسمسيلت |
| El Oued | 329604 | 317944 | 647548 | **2.6** | الوادى |
| Khenchela | 195502 | 191182 | 386683 | **1.7** | خنشلة |
| Souk Ahras | 218911 | 219216 | 438127 | **1.8** | سوق أهراس |
| Tipaza | 298885 | 292125 | 591010 | **1.6** | تيبازة |
| Mila | 386591 | 380295 | 766886 | **1.3** | ميلة |
| Ain Defla | 388776 | 377236 | 766013 | **1.5** | عين الدفلى |
| Naama | 98299 | 94592 | 192891 | **4.3** | النعامة |
| Ain Temouchent | 187603 | 183636 | 371239 | **1.3** | عين تموشنت |
| Ghardaïa | 185209 | 178390 | 363598 | **2.0** | غرداية |
| Relizane | 366301 | 359879 | 726180 | **1.3** | غليزان |
| **Total** | **17232747** | **16847283** | **34080030** | **1.6** | **المجموع** |

## Annex Number 02

| Province | Subdivision | Agglomerated population (projection) | Allocation (l/d/inhab) | Qave/d (l/d) | K max/d | Qmax/d (l/d) |
|---|---|---|---|---|---|---|
| Bordj Bou-Arréridj | Colla | 7,529 | 150 | 1129293 | 1.45 | 1,637,474.88 |
| | Djaafra | 9,834 | 150 | 1475108 | 1.45 | 2,138,906.43 |
| | El main | 7,669 | 150 | 1150319 | 1.45 | 1,667,961.92 |
| | Taffreg | 2,661 | 100 | 266078 | 1.45 | 385,812.58 |
| | Ouled Dehmane | 20,289 | 150 | 3043355 | 1.45 | 4,412,865.10 |
| | Thassameurt | 5,083 | 150 | 762453 | 1.45 | 1,105,556.29 |
| | Bordj Zemmoura | 12,660 | 150 | 1898939 | 1.60 | 3,038,301.73 |
| | Theniet Annesr | 7,101 | 150 | 1065110 | 1.45 | 1,544,409.18 |
| Sétif | Ain Legredj | 18,035 | 150 | 2705287 | 1.45 | 3,922,665.61 |
| | Béni Chébana | 16,198 | 150 | 2429741 | 1.45 | 3,523,124.95 |
| | Béni Mohli | 10,477 | 100 | 1047711 | 1.45 | 1,519,181.61 |
| | Béni Ourtilane | 13,022 | 150 | 1953347 | 1.45 | 2,832,352.84 |
| | Harbil | 4,519 | 150 | 677797 | 1.45 | 982,805.84 |
| | Guenzet | 4,354 | 150 | 653083 | 1.45 | 946,970.20 |
| Béjaia | Bouhamza | 10,103 | 150 | 1515511 | 1.45 | 2,197,490.40 |
| | | | | | | 31,855,879.58 l/day |
| | | | | | | **31,855.88** **(m³/day)** |

| | | |
|---|---|---|
| **Domestic need (m³/day)** | 31,855.88 | |
| **Public sector (m³/day)** | 3938.4 | |
| **Industrial sector (m³/day)** | 757.39 | |
| **Tertiary sector (m³/day)** | 1514.77 | |
| **TOTAL** | **38,066.44** | **(m³/day)** |

***Figure 1: Domestic needs for the 15 municipalities projected for the year 2024***

| Province | Municipality | Agglomerated population (projection) | Allocation (l/d/inhab) | Qave/d (l/d) | K max/d | Qmax/d (l/d) |
|---|---|---|---|---|---|---|
| Bordj Bou-Arreridj | Colla | 8,135 | 150 | 1220250 | 1.45 | 1,769,362.50 |
| | Djaafra | 10,627 | 150 | 1594050 | 1.45 | 2,311,372.50 |
| | El main | 8,287 | 150 | 1243050 | 1.45 | 1,802,422.50 |
| | Taffreg | 2,875 | 100 | 287500 | 1.45 | 416,875.00 |
| | Ouled Dehmane | 21,924 | 150 | 3288600 | 1.45 | 4,768,470.00 |
| | Thassameurt | 5,493 | 150 | 823950 | 1.45 | 1,194,727.50 |
| | Bordj Zemmoura | 13,680 | 150 | 2052000 | 1.6 | 3,283,200.00 |
| | Theniet Annesr | 7,673 | 150 | 1150950 | 1.45 | 1,668,877.50 |
| Setif | Ain Legredj | 19,489 | 150 | 2923350 | 1.45 | 4,238,857.50 |
| | Béni Chébana | 17,504 | 150 | 2625600 | 1.45 | 3,807,120.00 |
| | Béni Mohli | 11,321 | 150 | 1698150 | 1.45 | 2,462,317.50 |
| | Béni Ourtilane | 14,072 | 150 | 2110800 | 1.45 | 3,060,660.00 |
| | Harbil | 4,883 | 150 | 732450 | 1.45 | 1,062,052.50 |
| | Guenzet | 4,705 | 150 | 705750 | 1.45 | 1,023,337.50 |
| Bejaia | Bouhamza | 10,498 | 150 | 1574700 | 1.45 | 2,283,315.00 |
| | | | | | | 35152967.5 l/day |
| | | | | | | **35,152.97** **(m³/day)** |

| | | |
|---|---|---|
| **Domestic need (m³/day)** | 35,152.97 | |
| **Public sector (m³/day)** | 3938.4 | |
| **Industrial sector (m³/day)** | 757.39 | |
| **Tertiary sector (m³/day)** | 1514.77 | |
| **TOTAL** | **41,363.53** | **m3/j** |

***Figure 2: Domestic needs for the 15 municipalities projected for the year 2030***

| Province | Municipality | Agglomerated population (projection) | Allocation (l/d/inhab) | Qave/d (l/d) | K max/d | Qmax/d (l/d) | |
|---|---|---|---|---|---|---|---|
| Bordj Bou-Arreridj | Colla | 9257 | 150 | 1388550 | 1.45 | 2013397.5 | |
| | Djaafra | 12092 | 150 | 1813800 | 1.45 | 2630010 | |
| | El main | 9429 | 150 | 1414350 | 1.45 | 2050807.5 | |
| | Taffreg | 3272 | 150 | 490800 | 1.45 | 711660 | |
| | Ouled Dehmane | 24947 | 150 | 3742050 | 1.45 | 5425972.5 | |
| | Thassameurt | 6250 | 150 | 937500 | 1.45 | 1359375 | |
| | Bordj Zemmoura | 15566 | 150 | 2334900 | 1.6 | 3735840 | |
| | Theniet Annesr | 8731 | 150 | 1309650 | 1.45 | 1898992.5 | |
| Setif | Ain Legredj | 22175 | 150 | 3326250 | 1.45 | 4823062.5 | |
| | Béni Chébana | 19917 | 150 | 2987550 | 1.45 | 4331947.5 | |
| | Béni Mohli | 12882 | 150 | 1932300 | 1.45 | 2801835 | |
| | Béni Ourtilane | 16012 | 150 | 2401800 | 1.45 | 3482610 | |
| | Harbil | 5556 | 150 | 833400 | 1.45 | 1208430 | |
| | Guenzet | 5353 | 150 | 802950 | 1.45 | 1164277.5 | |
| Bejaia | Bouhamza | 11189 | 150 | 1678350 | 1.45 | 2433607.5 | |
| | | | | | | 40071825 | l/day |
| | | | | | | **40071.825** | **(m³/day)** |

| | | |
|---|---|---|
| **Domestic need (m³/day)** | 40,071.83 | |
| **Public sector (m³/day)** | 3938.4 | |
| **Industrial sector (m³/day)** | 757.39 | |
| **Tertiary sector (m³/day)** | 1514.77 | |
| **TOTAL** | **46282.385** | **(m³/day)** |

***Figure 3: Domestic needs for the 15 municipalities projected for the year 2040***

| Province | Municipality | Agglomerated population (projection) | Allocation (l/d/inhab) | Qave/d (l/d) | K max/d | Qmax/d (l/d) | Sparse population projection 2050 | Allocation (l/d/inhab) | Qave/d (l/d) | K max/d | Qmax/d (l/d) | Domestic need (m³/day) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bordj Bou-Arreridj | Colla | 10533 | 150 | 1579950 | 1.45 | 2290927.5 | 715 | 95 | 67925 | 1.45 | 98491.25 | 2389418.75 | |
| | Djaafra | 13759 | 150 | 2063850 | 1.45 | 2992582.5 | 1535 | 95 | 145825 | 1.45 | 211446.25 | 3204028.75 | |
| | El main | 10729 | 150 | 1609350 | 1.45 | 2333557.5 | 796 | 95 | 75620 | 1.45 | 109649 | 2443206.5 | |
| | Taffreg | 3723 | 150 | 558450 | 1.45 | 809752.5 | 498 | 95 | 47310 | 1.45 | 68599.5 | 878352 | |
| | Ouled Dehmane | 28386 | 150 | 4257900 | 1.45 | 6173955 | 2908 | 95 | 276260 | 1.45 | 400577 | 6574532 | |
| | Thassameurt | 7112 | 150 | 1066800 | 1.45 | 1546860 | 1021 | 95 | 96995 | 1.45 | 140642.75 | 1687502.75 | |
| | Bordj Zemmoura | 17712 | 150 | 2656800 | 1.6 | 4250880 | 1552 | 95 | 147440 | 1.6 | 235904 | 4486784 | |
| | Theniet Annesr | 9935 | 150 | 1490250 | 1.45 | 2160862.5 | 3158 | 95 | 300010 | 1.45 | 435014.5 | 2595877 | |
| Setif | Ain Legredj | 25233 | 150 | 3784950 | 1.45 | 5488177.5 | 2187 | 95 | 207765 | 1.45 | 301259.25 | 5789436.75 | |
| | Béni Chébana | 22663 | 150 | 3399450 | 1.45 | 4929202.5 | 2067 | 95 | 196365 | 1.45 | 284729.25 | 5213931.75 | |
| | Béni Mohli | 14658 | 150 | 2198700 | 1.45 | 3188115 | 976 | 95 | 92720 | 1.45 | 134444 | 3322559 | |
| | Béni Ourtilane | 18219 | 150 | 2732850 | 1.45 | 3962632.5 | 890 | 95 | 84550 | 1.45 | 122597.5 | 4085230 | |
| | Harbil | 6322 | 150 | 948300 | 1.45 | 1375035 | 725 | 95 | 68875 | 1.45 | 99868.75 | 1474903.75 | |
| | Guenzet | 6091 | 150 | 913650 | 1.45 | 1324792.5 | 1049 | 95 | 99655 | 1.45 | 144499.75 | 1469292.25 | |
| Bejaia | Bouhamza | 11926 | 150 | 1788900 | 1.45 | 2593905 | 0 | 95 | 0 | 1.45 | 0 | 2593905 | |
| | | | | | **TOTAL** | 45421237.5 | **l/day** | | | **TOTAL** | 2787722.75 | | |
| | | | | | | | | | | | | 48208960.25 | l/day |
| | | | | | | | | | | | | **48,208.96** | **(m³/day)** |

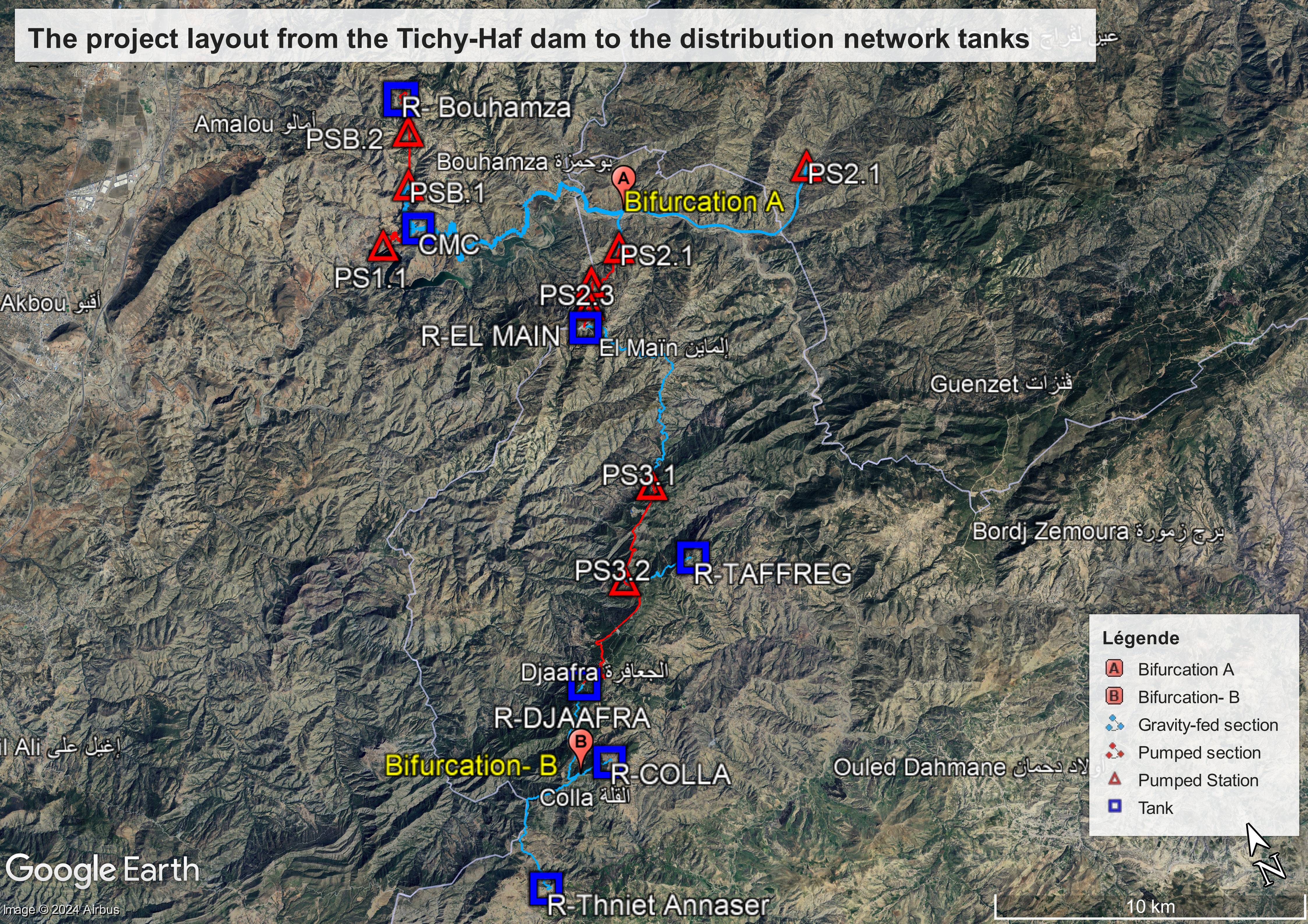
| Horizon of 2050 | | | | water needs (m³/day) | | | | |
|---|---|---|---|---|---|---|---|---|
| **Province** | **Subdivision** | **Agglomerated population (projection)** | **Sparse population projection 2050** | **Domestic need (m3/j)** | **public sector (m³/day)** | **industrial sector (m³/day)** | **tertiary sector (m³/day)** | TOTAL (m³/day) |
| Bordj Bou-Arreridj | Colla | 10533 | 715 | 2,389.42 | 215.92 | 41.52 | 83.05 | 2,729.91 |
| | Djaafra | 13759 | 15087 | 3,204.03 | 283.73 | 54.56 | 109.13 | 3,651.45 |
| | El main | 10729 | 11935 | 2,443.21 | 219.29 | 42.17 | 84.34 | 2,789.01 |
| | Taffreg | 3723 | 4108 | 878.35 | 70.24 | 13.51 | 27.01 | 989.11 |
| | Ouled Dehmane | 28386 | 30739 | 6,574.53 | 575.38 | 110.65 | 221.3 | 7,481.86 |
| | Thassameurt | 7112 | 7840 | 1,687.50 | 134.91 | 25.94 | 51.89 | 1,900.24 |
| | Bordj Zemmoura | 17712 | 18204 | 4,486.78 | 338.65 | 65.12 | 130.25 | 5,020.80 |
| | Theniet Annesr | 9935 | 7903 | 2,595.88 | 162.29 | 31.21 | 62.42 | 2,851.80 |
| Setif | Ain Legredj | 25233 | 29137 | 5,789.44 | 538.36 | 103.53 | 207.06 | 6,638.39 |
| | Béni Chébana | 22663 | 25421 | 5,213.93 | 471.67 | 90.71 | 181.41 | 5,957.72 |
| | Béni Mohli | 14658 | 16240 | 3,322.56 | 297.07 | 57.13 | 114.26 | 3,791.02 |
| | Béni Ourtilane | 18219 | 22144 | 4,085.23 | 399.62 | 76.85 | 153.7 | 4,715.40 |
| | Harbil | 6322 | 7157 | 1,474.90 | 120.6 | 23.19 | 46.39 | 1,665.08 |
| | Guenzet | 6091 | 6264 | 1,469.29 | 110.67 | 21.28 | 42.57 | 1,643.81 |
| Bejaia | Bouhamza | 11926 | 0 | 2,593.91 | 0 | 0 | 0 | 2,593.91 |
| **TOTAL** | | 207001 | 202894 | 48,208.96 | 3938.4 | 757.37 | 1514.78 | 54,419.51 |

***Figure 4: Domestic needs for the 15 municipalities projected for the year 2050***

| Province | Municipality | Agglomerated population (projection) | Allocation (l/d/inhab) | Qave/d (l/d) | K max/d | Qmax/d (l/d) | Sparse population projection 2050 | Allocation (l/d/inhab) | Qave/d (l/d) | K max/d | Qmax/d (l/d) | Domestic need ($m^3$/day) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bordj Bou-Arreridj | Colla | 11092 | 150 | 1663800 | 1.45 | 2,412,510.00 | 753 | 95 | 71535 | 1.45 | 103,725.75 | 2,516,235.75 | |
| | Djaafra | 14488 | 150 | 2173200 | 1.45 | 3,151,140.00 | 1616 | 95 | 153520 | 1.45 | 222,604.00 | 3,373,744.00 | |
| | El main | 11298 | 150 | 1694700 | 1.45 | 2,457,315.00 | 838 | 95 | 79610 | 1.45 | 115,434.50 | 2,572,749.50 | |
| | Taffreg | 3920 | 150 | 588000 | 1.45 | 852,600.00 | 524 | 95 | 49780 | 1.45 | 72,181.00 | 924,781.00 | |
| | Ouled Dehmane | 29891 | 150 | 4483650 | 1.45 | 6,501,292.50 | 3062 | 95 | 290890 | 1.45 | 421,790.50 | 6,923,083.00 | |
| | Thassameurt | 7489 | 150 | 1123350 | 1.45 | 1,628,857.50 | 1075 | 95 | 102125 | 1.45 | 148,081.25 | 1,776,938.75 | |
| | Bordj Zemmoura | 18651 | 150 | 2797650 | 1.6 | 4,476,240.00 | 1634 | 95 | 155230 | 1.6 | 248,368.00 | 4,724,608.00 | |
| | Theniet Annesr | 10461 | 150 | 1569150 | 1.45 | 2,275,267.50 | 3325 | 95 | 315875 | 1.45 | 458,018.75 | 2,733,286.25 | |
| Setif | Ain Legredj | 26571 | 150 | 3985650 | 1.45 | 5,779,192.50 | 2303 | 95 | 218785 | 1.45 | 317,238.25 | 6,096,430.75 | |
| | Béni Chébana | 23864 | 150 | 3579600 | 1.45 | 5,190,420.00 | 2177 | 95 | 206815 | 1.45 | 299,881.75 | 5,490,301.75 | |
| | Béni Mohli | 15436 | 150 | 2315400 | 1.45 | 3,357,330.00 | 1028 | 95 | 97660 | 1.45 | 141,607.00 | 3,498,937.00 | |
| | Béni Ourtilane | 19185 | 150 | 2877750 | 1.45 | 4,172,737.50 | 937 | 95 | 89015 | 1.45 | 129,071.75 | 4,301,809.25 | |
| | Harbil | 6657 | 150 | 998550 | 1.45 | 1,447,897.50 | 763 | 95 | 72485 | 1.45 | 105,103.25 | 1,553,000.75 | |
| | Guenzet | 6415 | 150 | 962250 | 1.45 | 1,395,262.50 | 1105 | 95 | 104975 | 1.45 | 152,213.75 | 1,547,476.25 | |
| Bejaia | Bouhamza | 12235 | 150 | 1835250 | 1.45 | 2,661,112.50 | 0 | 95 | 0 | 1.45 | 0.00 | 2,661,112.50 | |
| | | | | | TOTAL | 47,759,175.00 | l/day | | | TOTAL | 2,935,319.50 | | |
| | | | | | | | | | | | | 50,694,494.50 | l/day |
| | | | | | | | | | | | | 50,694.49 | ($m^3$/day) |

| Horizon of 2054 | | | | Water needs ($m^3$/day) | | | | |
|---|---|---|---|---|---|---|---|---|
| Province | Municipality | Agglomerated population (projection) | Sparse population projection 2054 | Domestic need (m3/day) | public sector ($m^3$/day) | industrial sector ($m^3$/day) | tertiary sector ($m^3$/day) | TOTAL ($m^3$/day) |
| Bordj Bou-Arreridj | Colla | 11092 | 715 | 2516.23575 | 215.92 | 41.52 | 83.05 | 2856.72575 |
| | Djaafra | 14488 | 15087 | 3373.744 | 283.73 | 54.56 | 109.13 | 3821.164 |
| | El main | 11298 | 11935 | 2572.7495 | 219.29 | 42.17 | 84.34 | 2918.5495 |
| | Taffreg | 3920 | 4108 | 924.781 | 70.24 | 13.51 | 27.01 | 1035.541 |
| | Ouled Dehmane | 29891 | 30739 | 6923.083 | 575.38 | 110.65 | 221.3 | 7830.413 |
| | Thassameurt | 7489 | 7840 | 1776.93875 | 134.91 | 25.94 | 51.89 | 1989.67875 |
| | Bordj Zemmoura | 18651 | 18204 | 4724.608 | 338.65 | 65.12 | 130.25 | 5258.628 |
| | Theniet Annesr | 10461 | 7903 | 2733.28625 | 162.29 | 31.21 | 62.42 | 2989.20625 |
| Setif | Ain Legredj | 26571 | 29137 | 6096.43075 | 538.36 | 103.53 | 207.06 | 6945.38075 |
| | Béni Chébana | 23864 | 25421 | 5490.30175 | 471.67 | 90.71 | 181.41 | 6234.09175 |
| | Béni Mohli | 15436 | 16240 | 3498.937 | 297.07 | 57.13 | 114.26 | 3967.397 |
| | Béni Ourtilane | 19185 | 22144 | 4301.80925 | 399.62 | 76.85 | 153.7 | 4931.97925 |
| | Harbil | 6657 | 7157 | 1553.00075 | 120.6 | 23.19 | 46.39 | 1743.18075 |
| | Guenzet | 6415 | 6264 | 1547.47625 | 110.67 | 21.28 | 42.57 | 1721.99625 |
| Bejaia | Bouhamza | 12235 | 0 | 2661.1125 | 0 | 0 | 0 | 2661.1125 |
| TOTAL | | 217653 | 202894 | 50694.4945 | 3938.4 | 757.37 | 1514.78 | 56905.0445 |

***Figure 5: Domestic needs for the 15 municipalities projected for the year 2054***


The project layout from the Tichy-Haf dam to the distribution network tanks
R- Bouhamza
Amalou أمالو
PSB.2
Bouhamza بوحمزة
PSB.1
CMC
PS1.1
Akbou أقبو
Bifurcation A
PS2.1
PS2.1
PS2.3
R-EL MAIN
El Maïn الماين
Guenzet قنزات
PS3.1
Bordj Zemoura برج زمورة
PS3.2
R-TAFFREG
Djaafra الجعافرة
R-DJAAFRA
Bifurcation- B
R-COLLA
Colla القلة
Ouled Dahmane
R-Thniet Annaser
Légende
Bifurcation A
Bifurcation- B
Gravity-fed section
Pumped section
Pumped Station
Tank
N
10 km
Google Earth
Image © 2024 Airbus

Annex 04

**Pumped water supply**

## Stretch 01: PS1.1 -CMC

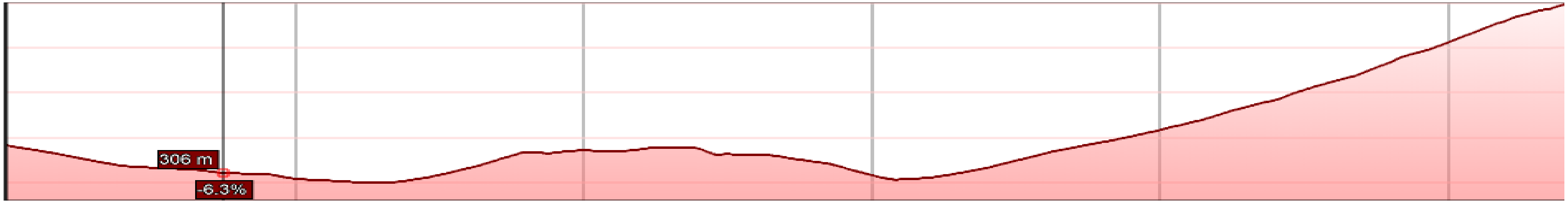



*Figure 1: The longitudinal profile of the conduit PS1.1- CMC*

| | | | | | roughness of steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stretch | | Cote (m) | | flow (m3/h) | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) | | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| | | upstream | downstream | | | | | | | | upstream | downstream | | | |
| PS1.1 | VID 01 | 325.40 | 301.00 | 2,500 | 292 | 800 | 1.51 | 0.0019756 | 0.58 | 0.66 | 463.85 | 463.19 | **162.19** | **162.85** | **NP40** |
| VID 01 | VNT 01 | 301.00 | 320.00 | 2,500 | 292 | 800 | 1.51 | 0.0019756 | 0.58 | 0.66 | 463.19 | 462.52 | **142.52** | **143.85** | |
| VNT 01 | VID 02 | 320.00 | 302.00 | 2,500 | 204 | 800 | 1.51 | 0.0019756 | 0.40 | 0.46 | 462.52 | 462.06 | **160.06** | **161.85** | |
| VID 02 | VNT 02 | 302.00 | 327.00 | 2,500 | 195 | 800 | 1.51 | 0.0019756 | 0.39 | 0.44 | 462.06 | 461.62 | **134.62** | **136.85** | |
| VNT 02 | VID 03 | 327.00 | 317.00 | 2,500 | 97 | 800 | 1.51 | 0.0019756 | 0.19 | 0.22 | 461.62 | 461.40 | **144.40** | **146.85** | |
| VID 03 | CMC | 317.00 | 460.00 | 2,500 | 620 | 800 | 1.51 | 0.0019756 | 1.22 | 1.41 | 461.40 | 459.99 | **-0.01** | **3.85** | |

*Figure 2: The nominal pressure for stretch number 01 PS1.1 -CMC*

**Stretch 02: PSB.1-PSB.2**

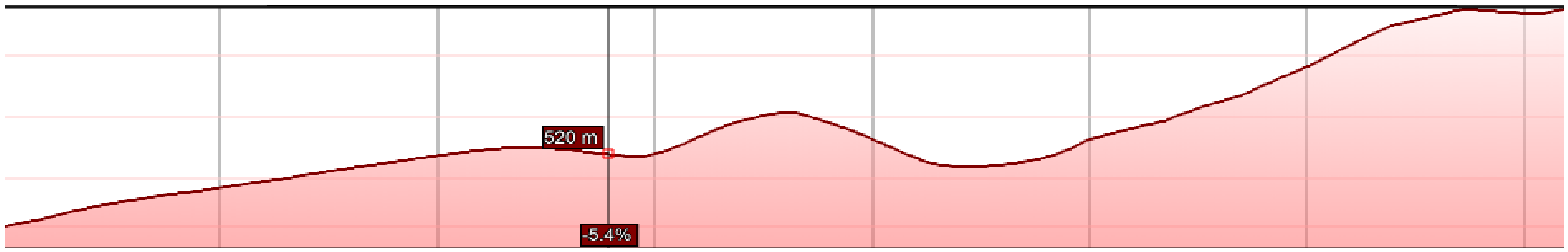



***Figure 3: The longitudinal profile of the conduit PSB.1-PSB.2***

| Stretch | | Cote (m) | | flow (m3/h) | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) | | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | roughness ofsteel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
| | | upstream | downstream | | | | | | | | upstream | downstream | | | |
| PSB.1 | VNT 01 | 450.00 | 525.00 | 116.12 | 597 | 200 | 1.23 | 0.0062074 | 3.71 | 4.26 | 659.18 | 654.92 | **129.92** | **134.18** | **PN40** |
| VNT 01 | VID 01 | 525.00 | 518.00 | 116.12 | 134 | 200 | 1.23 | 0.0062074 | 0.83 | 0.96 | 654.92 | 653.96 | **135.96** | **141.18** | |
| VID 01 | VNT 02 | 518.00 | 555.00 | 116.12 | 175 | 200 | 1.23 | 0.0062074 | 1.09 | 1.25 | 653.96 | 652.71 | **97.71** | **104.18** | |
| VNT 02 | VID 02 | 555.00 | 510.00 | 116.12 | 194 | 200 | 1.23 | 0.0062074 | 1.20 | 1.38 | 652.71 | 651.33 | **141.33** | **149.18** | |
| VID 02 | PSB.2 | 510.00 | 629.30 | 116.12 | 4430 | 200 | 1.23 | 0.0062074 | 27.50 | 31.62 | 651.33 | 619.70 | **-9.60** | **29.88** | |

***Figure 4: The nominal pressure for stretch number 02 PSB.1-PSB.2***

**Stretch 03: PSB.2- R.Bouhamza**

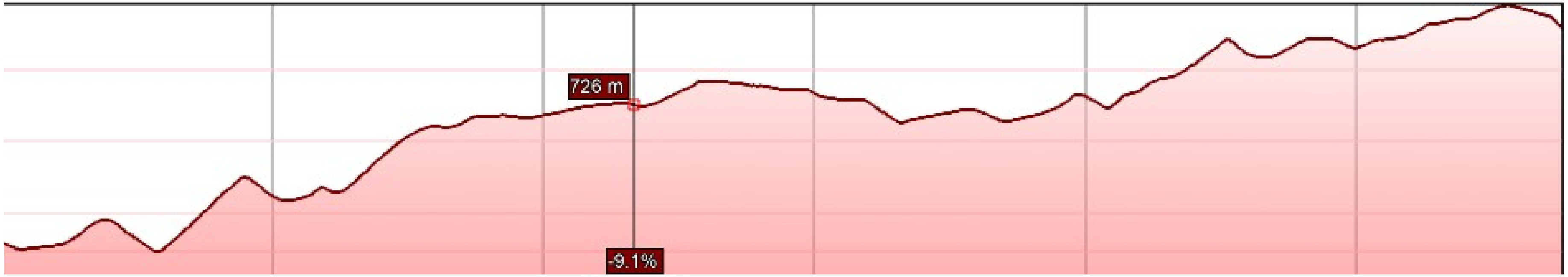



*Figure 5: The longitudinal profile of the conduit PSB.2 - R.Bouhamza*

| Stretch | | Cote (m) | | flow (m3/h) | roughness ofsteel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | upstream | downstream | | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) upstream | Hydraulic head (m) downstream | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| PSB.2 | VNT 01 | 629.30 | 646.00 | 116.12 | 189 | 200 | 1.23 | 0.0062074 | 1.17 | 1.35 | 788.36 | 787.01 | **141.01** | **142.36** | **NP40** |
| VNT 01 | VID 01 | 646.00 | 623.00 | 116.12 | 97 | 200 | 1.23 | 0.0062074 | 0.60 | 0.69 | 787.01 | 786.32 | **163.32** | **165.36** | |
| VID 01 | VNT 02 | 623.00 | 675.00 | 116.12 | 162 | 200 | 1.23 | 0.0062074 | 1.01 | 1.16 | 786.32 | 785.16 | **110.16** | **113.36** | |
| VNT 02 | VID 02 | 675.00 | 659.00 | 116.12 | 70 | 200 | 1.23 | 0.0062074 | 0.43 | 0.50 | 785.16 | 784.66 | **125.66** | **129.36** | |
| VID 02 | VNT.03 | 659.00 | 718.00 | 116.12 | 275 | 200 | 1.23 | 0.0062074 | 1.71 | 1.96 | 784.66 | 782.70 | **64.70** | **70.36** | |
| VNT.03 | VID.03 | 718.00 | 726.00 | 116.12 | 313 | 200 | 1.23 | 0.0062074 | 1.94 | 2.23 | 782.70 | 780.46 | **54.46** | **62.36** | |
| VID.03 | R-Bouhamza | 726.00 | 743.00 | 116.12 | 107 | 200 | 1.23 | 0.0062074 | 0.66 | 0.76 | 780.46 | 779.70 | **36.70** | **45.36** | |

*Figure 6: The nominal pressure for stretch number 03 SPB.2- R.Bouhamza*

**Stretch 04: PS2.1 – PS2.2**

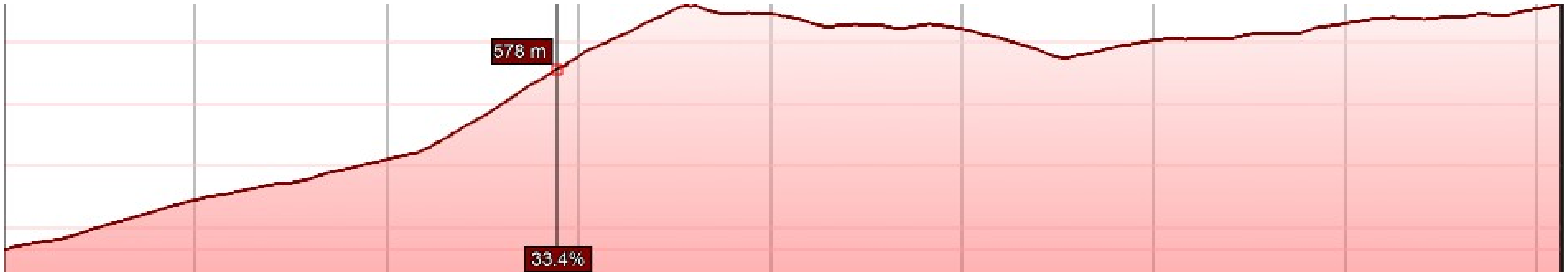



*Figure 7: The longitudinal profile of the conduit PS2.1 - PS2.2*

| | | | | | roughness of Steel K=0,1 mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stretch | | Cote (m) | | flow (m3/h) | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) | | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| | | upstream | downstream | | | | | | | | upstream | downstream | | | |
| PS2.1 | VNT 01 | 443.18 | 630.00 | 612.84 | 898 | 450 | 1.28 | 0.0028949 | 2.60 | 2.99 | 649.03 | 646.04 | **16.04** | **19.03** | **NP40** |
| VNT 01 | VID 01 | 630.00 | 588.00 | 612.84 | 492 | 450 | 1.28 | 0.0028949 | 1.42 | 1.64 | 646.04 | 644.40 | **56.40** | **61.03** | |
| VID 01 | PS2.1 | 588.00 | 642.18 | 612.84 | 666 | 450 | 1.28 | 0.0028949 | 1.93 | 2.22 | 644.40 | 642.19 | **0.01** | **6.85** | |

*Figure 8: The nominal pressure for stretch number 04 PS2.1 - PS2.2*

## Stretch 05: PS2.2-PS2.3

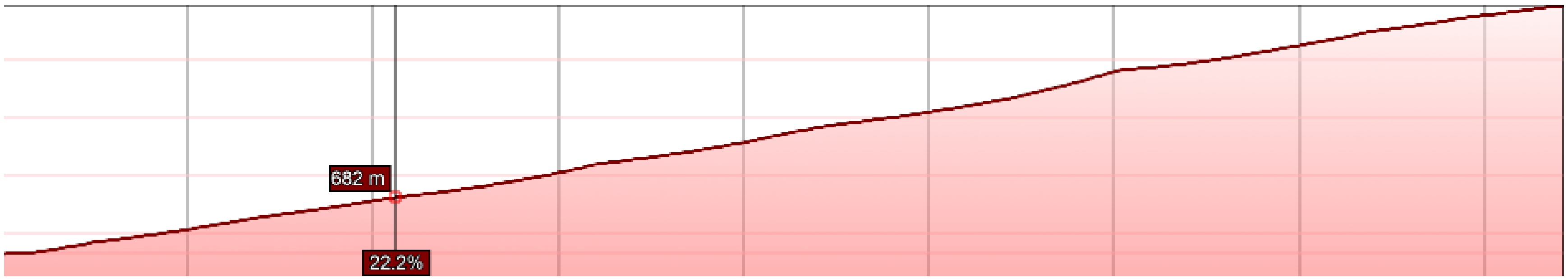



*Figure 9: The longitudinal profile of the conduit PS2.2- PS2.3*

| Stretch | | Cote (m) | | flow (m3/h) | roughness of steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) | | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| | | upstream | downstream | | | | | | | | upstream | downstream | | | |
| PS2.2 | VNT 01 | 642.18 | 791.00 | 612.84 | 603 | 450 | 1.28 | 0.0028949 | 1.75 | 2.01 | 878.16 | 876.15 | **85.15** | **87.16** | **NP40** |
| VNT 01 | PS2.3 | 791.00 | 875.18 | 612.84 | 292 | 450 | 1.28 | 0.0028949 | 0.85 | 0.97 | 876.15 | 875.18 | **0.00** | **2.98** | |

*Figure 10: The nominal pressure for stretch number 05 PS2.2-PS2.3*

## Stretch 06: PS2.3-R.El main

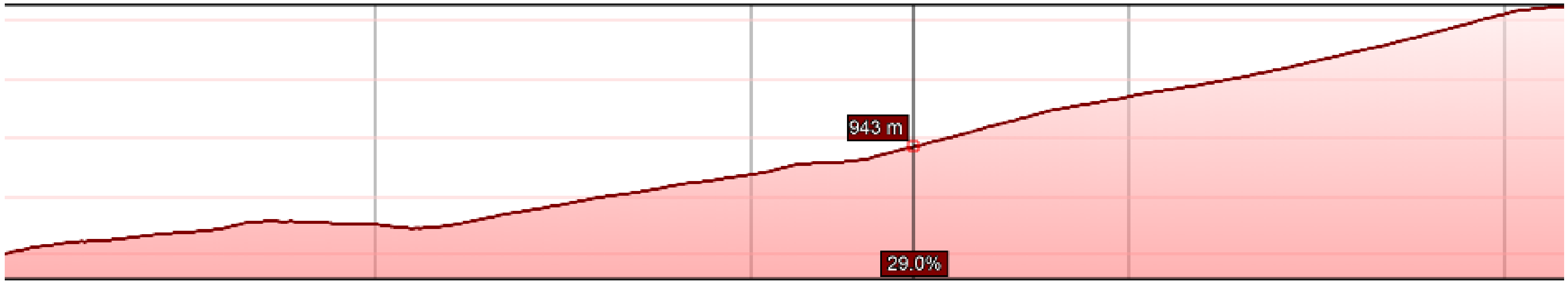



*Figure 11: The longitudinal profile of the conduit PS2.3 - R.Elmain*

| | | | | | roughness of steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stretch | | Cote (m) | | flow (m3/h) | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) | | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| | | upstream | downstream | | | | | | | | upstream | downstream | | | |
| PS2.3 | VNT 01 | 875.18 | 881.00 | 612.84 | 192 | 450 | 1.28 | 0.0028949 | 0.56 | 0.64 | 1074.76 | 1074.12 | **193.12** | **193.76** | **NP40** |
| VNT 01 | VID 01 | 881.00 | 875.00 | 612.84 | 93 | 450 | 1.28 | 0.0028949 | 0.27 | 0.31 | 1074.12 | 1073.81 | **198.81** | **199.76** | |
| VID 01 | VNT 02 | 875.00 | 986.00 | 612.84 | 467 | 450 | 1.28 | 0.0028949 | 1.35 | 1.55 | 1073.81 | 1072.26 | **86.26** | **88.76** | |
| VNT 02 | R-Elmain | 986.00 | 1072.00 | 612.84 | 78 | 450 | 1.28 | 0.0028949 | 0.23 | 0.26 | 1072.26 | 1072.00 | **0.00** | **2.76** | |

*Figure 12: The nominal pressure for stretch number 06 PS2.3-R.El main*

**Stretch 07: PS3.1 -PS3.2**

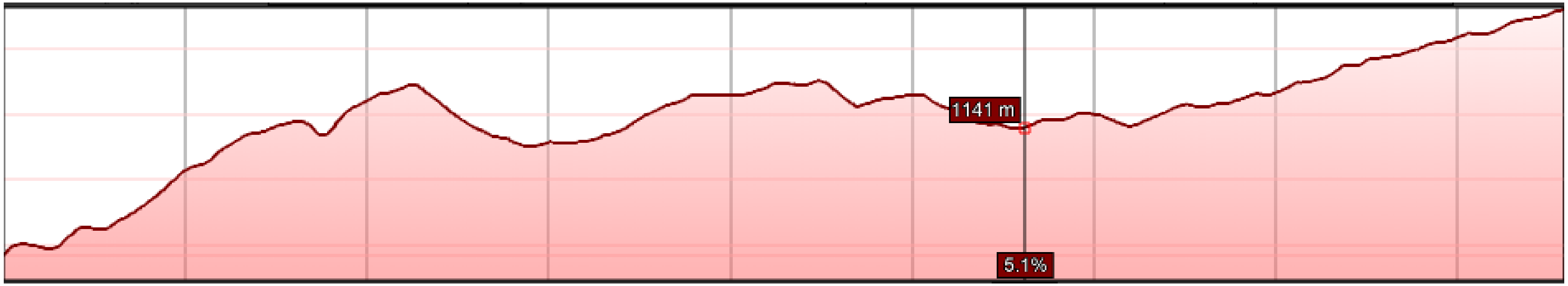



***Figure 13: The longitudinal profile of the conduit PS3.1 -PS3.2***

| | | | | | roughness of steel K=0,1mm | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stretch | | Cote (m) | | flow (m3/h) | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) | | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| | | upstream | downstream | | | | | | | | upstream | downstream | | | |
| PS3.1 | VNT 01 | 998.20 | 1052.00 | 481.68 | 40.9 | 400 | 1.28 | 0.0033403 | 0.14 | 0.16 | 1223.57 | 1223.41 | **171.41** | **171.57** | **NP40** |
| VNT 01 | VID 01 | 1052.00 | 1049.00 | 481.68 | 95.1 | 400 | 1.28 | 0.0033403 | 0.32 | 0.37 | 1223.41 | 1223.05 | **174.05** | **174.57** | |
| VID 01 | VNT 02 | 1049.00 | 1065.00 | 481.68 | 168.1 | 400 | 1.28 | 0.0033403 | 0.56 | 0.65 | 1223.05 | 1222.40 | **157.40** | **158.57** | |
| VNT 02 | VNT.03 | 1065.00 | 1145.00 | 481.68 | 508.9 | 400 | 1.28 | 0.0033403 | 1.70 | 1.95 | 1222.40 | 1220.45 | **75.45** | **78.57** | |
| VNT.03 | VID.02 | 1145.00 | 1135.00 | 481.68 | 63 | 400 | 1.28 | 0.0033403 | 0.21 | 0.24 | 1220.45 | 1220.21 | **85.21** | **88.57** | |
| VID.02 | VNT.04 | 1135.00 | 1173.00 | 481.68 | 254 | 400 | 1.28 | 0.0033403 | 0.85 | 0.98 | 1220.21 | 1219.23 | **46.23** | **50.57** | |
| VNT.04 | VID.03 | 1173.00 | 1126.00 | 481.68 | 310 | 400 | 1.28 | 0.0033403 | 1.04 | 1.19 | 1219.23 | 1218.04 | **92.04** | **97.57** | |
| VID.03 | VNT.05 | 1126.00 | 1176.00 | 481.68 | 810 | 400 | 1.28 | 0.0033403 | 2.71 | 3.11 | 1218.04 | 1214.93 | **38.93** | **47.57** | |
| VNT.05 | VID.04 | 1176.00 | 1156.00 | 481.68 | 100 | 400 | 1.28 | 0.0033403 | 0.33 | 0.38 | 1214.93 | 1214.54 | **58.54** | **67.57** | |
| VID.04 | VNT.06 | 1156.00 | 1165.00 | 481.68 | 150 | 400 | 1.28 | 0.0033403 | 0.50 | 0.58 | 1214.54 | 1213.97 | **48.97** | **58.57** | |
| VNT.06 | VID.05 | 1165.00 | 1140.00 | 481.68 | 280 | 400 | 1.28 | 0.0033403 | 0.94 | 1.08 | 1213.97 | 1212.89 | **72.89** | **83.57** | |
| VID.05 | VNT.07 | 1140.00 | 1151.00 | 481.68 | 190 | 400 | 1.28 | 0.0033403 | 0.63 | 0.73 | 1212.89 | 1212.16 | **61.16** | **72.57** | |
| VNT.07 | PS3.2 | 1151.00 | 1208.18 | 481.68 | 1103 | 400 | 1.28 | 0.0033403 | 3.68 | 4.24 | 1212.16 | 1207.92 | **-0.26** | **15.39** | |

***Figure 14: The nominal pressure for stretch number 07 SP3.1 -SP3.2***

**Stretch 08: PS3.2- R.Djaafra**

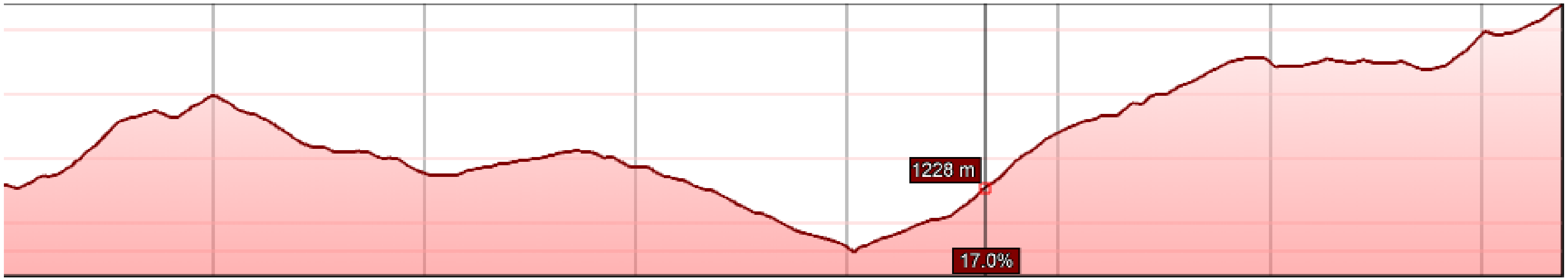



***Figure 15: The longitudinal profile of the conduit PS3.2 - R.Djaafra***

| Stretch | | Cote (m) | | flow (m3/h) | roughness of Steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | upstream | downstream | | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) upstream | Hydraulic head (m) downstream | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| PS3.2 | VNT 01 | 1208.18 | 1299.00 | 434.50 | 749 | 400 | 1.15 | 0.0027299 | 2.04 | 2.35 | 1398.01 | 1395.66 | **96.66** | **99.01** | **NP40** |
| VNT 01 | VID 01 | 1299.00 | 1237.00 | 434.50 | 801 | 400 | 1.15 | 0.0027299 | 2.19 | 2.51 | 1395.66 | 1393.14 | **156.14** | **161.01** | |
| VID 01 | VNT 02 | 1237.00 | 1255.00 | 434.50 | 520 | 400 | 1.15 | 0.0027299 | 1.42 | 1.63 | 1393.14 | 1391.51 | **136.51** | **143.01** | |
| VNT 02 | VID 02 | 1255.00 | 1179.00 | 434.50 | 950 | 400 | 1.15 | 0.0027299 | 2.59 | 2.98 | 1391.51 | 1388.53 | **209.53** | **219.01** | |
| VID 02 | VNT 03 | 1179.00 | 1329.00 | 434.50 | 1450 | 400 | 1.15 | 0.0027299 | 3.96 | 4.55 | 1388.53 | 1383.98 | **54.98** | **69.01** | |
| VNT 03 | R-DJAAFRA | 1329.00 | 1383.21 | 434.50 | 282 | 400 | 1.15 | 0.0027299 | 0.77 | 0.89 | 1383.98 | 1383.09 | **-0.12** | **14.80** | |

***Figure 16: The nominal pressure for stretch number 08 SP3.2- R.Djaafra***

## Gravity-fed water supply

### Stretch 01: CMC- PSB.1

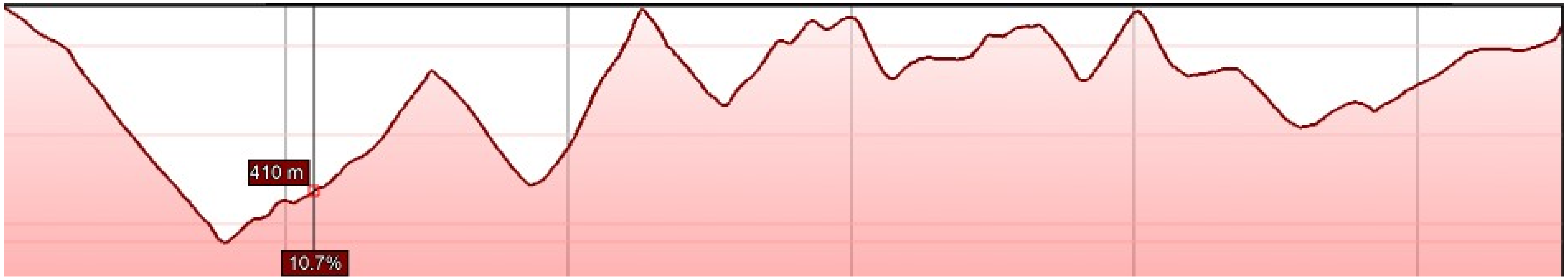



*Figure 17: The longitudinal profile of the conduit CMC - PSB.1*

| Stretch | | Cote (m) | | flow (m3/h) | roughness of Steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | upstream | downstream | | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) upstream | Hydraulic head (m) downstream | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| CMC | VID 01 | 460.00 | 395.00 | 116.12 | 388 | 250 | 0.66 | 0.0014653 | 0.57 | 0.65 | 460.00 | 459.35 | **64.35** | **65.00** | **NP10** |
| VID 01 | VNT 01 | 395.00 | 443.00 | 116.12 | 367 | 250 | 0.66 | 0.0014653 | 0.54 | 0.62 | 459.35 | 458.73 | **15.73** | **17.00** | |
| VNT 01 | VID 02 | 443.00 | 411.00 | 116.12 | 208 | 250 | 0.66 | 0.0014653 | 0.30 | 0.35 | 458.73 | 458.38 | **47.38** | **49.00** | |
| VID 02 | VNT 02 | 411.00 | 461.00 | 116.12 | 167 | 250 | 0.66 | 0.0014653 | 0.24 | 0.28 | 458.38 | 458.10 | **-2.90** | **-1.00** | |
| VNT 02 | VID 03 | 461.00 | 434.00 | 116.12 | 150 | 250 | 0.66 | 0.0014653 | 0.22 | 0.25 | 458.10 | 457.84 | **23.84** | **26.00** | |
| VID 03 | VNT 03 | 434.00 | 458.00 | 116.12 | 220 | 250 | 0.66 | 0.0014653 | 0.32 | 0.37 | 457.84 | 457.47 | **-0.53** | **2.00** | |
| VNT 03 | VID 04 | 458.00 | 441.00 | 116.12 | 70 | 250 | 0.66 | 0.0014653 | 0.10 | 0.12 | 457.47 | 457.35 | **16.35** | **19.00** | |
| VID 04 | VNT 04 | 441.00 | 458.00 | 116.12 | 250 | 250 | 0.66 | 0.0014653 | 0.37 | 0.42 | 457.35 | 456.93 | **-1.07** | **2.00** | |
| VNT 04 | VID 05 | 458.00 | 441.00 | 116.12 | 100 | 250 | 0.66 | 0.0014653 | 0.15 | 0.17 | 456.93 | 456.76 | **15.76** | **19.00** | |
| VID 05 | VNT 05 | 441.00 | 460.00 | 116.12 | 80 | 250 | 0.66 | 0.0014653 | 0.12 | 0.13 | 456.76 | 456.63 | **-3.37** | **0.00** | |
| VNT 05 | VID 06 | 460.00 | 427.00 | 116.12 | 300 | 250 | 0.66 | 0.0014653 | 0.44 | 0.51 | 456.63 | 456.12 | **29.12** | **33.00** | |
| VID 06 | PSB.1 | 427.00 | 450.00 | 116.12 | 450 | 250 | 0.66 | 0.0014653 | 0.66 | 0.76 | 456.12 | 455.37 | **5.37** | **10.00** | |

*Figure 18: The nominal pressure for stretch number 01 CMC- PSB.1*

## Stretch 02: CMC -Bif A

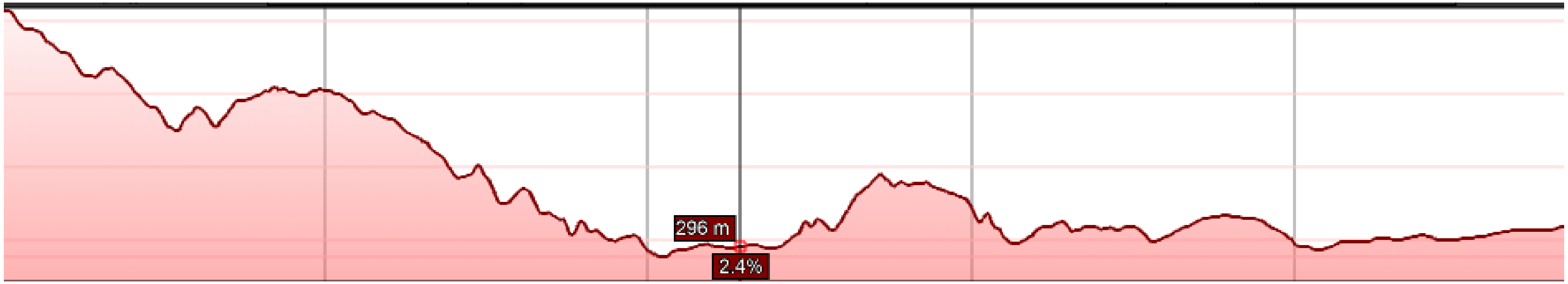



*Figure 19: The longitudinal profile of the conduit CMC - Bif A*

| | | | | | roughness of Steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Stretch** | | **Cote (m)** | | **flow (m3/h)** | **length (m)** | **Inner diameter (mm)** | **Velocity (m/s)** | **J (m/m)** | **L Head loss (m)** | **Total head loss (m)** | **Hydraulic head (m)** | | **Maximum operating pressure (m)** | **Static pressure (m)** | **Nominal Pressure** |
| | | **upstream** | **downstream** | | | | | | | | **upstream** | **downstream** | | | |
| CMC | VID 01 | 460.00 | 375.00 | 2,383.88 | 1060 | 1000 | 0.84 | 0.0004927 | 0.52 | 0.60 | 460.00 | 459.40 | **84.40** | **85.00** | **NP25** |
| VID 01 | VNT 01 | 375.00 | 390.00 | 2,383.88 | 130 | 1000 | 0.84 | 0.0004927 | 0.06 | 0.07 | 459.40 | 459.33 | **69.33** | **70.00** | |
| VNT 01 | VID 02 | 390.00 | 377.00 | 2,383.88 | 150 | 1000 | 0.84 | 0.0004927 | 0.07 | 0.08 | 459.33 | 459.24 | **82.24** | **83.00** | |
| VID 02 | VNT 02 | 377.00 | 406.00 | 2,383.88 | 470 | 1000 | 0.84 | 0.0004927 | 0.23 | 0.27 | 459.24 | 458.97 | **52.97** | **54.00** | |
| VNT 02 | VID 03 | 406.00 | 342.00 | 2,383.88 | 1440 | 1000 | 0.84 | 0.0004927 | 0.71 | 0.82 | 458.97 | 458.16 | **116.16** | **118.00** | |
| VID 03 | VID 04 | 342.00 | 288.00 | 2,383.88 | 1620 | 1000 | 0.84 | 0.0004927 | 0.80 | 0.92 | 458.16 | 457.24 | **169.24** | **172.00** | |
| VID 04 | VNT 03 | 288.00 | 344.00 | 2,383.88 | 1650 | 1000 | 0.84 | 0.0004927 | 0.81 | 0.93 | 457.24 | 456.31 | **112.31** | **116.00** | |
| VNT 03 | VID 05 | 344.00 | 298.00 | 2,383.88 | 1030 | 1000 | 0.84 | 0.0004927 | 0.51 | 0.58 | 456.31 | 455.72 | **157.72** | **162.00** | |
| VID 05 | VNT 04 | 298.00 | 358.00 | 2,383.88 | 360 | 1000 | 0.84 | 0.0004927 | 0.18 | 0.20 | 455.72 | 455.52 | **97.52** | **102.00** | |
| VNT 04 | VID 06 | 358.00 | 298.00 | 2,383.88 | 1240 | 1000 | 0.84 | 0.0004927 | 0.61 | 0.70 | 455.52 | 454.82 | **156.82** | **162.00** | |
| VID 06 | Bif-A | 298.00 | 450.00 | 2,383.88 | 2650 | 1000 | 0.84 | 0.0004927 | 1.31 | 1.50 | 454.82 | 453.31 | **3.31** | **10.00** | |

*Figure 20: The nominal pressure for stretch number 02 CMC -Bif A*

## Stretch 03: Bif A - LOT 03

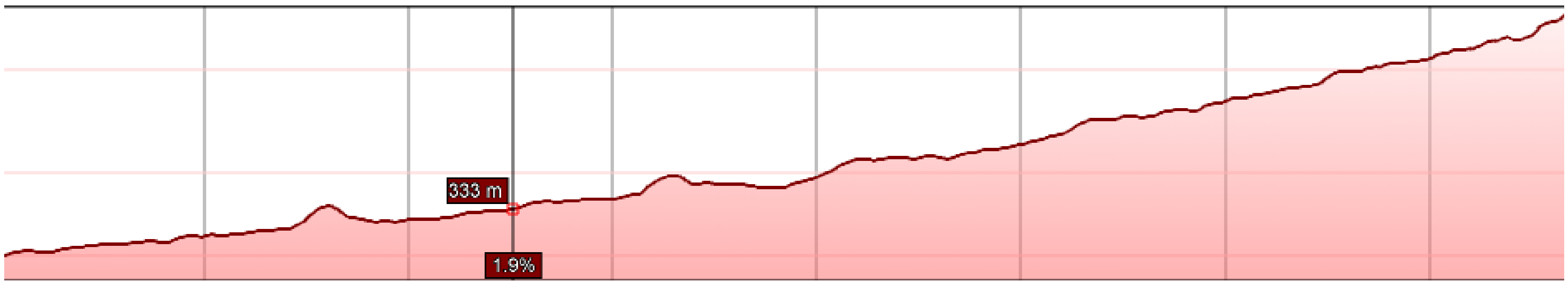



***Figure 21: The longitudinal profile of the conduit Bif A - LOT 03***

| | | | | | roughness of Steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stretch | | Cote (m) | | flow (m3/h) | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) | | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| | | upstream | downstream | | | | | | | | upstream | downstream | | | |
| Bif-A | VNT 01 | 450.00 | 334.00 | 1,771.04 | 1600 | 800 | 0.97 | 0.0008452 | 1.35 | 1.56 | 450.00 | 448.44 | **114.44** | **116.00** | **NP16** |
| VNT 01 | VID 01 | 334.00 | 326.00 | 1,771.04 | 330 | 800 | 0.97 | 0.0008452 | 0.28 | 0.32 | 448.44 | 448.12 | **122.12** | **124.00** | |
| VID 01 | VNT 02 | 326.00 | 349.00 | 1,771.04 | 1370 | 800 | 0.97 | 0.0008452 | 1.16 | 1.33 | 448.12 | 446.79 | **97.79** | **101.00** | |
| VNT 02 | VNT 02 | 349.00 | 343.00 | 1,771.04 | 490 | 800 | 0.97 | 0.0008452 | 0.41 | 0.48 | 446.79 | 446.32 | **103.32** | **107.00** | |
| VNT 02 | LOT-03 | 343.00 | 434.35 | 1,771.04 | 3849 | 800 | 0.97 | 0.0008452 | 3.25 | 3.74 | 446.32 | 442.57 | **8.22** | **15.65** | |

***Figure 22: The nominal pressure for stretch number 03 Bif A - LOT 03***

**Stretch 04: Bif A -PS2.1**

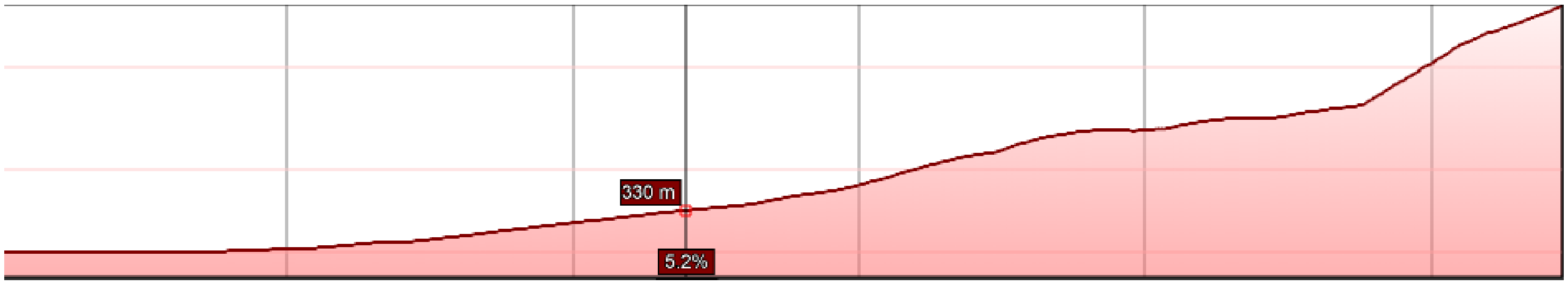



***Figure 23: The longitudinal profile of the conduit Bif A - PS2.1***

| | | | | | roughness of Steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stretch | | Cote (m) | | flow (m3/h) | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) | | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| | | upstream | downstream | | | | | | | | upstream | downstream | | | |
| Bif-A | VID 01 | 450.00 | 309.00 | 612.84 | 164 | 450 | 1.07 | 0.0017895 | 0.29 | 0.34 | 450.00 | 449.66 | **140.66** | **141.00** | **NP16** |
| VID 01 | VNT 01 | 309.00 | 370.00 | 612.84 | 798 | 450 | 1.07 | 0.0017895 | 1.43 | 1.64 | 449.66 | 448.02 | **78.02** | **80.00** | |
| VNT 01 | PS2.1 | 370.00 | 443.18 | 612.84 | 378 | 450 | 1.07 | 0.0017895 | 0.68 | 0.78 | 448.02 | 447.24 | **4.06** | **6.82** | |

***Figure 24: The nominal pressure for stretch number 04 Bif A -PS2.1***

### Stretch 05: R Elmain – PS3.1

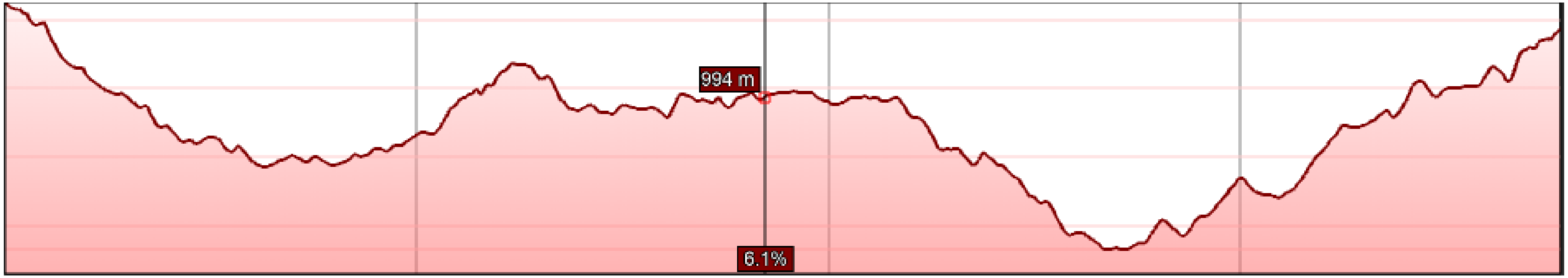



*Figure 25: The longitudinal profile of the conduit R Elmain - PS3.1*

| Stretch | | Cote (m) | | flow (m3/h) | roughness of Steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | upstream | downstream | | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) upstream | Hydraulic head (m) downstream | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| R-Elmain | VID 01 | 1072.00 | 944.00 | 481.66 | 1540 | 400 | 1.06 | 0.0020044 | 3.09 | 3.55 | 1072.00 | 1068.45 | **124.45** | **128.00** | NP25 |
| VID 01 | VNT 01 | 944.00 | 1018.00 | 481.66 | 1560 | 400 | 1.06 | 0.0020044 | 3.13 | 3.60 | 1068.45 | 1064.85 | **46.85** | **54.00** | |
| VNT 01 | VID 02 | 1018.00 | 979.00 | 481.66 | 920 | 400 | 1.06 | 0.0020044 | 1.84 | 2.12 | 1064.85 | 1062.73 | **83.73** | **93.00** | |
| VID 02 | VNT 02 | 979.00 | 994.00 | 481.66 | 1390 | 400 | 1.06 | 0.0020044 | 2.79 | 3.20 | 1062.73 | 1059.53 | **65.53** | **78.00** | |
| VNT 02 | VID 03 | 994.00 | 883.00 | 481.66 | 1390 | 400 | 1.06 | 0.0020044 | 2.79 | 3.20 | 1059.53 | 1056.33 | **173.33** | **189.00** | |
| VID 03 | VNT 03 | 883.00 | 935.00 | 481.66 | 700 | 400 | 1.06 | 0.0020044 | 1.40 | 1.61 | 1056.33 | 1054.71 | **119.71** | **137.00** | |
| VNT 03 | VID 04 | 935.00 | 923.00 | 481.66 | 200 | 400 | 1.06 | 0.0020044 | 0.40 | 0.46 | 1054.71 | 1054.25 | **131.25** | **149.00** | |
| VNT 03 | VNT 04 | 923.00 | 1006.00 | 481.66 | 900 | 400 | 1.06 | 0.0020044 | 1.80 | 2.07 | 1054.25 | 1052.18 | **46.18** | **66.00** | |
| VNT 04 | PS3.1 | 1006.00 | 998.20 | 481.66 | 230 | 400 | 1.06 | 0.0020044 | 0.46 | 0.53 | 1052.18 | 1051.65 | **53.45** | **73.80** | |

*Figure 26: The nominal pressure for stretch number 05 R Elmain - PS3.1*

**Stretch 06: PS3.2 – R Tafreg**

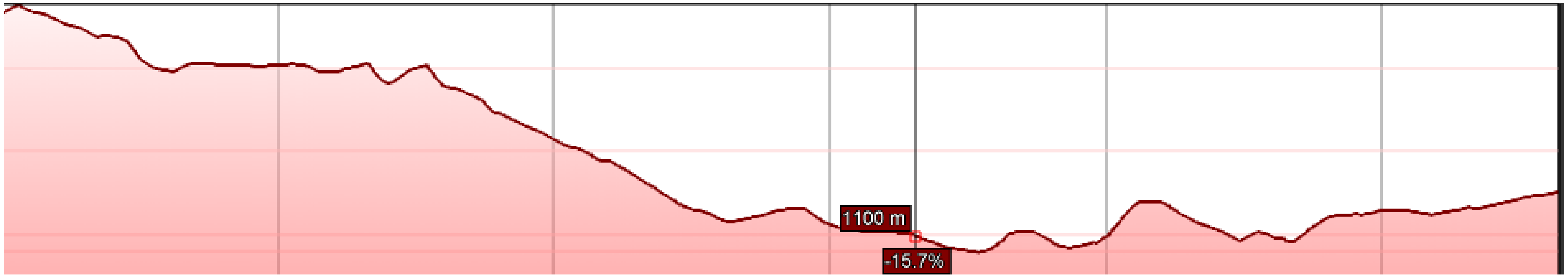



***Figure 27: The longitudinal profile of the conduit  PS3.2 - R Tafreg***

| | | | | | roughness of HDPE K=0,02mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stretch | | Cote (m) | | flow (m3/h) | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) | | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| | | upstream | downstream | | | | | | | | upstream | downstream | | | |
| PS3.2 | VID 01 | 1208.18 | 1214.00 | 47.17 | 173 | 130.8 | 0.98 | 0.0066240 | 1.15 | 1.32 | 1208.18 | 1206.86 | **-7.14** | **-5.82** | **NP16** |
| VID 01 | VNT 01 | 1214.00 | 1207.00 | 47.17 | 578 | 130.8 | 0.98 | 0.0066240 | 3.83 | 4.40 | 1206.86 | 1202.46 | **-4.54** | **1.18** | |
| VNT 01 | VID 02 | 1207.00 | 1090.00 | 47.17 | 1019 | 130.8 | 0.98 | 0.0066240 | 6.75 | 7.76 | 1202.46 | 1194.70 | **104.70** | **118.18** | |
| VID 02 | VNT 02 | 1090.00 | 1118.00 | 47.17 | 310 | 130.8 | 0.98 | 0.0066240 | 2.05 | 2.36 | 1194.70 | 1192.34 | **74.34** | **90.18** | |
| VNT 02 | R-TAFREG | 1118.00 | 1157.48 | 47.17 | 810 | 130.8 | 0.98 | 0.0066240 | 5.37 | 6.17 | 1192.34 | 1186.17 | **28.69** | **50.70** | |

***Figure 28: The nominal pressure for stretch number 06 PS3.2 – R Tafreg***

## Stretch 07: R Djaafra -Bif B

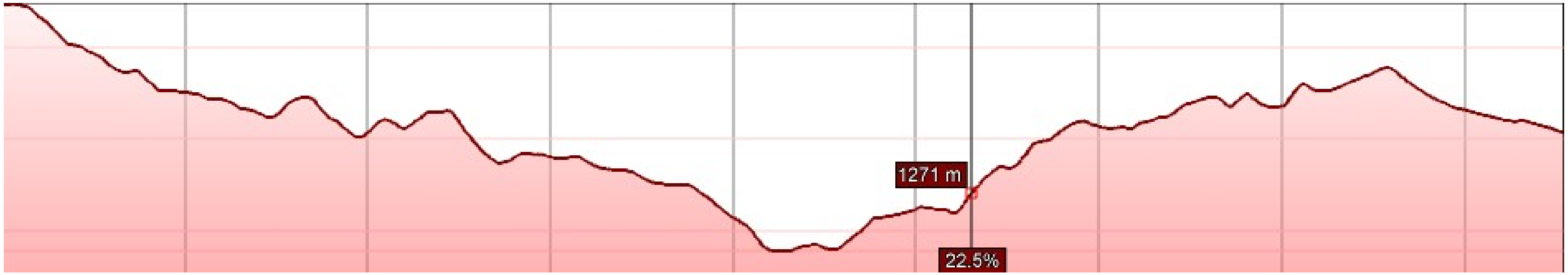



*Figure 29: The longitudinal profile of the conduit  R Djaafra - Bif B*

| | | | | | roughness of Steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stretch | | Cote (m) | | flow (m3/h) | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) | | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| | | upstream | downstream | | | | | | | | upstream | downstream | | | |
| R-DJAAFR | VID 01 | 1383.21 | 1313.00 | 263.04 | 736 | 200 | 2.33 | 0.0201993 | 14.87 | 17.10 | 1383.21 | 1366.11 | **53.11** | **70.21** | **NP20** |
| VID 01 | VNT 01 | 1313.00 | 1323.00 | 263.04 | 86 | 200 | 2.33 | 0.0201993 | 1.74 | 2.00 | 1366.11 | 1364.12 | **41.12** | **60.21** | |
| VNT 01 | VID 02 | 1323.00 | 1302.00 | 263.04 | 158 | 200 | 2.33 | 0.0201993 | 3.19 | 3.67 | 1364.12 | 1360.45 | **58.45** | **81.21** | |
| VID 02 | VNT 02 | 1302.00 | 1316.00 | 263.04 | 240 | 200 | 2.33 | 0.0201993 | 4.85 | 5.57 | 1360.45 | 1354.87 | **38.87** | **67.21** | |
| VNT 02 | VID 03 | 1316.00 | 1239.00 | 263.04 | 164 | 200 | 2.33 | 0.0201993 | 3.31 | 3.81 | 1354.87 | 1351.06 | **112.06** | **144.21** | |
| VID 03 | VNT 03 | 1239.00 | 1309.00 | 263.04 | 1556 | 200 | 2.33 | 0.0201993 | 31.43 | 36.14 | 1351.06 | 1314.92 | **5.92** | **74.21** | |
| VNT 03 | VNT 04 | 1309.00 | 1340.00 | 263.04 | 850 | 200 | 2.33 | 0.0201993 | 17.17 | 19.74 | 1314.92 | 1295.17 | **-44.83** | **43.21** | |
| VNT 04 | Bif-B | 1340.00 | 1300.00 | 263.04 | 324 | 200 | 2.33 | 0.0201993 | 6.54 | 7.53 | 1295.17 | 1287.65 | **-12.35** | **83.21** | |

*Figure 30: The nominal pressure for stretch number 07 R Djaafra -Bif B*

### Stretch 08: Bif B-R Colla


***Figure 31: The longitudinal profile of the conduit Bif B - R Colla***

| | | | | | roughness of Steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stretch | | Cote (m) | | flow (m3/h) | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) | | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
| | | upstream | downstream | | | | | | | | upstream | downstream | | | |
| Bif-B | VID 01 | 1300.00 | 1297.00 | 128.39 | 77.6 | 150 | 2.02 | 0.0220450 | 1.71 | 1.97 | 1300.00 | 1298.03 | **1.03** | **3.00** | **NP10** |
| VID 01 | VNT 01 | 1297.00 | 1303.00 | 128.39 | 112.4 | 150 | 2.02 | 0.0220450 | 2.48 | 2.85 | 1298.03 | 1295.18 | **-7.82** | **-3.00** | |
| VNT 01 | VID 02 | 1303.00 | 1257.00 | 128.39 | 636 | 150 | 2.02 | 0.0220450 | 14.02 | 16.12 | 1295.18 | 1279.06 | **22.06** | **43.00** | |
| VID 02 | VNT 02 | 1257.00 | 1263.00 | 128.39 | 58 | 150 | 2.02 | 0.0220450 | 1.28 | 1.47 | 1279.06 | 1277.59 | **14.59** | **37.00** | |
| VNT 02 | VID 03 | 1263.00 | 1226.00 | 128.39 | 274 | 150 | 2.02 | 0.0220450 | 6.04 | 6.95 | 1277.59 | 1270.64 | **44.64** | **74.00** | |
| VID 03 | R-COLLA | 1226.00 | 1256.25 | 128.39 | 179 | 150 | 2.02 | 0.0220450 | 3.95 | 4.54 | 1270.64 | 1266.10 | **9.85** | **43.75** | |

***Figure 32: The nominal pressure for stretch number 08 Bif B-R Colla***

**Stretch 09: Bif B - R Theniet enaser**

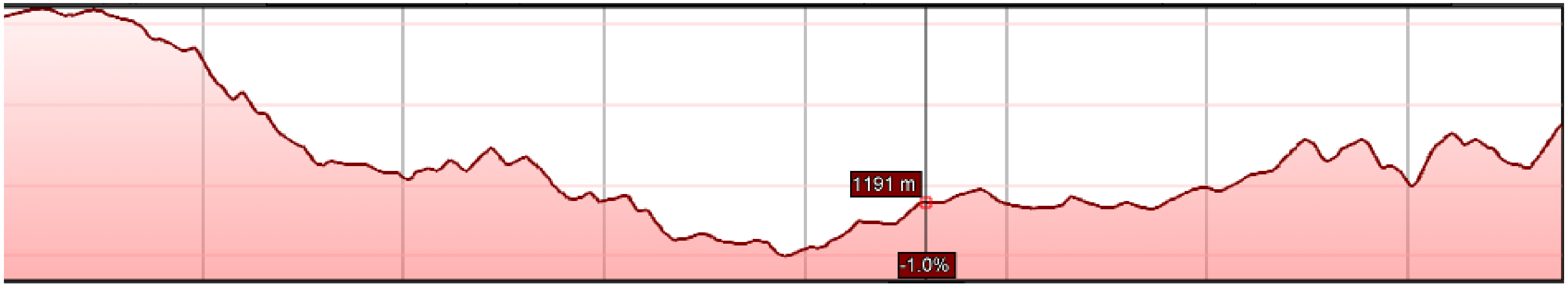



*Figure 33: The longitudinal profile of the conduit Bif B - R Theniet enaser*

| Stretch | | Cote (m) upstream | Cote (m) downstream | flow (m3/h) | length (m) | Inner diameter (mm) | Velocity (m/s) | J (m/m) | L Head loss (m) | Total head loss (m) | Hydraulic head (m) upstream | Hydraulic head (m) downstream | Maximum operating pressure (m) | Static pressure (m) | Nominal Pressure |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | roughness of Steel K=0,1mm | | | | | ΔHs=15% ΔHL | | | | | |
| Bif-B | VID 01 | 1300.00 | 1204.00 | 134.65 | 1520 | 200 | 1.19 | 0.0058102 | 8.83 | 10.16 | 1300.00 | 1289.84 | **85.84** | **96.00** | NP16 |
| VID 01 | VNT 01 | 1204.00 | 1224.00 | 134.65 | 310 | 200 | 1.19 | 0.0058102 | 1.80 | 2.07 | 1289.84 | 1287.77 | **63.77** | **76.00** | |
| VNT 01 | VID 02 | 1224.00 | 1157.00 | 134.65 | 1100 | 200 | 1.19 | 0.0058102 | 6.39 | 7.35 | 1287.77 | 1280.42 | **123.42** | **143.00** | |
| VID 02 | VNT 02 | 1157.00 | 1198.00 | 134.65 | 720 | 200 | 1.19 | 0.0058102 | 4.18 | 4.81 | 1280.42 | 1275.61 | **77.61** | **102.00** | |
| VNT 02 | VID 03 | 1198.00 | 1187.00 | 134.65 | 650 | 200 | 1.19 | 0.0058102 | 3.78 | 4.34 | 1275.61 | 1271.27 | **84.27** | **113.00** | |
| VID 03 | VNT 03 | 1187.00 | 1229.00 | 134.65 | 570 | 200 | 1.19 | 0.0058102 | 3.31 | 3.81 | 1271.27 | 1267.46 | **38.46** | **71.00** | |
| VNT 03 | VID 04 | 1229.00 | 1216.00 | 134.65 | 80 | 200 | 1.19 | 0.0058102 | 0.46 | 0.53 | 1267.46 | 1266.93 | **50.93** | **84.00** | |
| VID 04 | VNT 04 | 1216.00 | 1228.00 | 134.65 | 110 | 200 | 1.19 | 0.0058102 | 0.64 | 0.73 | 1266.93 | 1266.19 | **38.19** | **72.00** | |
| VNT 04 | VID 05 | 1228.00 | 1201.00 | 134.65 | 200 | 200 | 1.19 | 0.0058102 | 1.16 | 1.34 | 1266.19 | 1264.85 | **63.85** | **99.00** | |
| VID 05 | VNT 05 | 1201.00 | 1232.00 | 134.65 | 160 | 200 | 1.19 | 0.0058102 | 0.93 | 1.07 | 1264.85 | 1263.79 | **31.79** | **68.00** | |
| VNT 05 | VID 06 | 1232.00 | 1212.00 | 134.65 | 280 | 200 | 1.19 | 0.0058102 | 1.63 | 1.87 | 1263.79 | 1261.91 | **49.91** | **88.00** | |
| VID 06 | R-THENIET.ENASER | 1212.00 | 1244.75 | 134.65 | 505 | 200 | 1.19 | 0.0058102 | 2.93 | 3.37 | 1261.91 | 1258.54 | **13.79** | **55.25** | |

*Figure 34: The nominal pressure for stretch number 09 Bif B - R Theniet enaser*

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# e-XC350-690/8000W/W45ADS4AG

## Technical data

| | |
|---|---|
| Company name | |
| Contact | |
| Phone number | |
| e-mail address | |

## Operating data

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Pumpe type | | Single pumps as parallel circuit | Fluid | | Water, pure |
| 2 | No. of pumps | | 2 | Operating temperature t A | °C | 20 |
| 3 | Nominal flow | m³/h | 2500 | pH-value at t A | | 7 |
| 4 | Nominal head | m | 138.4 | Density at t A | kg/m³ | 998 |
| 5 | Static head | m | 134.6 | Kin. viscosity at t A | mm²/s | 1 |
| 6 | Inlet pressure | kPa | 0 | Vapor pressure at t A | kPa | 100 |
| 7 | Environmental temperature | °C | 20 | Content of solid% / Solid size | mm | 0 / 0 |
| 8 | Available system NPSH | m | 0 | Altitude | m | 0 |

## Pump data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | Design | | Double Suction Split Case Pumps | Execution | Clockwise Rotation - viewed from motor end [STD] | | |
| 10 | Operating speed | rpm | 1492 | Impeller | Max. | mm | 705 |
| 11 | Number of stages | | 1 | | designed | mm | 625 |
| 12 | Suction nozzle | | DNs 400 / EN1092-2 / PN40 | | Min. | mm | 500 |
| 13 | Discharge nozzle | | DNd 350 / EN1092-2 / PN40 | Flow | Nominal | m³/h | 2500 |
| 14 | Connection | | Type A - Flat Face | | Max- | m³/h | 2857 |
| 15 | Max. casing pressure | kPa | 3100.1 | | Min- | m³/h | 760.7 |
| 16 | Max. working pressure | kPa | 1398.9 | Head | Nominal | m | 138.4 |
| 17 | Impeller type | | Radial impeller | | at Qmax | m | 90.2 |
| 18 | Head H(Q=0) | m | 140 | | at Qmin | m | 143.1 |
| 19 | Max. shaft power | kW | 1815.6 | Shaft power | | kW | 1237.5 |
| 20 | Pump weight | kg | 2,676.0 | Efficiency | | % | 76.01 |
| 21 | Total weight | kg | 7,850.5 | NPSH 3% | | m | 4.34 |

## Materials

| | | | | |
|---|---|---|---|---|
| 22 | Pump | | Shaft Seal | |
| 23 | Casings | [D] - EN-GJS-500-7 / QT500-7 / ASTM A536, 80-55-06 | Burgmann | Rubber below seal |
| 24 | Impeller | [S] - 304 SS - 1.4308 / ZG0Cr18Ni9 / ASTM - CF8 | MG12 - Seal on sleeve (ID 105/130 mm) | |
| 25 | Shaft Construction | Dry(sleeves) [STD] | Mechanical seal diameter | 130 mm |
| 26 | Shaft | 1.7035 / 40Cr / AISI - 5140 | Rotating ring | Carbon [STD] |
| 27 | Shaft Sleeves | 304 SS - 1.4301 / 0Cr18Ni9 / AISI - 304 | Stationary ring | Silicon Carbide |
| 28 | Shaft Sleeve Nuts | 304 SS - 1.4301 / 0Cr18Ni9 / AISI - 304 | Elastomers | EPDM [STD] |
| 29 | Casing Wear Ring | Bronze - CuSn8Zn4 / ASTM - C90300 | Springs | 316 SS - 1.4408 / 316 / CF8M |
| 30 | Impeller Wear Ring | [S] - 304 SS - 1.4308 / ZG0Cr18Ni9 / ASTM - CF8 | Other metal parts | 316 SS - 1.4408 / 316 / CF8M |
| 31 | Lantern Ring | Cast Iron | | |
| 32 | Seal flush lines | 304 SS - 1.4301 / 0Cr18Ni9 / AISI - 304 | | |
| 33 | | | | |
| 34 | | | | |
| 35 | | | | |
| 36 | | | | |
| 37 | | | | |
| 38 | | | | |
| 39 | | | | |
| 40 | | | | |
| 41 | | | | |

## Motor data / Coupling

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 42 | Manufacturer | | WEG | | Manufacturer | | Flender | |
| 43 | Specific design | | 3ph Surface Motor - Low voltage | | Series | | N-EUPEX - Type A | |
| 44 | Type | | W50 450 L/K B3 800 kW | | Type | | A 315/4-105/130 | |
| 45 | Rated power | | 800 kW | Item no. | Frame size | | 315 | |
| 46 | Nominal speed | | 1492 rpm | Service factor 1 | Spacer length | mm | 4 | |
| 47 | Frame size | | 450 L/K | Electric voltage 400 V | Weight | kg | 134.5 | |
| 48 | Weight | kg | 4,355.0 | Shaft diameter 130 mm | Coupling protection | kg | CG-06 | 35.001 kg |

## Base plate / Remarks

| | | | | |
|---|---|---|---|---|
| 49 | Name | | FRAME XC35-1172-450LK | |
| 50 | Weight | kg | 650.0 | |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | Xylect-20156765 | roumaissa bouras | 06-11-24 | 06-11-24 |

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# e-XC350-690/8000W/W45ADS4AG

## Performance curve

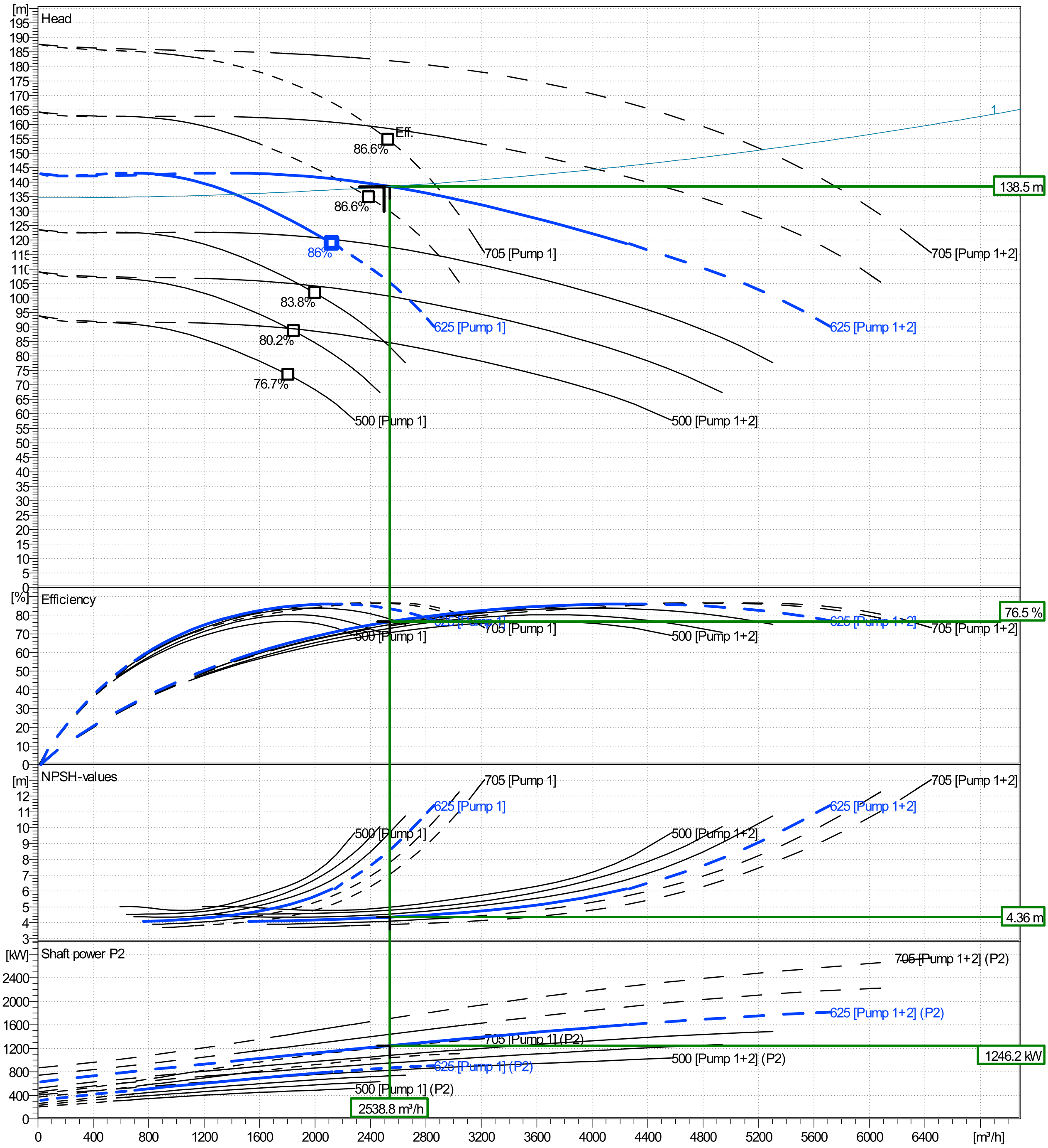
Company name
Contact
Phone number
e-mail address

| | Ø | Pump capacity | | | Pump head | | Shaft power P2 | | | Frequency | Hz | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Operating range Min. | Max. | η Max. | H(Q=0) | η Max. | P2(Q=0) | Max. | η Max. | Operating speed | rpm | 1492 |
| | inch | m³/h | m³/h | m³/h | m | m | kW | kW | kW | Nominal flow | m³/h | 2500 |
| actual | 625 | 761 | 2120 | 2120 | 143 | 119 | | 1820 | 800 | Nominal head | m | 138.4 |
| Min. | 500 | / | / | 1810 | 93.8 | 73.4 | | / | 472 | Inlet pressure | kPa | 0 |
| Max. | 705 | / | / | 2530 | 188 | 155 | | / | 1220 | Static head | m | 134.6 |

**Power datas refered to:**

Water, pure [100%] ; 20°C; 998kg/m³; 1mm²/s

**hydr. Performance acceptance acc. To EN ISO 9906 Class** Grade 2B




| | | | | | |
|---|---|---|---|---|---|
| **Project** | Xylect-20156765 | **Created by** | roumaissa bouras | **Last update** | 6/11/2024 |
| **Block** | e-XC350-690/8000W/W45ADS4AG | **Created on** | 6/11/2024 | | Page 2 / 3 |

Program version 73.0 - 23/04/2024 (Build 125)
Data version 14/05/2024 09:17
User group(s) Xylem:Algeria - EXT

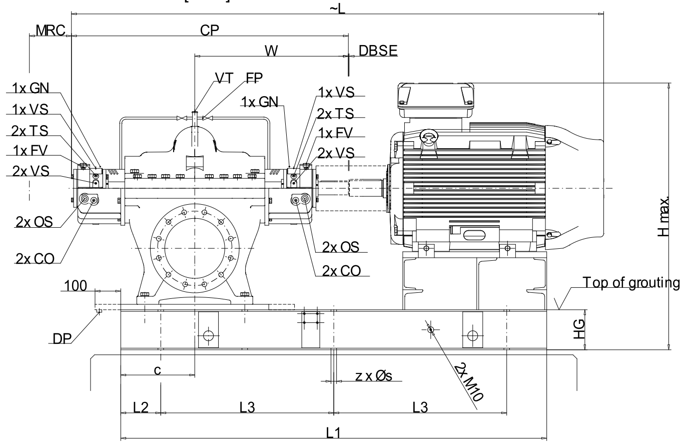
e-XC350-690/8000W/W45ADS4AG

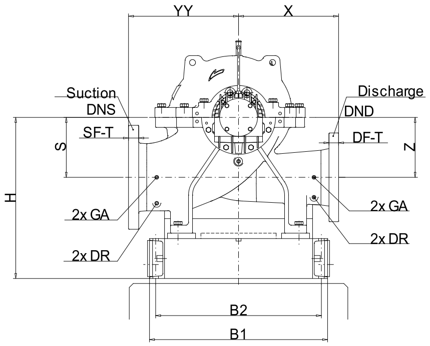
## Dimensions

| | |
|---|---|
| Company name | |
| Contact | |
| Phone number | |
| e-mail address | |

Complete Unit with Baseplate
Clockwise Rotation - viewed from motor end [STD]

3ph Surface Motor - Low voltage
W50 450 L/K B3 800 kW



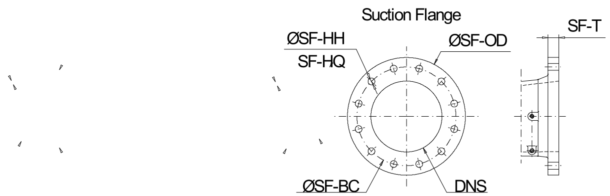

DR ... Drain Rp1/2
FP ... Flush Rp3/8
FV ... Fill/Vent Cup Rp3/8 standard
GA ... Gauge Connection Rp1/2
GN ... Grease Nipple M10x1 standard
TS ... Temperature Sensor M10x1
VT ... VentRp1/2
VS ..

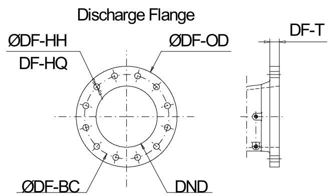
Rotation: CW View from Motor to Pump

MRC .... Minimum removal clearance for bearing and seal maintenance
DBSE ... Distance between shaft ends

| Dimensions | [ mm ] |
|---|---|
| B1 | 1410 |
| B2 | 1320 |
| c | 460 |
| CP | 1745 |
| DBSE | 4 |
| H Max. | 2087 |
| H | 1172 |
| HG | 300 |
| L | 3853 |
| L1 | 3300 |
| L2 | 300 |
| L3 | 900 |
| MRC | 115 |
| s | 29 |
| S | 480 |
| W | 983 |
| X | 750 |
| YY | 900 |
| Z | 480 |
| z | 8x |

**Weight** (+/- 5% ) **7,850 kg**




## Connections [ mm ]

| Suction nozzle | | Discharge nozzle | |
|---|---|---|---|
| DNs 400 | | DNd 350 | |
| PN40 | | PN40 | |
| EN1092-2 | | EN1092-2 | |
| Type A - Flat Face | | | |
| SF-BC | 585 | DF-BC | 510 |
| SF-HH | 41 | DF-HH | 37 |
| SF-HQ | 16 | DF-HQ | 16 |
| SF-OD | 660 | DF-OD | 580 |
| SF-T | 57,2 | DF-T | 54 |

Flange drillings (SF-HH, SF-HQ, DF-HH, DF-HQ) according standard.
Outer diameter (SF-OD, DF-OD) according standard.
Flange thickness (SF-T, DF-T) varies from Standard.

**Dimensions and weight without obligation**

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | Xylect-20156765 | roumaissa bouras | 06-11-24 | 06-11-24 |

LOWARA a xylem brand

# IXPC125-100-315D750L25BDN4S1G

## Technical data

Company name
Contact
Phone number
e-mail address

## Operating data

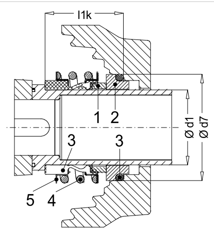
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Pumpe type | | Single pumps as serial circuit | Fluid | | | Water, pure |
| 2 | No. of pumps | | 2 | Operating temperature t A | °C | | 20 |
| 3 | Nominal flow | m³/h | 116.12 | Max / Min Operating Temperature | °C | | 120 / -40 |
| 4 | Nominal head | m | 209.18 | pH-value at t A | | | 7 |
| 5 | Static head | m | 171 | Density at t A | kg/m³ | | 998 |
| 6 | Inlet pressure | kPa | 0 | Kin. viscosity at t A | mm²/s | | 1 |
| 7 | Environmental temperature | °C | 20 | Vapor pressure at t A | kPa | | 100 |
| 8 | Available system NPSH | m | 0 | Altitude | | | 0 |

## Pump data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | Lubrication | Grease Lubrication [Std] (Size 42) | | | | | |
| 10 | Execution | Spacer coupling | | Impeller Ø | Max. | mm | 322 |
| 11 | Design | Horizontal | | | designed | mm | 270 |
| 12 | Operating speed | 2985 rpm | | | Min. | mm | 270 |
| 13 | Suction nozzle | EN1092-2 | DNs 125 PN10/16 | Flow | Nominal | m³/h | 116.2 |
| 14 | Discharge nozzle | EN1092-2 | DNd 100 PN10/16 | | Max- | m³/h | 451.5 |
| 15 | Max. casing pressure | kPa | 1600 | | Min- | m³/h | 80.3 |
| 16 | Max. working pressure | kPa | 1028.4 | Head | Nominal | m | 209.2 |
| 17 | Impeller type | | Radial impeller | | at Qmax | m | 60.1 |
| 18 | Head H(Q=0) | m | 110 | | at Qmin | m | 105.7 |
| 19 | Max. shaft power | kW | 219.9 | Shaft power | | kW | 115.2 |
| 20 | Pump weight | kg | 165 | Efficiency | | % | 57.6 |
| 21 | Total weight | kg | 946.0 | NPSH 3% | | m | 3.4 |

## Materials

| | | | | |
|---|---|---|---|---|
| 22 | Pump | | Shaft Seal | |
| 23 | Impeller (1) | Austenitic Stainless Steel, 1.4408, ASTM CF8M | [S1] Single Mechanical Seal - Unbalanced | |
| 24 | Discharge Casing (2) | Ductile Iron, EN-GJS-400-15, ASTM 65-45-12 | eMG12 - Ø53mm | BQ7EGG |
| 25 | Casing Cover (3) | Ductile Iron, EN-GJS-400-15, ASTM 65-45-12 | Mechanical seal diameter | 53 mm |
| 26 | Seal Cover (4) | not applicable for selected seal configuration | 1. Rotating ring | Carbon graphite resin impregnated |
| 27 | Wear Ring (5) | Duplex Stainless Steel, 1.4462/1.4517 | 2. Stationary ring | SiC, silicon carbide, sintered press.less |
| 28 | Impeller Nut (6) | Duplex Stainless Steel, 1.4517, ASTM CD4MCuN | 3. Secondary seal | Ethylene propylene rubber (EPDM) |
| 29 | Quench Labyrinth Ring (7) | not applicable for selected seal configuration | 4. Springs | CrNiMo - Steel |
| 30 | Shaft Sleeve (8) | Duplex Stainless Steel, 1.4462, ASTM F51 | 5. Others | CrNiMo - Steel |
| 31 | Shaft (9) | Stainless Steel, 1.4057, ASTM 431 | Supplier Code | BQ7EGG |
| 32 | Bearing Bracket (11) | Cast Iron, EN-GJL-250, ASTM Class 35 | | |
| 33 | Bearing Cover (12) | Cast Iron, EN-GJL-250, ASTM Class 35 | | |
| 34 | Pump Support Foot (14) | Carbon Steel, 1.0038, ASTM Grade C, D | | |
| 35 | O-Ring (16) | PTFE | | |
| 36 | O-Ring Casing Cover (17) | Ethylene propylene rubber (EPDM) | | |
| 37 | Plug (19) | Austenitic Stainless Steel | | |
| 38 | Key (21) | Stainless Steel, 1.4571, ASTM - 316Ti | | |
| 39 | Screw & Nut (22) | Austenitic Stainless Steel | | |
| 40 | | | | |
| 41 | Shaft Sealing | Radial Shaft Seal Ring - FKM | | |




## Motor data

Electrical and dimensional data refer to IE4 motor

| | | | | | |
|---|---|---|---|---|---|
| 42 | Manufacturer | Lowara | | | |
| 43 | Specific design | IE4 3ph Surface Motor - Super Premium Efficiency | | | |
| 44 | Type | 3MGS 280 S B3 75 kW E4 | | | |
| 45 | Rated power | 75 kW | Rated current | 129 A | |
| 46 | Nominal speed | 2985 rpm | Rated voltage | 400 V | |
| 47 | Frame size | 280 S | Service factor | 1 | |
| 48 | Weight kg | 596.0 | Degree of protection | IP55 | |
| 49 | Length shaft end | 140 mm | Design acc. standard | IEC | |

## Coupling

| | | | | | |
|---|---|---|---|---|---|
| Manufacturer | | Flender | | | |
| Series | | Spacer Coupling - N-EUPEX - Type H | | | |
| Spacer length | 140 mm | Suitable for EEx-design | | | NO |
| Shaft diameter | | Motor | 65 mm | Frame size | 160 |
| | | Pump | 42 mm | Weight | 15.2 kg |
| Coupling protection | | GR.COUPLGUARD ES42-230-37 A4 | | | |
| | | Material | Edelstahl | | |
| | | Weight | 4.6 kg | | |

## Base plate

| | | |
|---|---|---|
| 50 | Name | FRAME 42B250C-315C280 |
| 51 | Weight kg | 165.2 |
| 52 | Drip Pan | Without Drip Pan |

## Remarks

LOWARA
a xylem brand

# IXPC125-100-315D750L25BDN4S1G

## Performance curve

Company name
Contact
Phone number
e-mail address

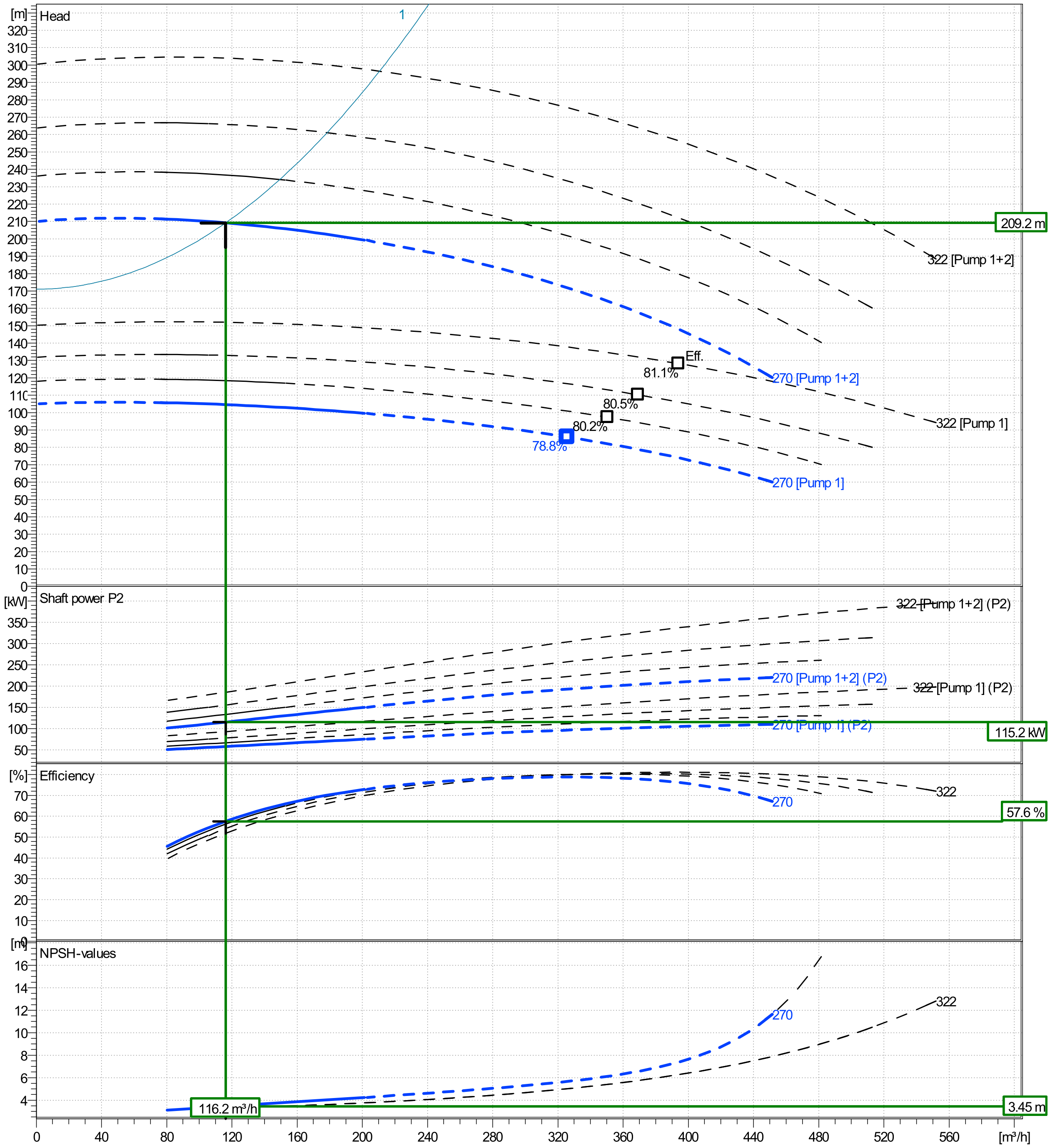
| | Ø | Pump capacity | | | Pump head | | Shaft power P2 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Operating range Min. | Max. | η Max. | H(Q=0) | η Max. | P2(Q=0) | Max. | η Max. |
| | mm | m³/h | m³/h | m³/h | m | m | kW | kW | kW |
| actual | 270 | 80.3 | 201 | 326 | 105 | 86 | | 220 | 96.3 |
| Min. | 270 | / | / | 326 | 105 | 86 | | / | 96.3 |
| Max. | 322 | / | / | 394 | 150 | 128 | | / | 169 |

| | | |
|---|---|---|
| Frequency | Hz | 50 |
| Operating speed | rpm | 2985 |
| Nominal flow | m³/h | 116.1 |
| Nominal head | m | 209.2 |
| Inlet pressure | kPa | 0 |
| Static head | m | 171 |

Power datas refered to:
Water, pure [100%] ; 20°C; 998kg/m³; 1mm²/s

hydr. Performance acceptance acc. To EN ISO 9906 Class 2B

MEI: N.A - according to Ecodesign Directive 2009/125/EC and Regulation (EU) No.547/2012




| | | | | | |
|---|---|---|---|---|---|
| Project | Xylect-20156793 | Created by | roumaissa bouras | Last update | 6/11/2024 |
| Block | IXPC125-100-315D750L25BDN4S1G | Created on | 6/11/2024 | | |

Program version 73.0 - 23/04/2024 (Build 125) | Data version 14/05/2024 09:17 | User group(s) Xylem:Algeria - EXT

LOWARA
a xylem brand

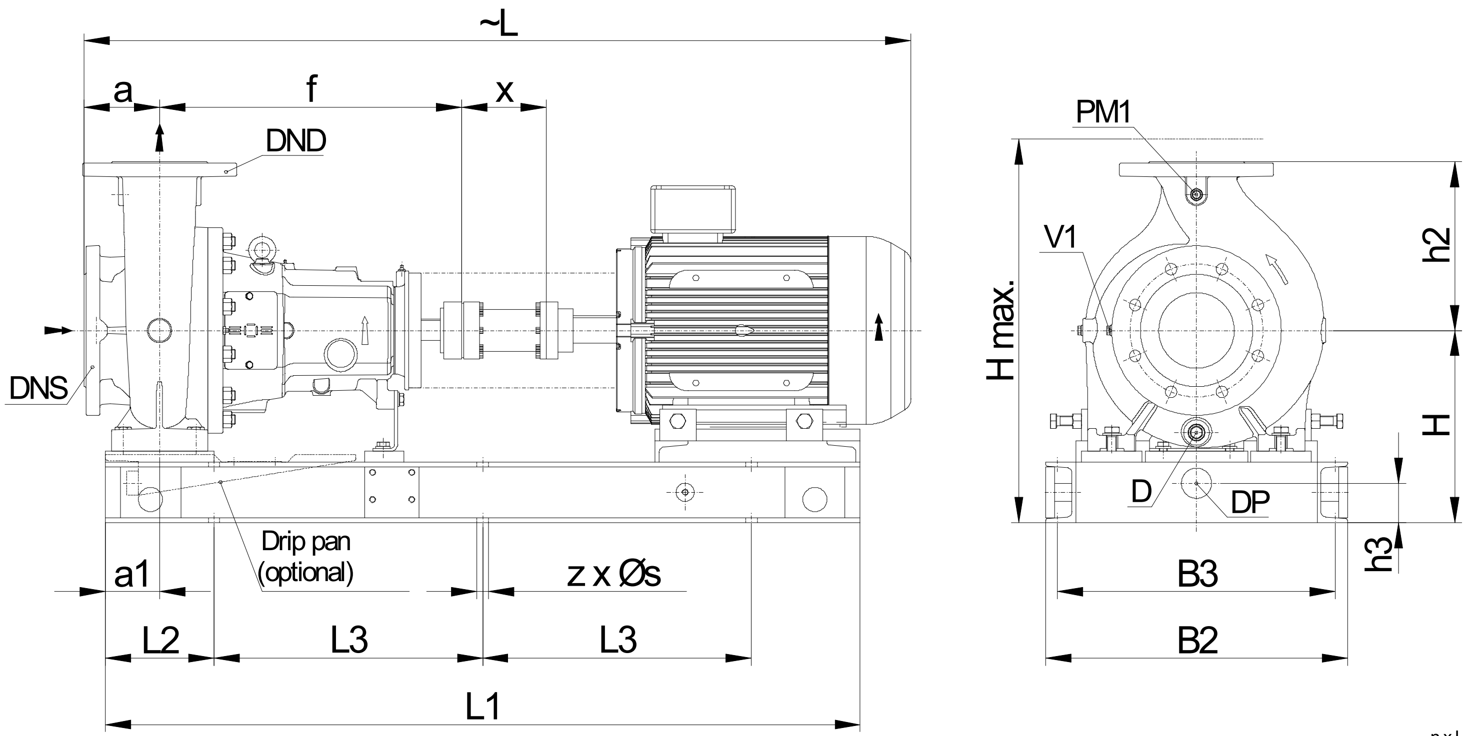
# IXPC125-100-315D750L25BDN4S1G

## Dimensions

**Company name**
**Contact**
**Phone number**
**e-mail address**

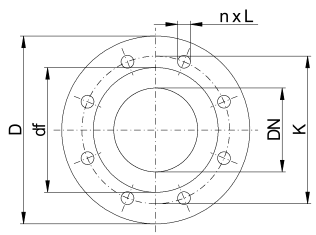
Frame mounted
Spacer coupling
3MGS 280 S B3 75 kW E4

Electrical and dimensional data refer to IE4 motor




| Dimensions | [ mm ] | | |
|---|---|---|---|
| a | 140 | s | 26 |
| a1 | 90 | Volumen | 1.1795 |
| B2 | 830 | x | 140 |
| B3 | 780 | z | 6 |
| DNd | 100 | | |
| DNs | 125 | | |
| f | 530 | | |
| Guard | 390 | | |
| H max. | 856 | | |
| H | 443 | | |
| h2 | 315 | | |
| h3 | 140 | | |
| L | 1766.5 | | |
| L1 | 1600 | | |
| L2 | 200 | | |
| L3 | 600 | | |

| Weight | (+/- 5%) |
|---|---|
| **Pump** | **165 kg** |
| **Coupling** | **15.2** |
| **Base plate** | **165** |
| **Motor** | **596** |
| **Total weight** | **946 kg** |




| Connections | | | |
|---|---|---|---|
| **Suction nozzle** | | **Discharge nozzle** | |
| **DNs 125** | | **DNd 100** | |
| **PN10/16** | | **PN10/16** | |
| **EN1092-2** | | **EN1092-2** | |
| C | 26 | C | 24 |
| D | 280 | D | 255 |
| df | 186 | df | 156 |
| K | 210 | K | 180 |
| n | 8x | n | 8x |
| ØL | 19 | ØL | 19 |

Connections:
D: Drain G1/2"
DP: Drip pan connection G1" (optional)
V1: Pressure gauge connector G1/4" (suction side)
PM1: Pressure gauge connector G1/4" (discharge side)

Note:
Value D, C and df may vary from standard

**Dimensions and weight without obligation**

| | | | | | |
|---|---|---|---|---|---|
| **Project** | Xylect-20156793 | **Created by** | roumaissa bouras | **Last update** | 6/11/2024 |
| **Block** | IXPC125-100-315D750L25BDN4S1G | **Created on** | 6/11/2024 | | |

LOWARA
a xylem brand

# MPA100A/08A/BD750/L45VCCC4

## Technical data

Company name
Contact
Phone number
e-mail address

## Operating data

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Pumpe type | | Single pumps as parallel circuit | Fluid | | Water, pure |
| 2 | No. of pumps | | 3 | Operating temperature t A | °C | 20 |
| 3 | Nominal flow | m³/h | 116.1 | Max / Min Operating Temperature | °C | 140 / -25 |
| 4 | Nominal head | m | 159.1 | Max / Min Operating Temperature mech. Seal | °C | 120 / -10 |
| 5 | Static head | m | 150.7 | pH-value at t A | | 7 |
| 6 | Inlet pressure / Vapor pressure at t A | kPa | 0 / 100 | Density at t A | kg/m³ | 998 |
| 7 | Environmental temperature | °C | 20 | Kin. viscosity at t A | mm²/s | 1 |
| 8 | Available system NPSH | m | 0 | Altitude | | 0 |

## Pump data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | Design | | Horizontal Multistage pump, axial DNs, radial DNd, 1 Slide bearing DNs, 1 Roller bearings DNd | | | | |
| 10 | Execution | | AO / DNs - axial, DNd - above | Impeller Ø | Max. | mm | 242 |
| 11 | Lubrication | | Grease Lubrication | | designed | mm | 8x 242 mm |
| 12 | Operating speed | rpm | 1490 Stages 8 | | Min. | mm | 176 |
| 13 | Flange connections | | | Flow | Nominal | m³/h | 120.3 |
| 14 | EN1092-2 / DNs150, PN10/16 - DNd100, PN25/40 | | | | Max- | m³/h | 102.8 |
| 15 | Max. casing pressure | kPa | 4000 | | Min- | m³/h | 20.6 |
| 16 | Max. working pressure | kPa | 1661.6 | Head | Nominal | m | 159.7 |
| 17 | Impeller type | | Radial impeller | | at Qmax | m | 71.4 |
| 18 | Head H(Q=0) | m | 170 | | at Qmin | m | 168.2 |
| 19 | Max. shaft power | kW | 102.8 | Shaft power | | kW | 76.9 |
| 20 | Pump weight | kg | 470 | Efficiency | | % | 67.8 |
| 21 | Total weight | kg | 1,386.7 | NPSH 3% | | m | 1.1 |

## Materials

| | | | | |
|---|---|---|---|---|
| 22 | Pump | | Shaft Seal | |
| 23 | Suction Impeller | Cast Iron, EN-GJL-200, ASTM Class 30 | Single mechanical seal, with shaft sleeve (unbalanced) | |
| 24 | Impeller | Cast Iron, EN-GJL-200, ASTM Class 30 | eMG12 - Ø55mm | BQ7EGG-WA |
| 25 | Diffuser | Cast Iron, EN-GJL-150, ASTM Class 25 | Mechanical seal diameter | 55 mm |
| 26 | Stage Casing | Cast Iron, EN-GJL-250, ASTM Class 35 | 1. Rotating ring | Carbon graphite resin impregnated |
| 27 | Suction Casing | Cast Iron, EN-GJL-250, ASTM Class 35 | 2. Stationary ring | SiC, silicon carbide, sintered press.less |
| 28 | Discharge Casing | Cast Iron, EN-GJL-250, ASTM Class 35 | 3. Secondary seal | Ethylene propylene rubber (EPDM) |
| 29 | Seal Cover | Cast Iron, EN-GJL-250, ASTM Class 35 | 4. Springs | CrNiMo - Steel |
| 30 | Bearing Bracket / Motor Adapter | Cast Iron, EN-GJL-250, ASTM Class 35 | 5. Others | EPDM - WRAS |
| 31 | Pump Foot | Cast Iron, EN-GJL-250, ASTM Class 35 | Gaskets of the pump | Ethylene propylene rubber (EPDM) |
| 32 | Wear ring | without [STD] | | |
| 33 | Drum | Stainless Steel, 1.4057, ASTM 431 | | |
| 34 | Drum Bush | Cast Iron, EN-GJL-250, ASTM Class 35 | | |
| 35 | Shaft | Stainless Steel, 1.4057, ASTM 431 | | |
| 36 | Shaft Sleeve | Stainless Steel, 1.4057, ASTM 431 | | |
| 37 | Spacer Sleeve | Stainless Steel, 1.4057, ASTM 431 | | |
| 38 | Shaft Nut | Stainless Steel, 1.4057, ASTM 431 | | |
| 39 | Impeller Nut | A4 | | |
| 40 | | | | |
| 41 | | | | |
| 42 | | | | |
| 43 | | | | |

## Motor data

Electrical and dimensional data refer to IE4 motor

| | | | | |
|---|---|---|---|---|
| 44 | Manufacturer | Lowara | | |
| 45 | Specific design | IE4 3ph Surface Motor - Super Premium Efficiency | | |
| 46 | Type | 3MGS 280 S B3 75 kW E4 | | |
| 47 | Rated power | 75 kW | Item no. | |
| 48 | Nominal speed | 1490 rpm | Service factor | 1 |
| 49 | Frame size | 280 S | Electric data | 400 V 134 A |
| 50 | Weight kg | 702.0 | Shaft diameter | 75.0 mm |

## Coupling

| | | |
|---|---|---|
| Manufacturer | | FLENDER |
| Series | | Standard Coupling - N-EUPEX - Type B |
| Shaft diameter Pump / Motor | mm | 45.0 / 75.0 |
| Frame size | | 180 |
| Spacer length | mm | 4 |
| Weight | kg | 11.5 |
| Coupling protection | e-MP_GR.COUPLGUARD ES42-230-23 A4 | 3.4 kg |

## Base plate

| | | | |
|---|---|---|---|
| 51 | Name | | FRAME EMP100-HJ-280 |
| 52 | Weight | kg | 199.8 |

## Remarks

| | | | | | |
|---|---|---|---|---|---|
| Project | Xylect-20156819 | Created by | roumaissa bouras | Last update | 6/11/2024 |
| Block | MPA100A/08A/BD750/L45VCCC4 | Created on | 6/11/2024 | | |

# MPA100A/08A/BD750/L45VCCC4

## Performance curve

Company name
Contact
Phone number
e-mail address

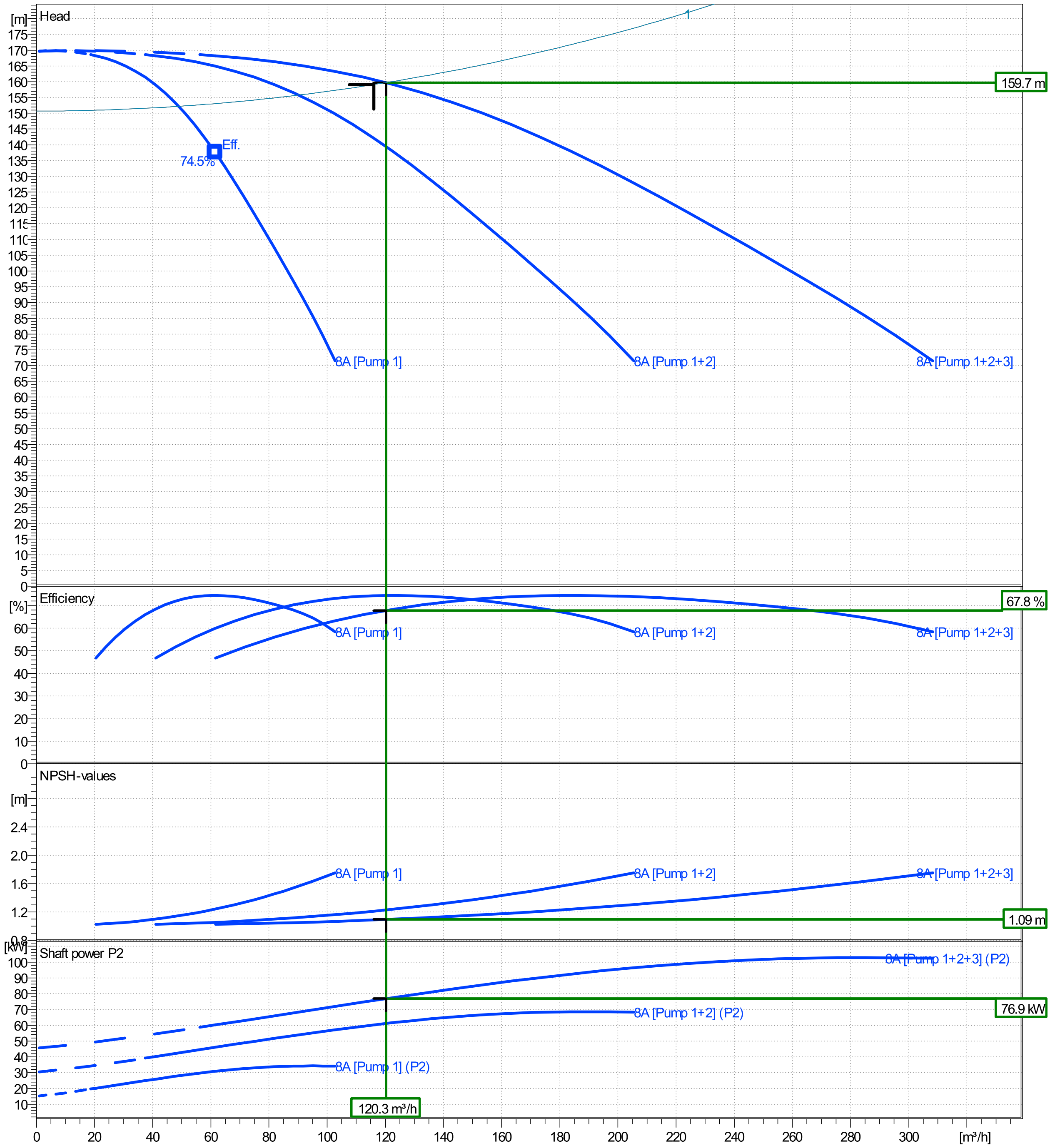
| | Ø | Pump capacity Operating range Min. | Max. | η Max. | Pump head H(Q=0) | η Max. | Shaft power P2 P2(Q=0) | Max. | η Max. |
|---|---|---|---|---|---|---|---|---|---|
| | mm | m³/h | m³/h | m³/h | m | m | kW | kW | kW |
| actual | 242 | 20.6 | 103 | 61.5 | 170 | 138 | | 103 | 30.9 |
| Min. | 176 | / | / | 61.5 | 170 | 138 | | / | 30.9 |
| Max. | 242 | / | / | 61.5 | 170 | 138 | | / | 30.9 |

| | | |
|---|---|---|
| Frequency | Hz | 50 |
| Operating speed | rpm | 1490 |
| Nominal flow | m³/h | 116.1 |
| Nominal head | m | 159.1 |
| Inlet pressure | kPa | 0 |
| Static head | m | 150.7 |

Power datas refered to: hydr. Performance acceptance acc. To EN ISO 9906 Class Grade 2B

Water, pure [100%] ; 20°C; 998kg/m³; 1mm²/s

MEI: N.A - according to Ecodesign Directive 2009/125/EC and Regulation (EU) No.547/2012




| | | | | | |
|---|---|---|---|---|---|
| Project | Xylect-20156819 | Created by | roumaissa bouras | Last update | 6/11/2024 |
| Block | MPA100A/08A/BD750/L45VCCC4 | Created on | 6/11/2024 | | |

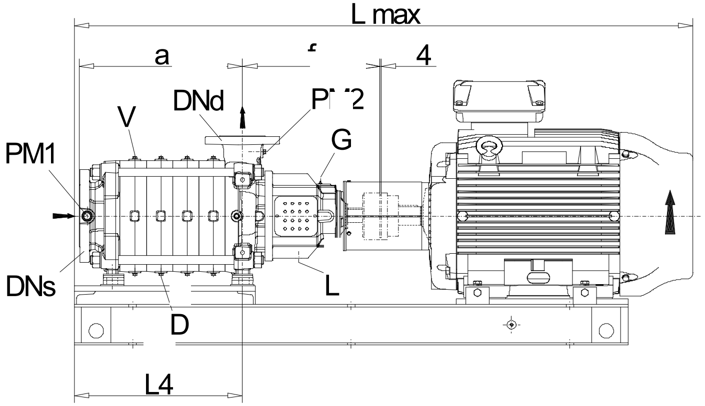
# MPA100A/08A/BD750/L45VCCC4

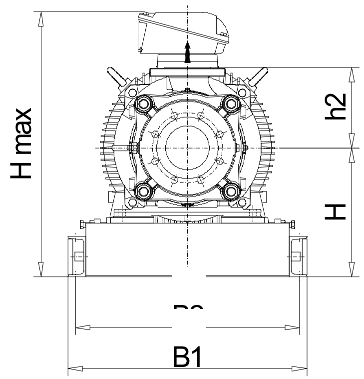
## Dimensions

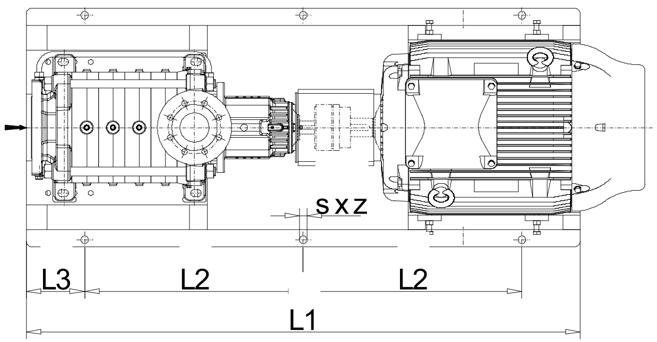
**Company name**
**Contact**
**Phone number**
**e-mail address**

Complete Unit with Baseplate
AO / DNs - axial, DNd - above
3MGS 280 S B3 75 kW E4

Electrical and dimensional data refer to IE4 motor



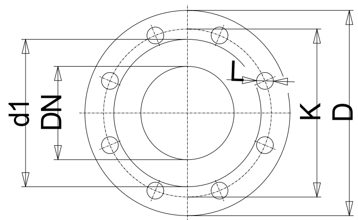




| Dimensions | [ mm ] | | |
|---|---|---|---|
| a | 830 | L4 | 937 |
| B1 | 820 | Lmax | 2369.5 |
| B2 | 770 | PM1 | G1/4 |
| D | G1/4 | PM2 | G1/4 |
| DNd | 100 | s | 26 |
| DNs | 150 | V | G1/4 |
| f | 472 | Volumen | 1.6632 |
| G | M8 | z | 6 |
| Guard | 254 | | |
| H | 443 | | |
| h2 | 275 | | |
| Hmax | 856 | | |
| L | G1/2 | | |
| L1 | 2250 | | |
| L2 | 925 | | |
| L3 | 200 | | |

| Weight | (+/- 5%) |
|---|---|
| **Pump** | **470** |
| **Coupling** | **11.5** |
| **Base plate** | **200** |
| **Motor** | **702** |
| **Total weight** | **1,387 kg** |

PM1...Pressure gauge connector
PM2...Pressure gauge connector
D...Drain
G...Grease nipple
L...Leakage
V...Venting




Note: Value D, C and d may vary from standard

| Connections | | | |
|---|---|---|---|
| **Suction nozzle** | | **Discharge nozzle** | |
| **DNs 150** | | **DNd 100** | |
| **PN10/16** | | **PN25/40** | |
| **EN1092-2** | | **EN1092-2** | |
| C | 34 | C | 28 |
| D | 320 | D | 255 |
| d1 | 211 | d1 | 156 |
| K | 240 | K | 190 |
| L | 23 | L | 23 |
| z | 8 | z | 8 |

**Dimensions and weight without obligation**

| | | | | | |
|---|---|---|---|---|---|
| **Project** | Xylect-20156819 | **Created by** | roumaissa bouras | **Last update** | 6/11/2024 |
| **Block** | MPA100A/08A/BD750/L45VCCC4 | **Created on** | 6/11/2024 | | |

Program version 73.0 - 23/04/2024 (Build 125)
Data version 14/05/2024 09:17
User group(s) Xylem: Algeria - EXT

LOWARA
a xylem brand

# MPA125A/02A/BD1600/L25VCCC4

## Technical data

Company name
Contact
Phone number
e-mail address

## Operating data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Pumpe type | Single pumps as parallel circuit | | Fluid | Water, pure | | |
| 2 | No. of pumps | | 4 | Operating temperature t A | °C | 20 | |
| 3 | Nominal flow | m³/h | 612.8 | Max / Min Operating Temperature | °C | 140 / -25 | |
| 4 | Nominal head | m | 205.8 | Max / Min Operating Temperature mech. Seal | °C | 120 / -10 | |
| 5 | Static head | m | 199 | pH-value at t A | | 7 | |
| 6 | Inlet pressure / Vapor pressure at t A | kPa | 0 / 100 | Density at t A | kg/m³ | 998 | |
| 7 | Environmental temperature | °C | 20 | Kin. viscosity at t A | mm²/s | 1 | |
| 8 | Available system NPSH | m | 0 | Altitude | | 0 | |

## Pump data

| | | | | | | |
|---|---|---|---|---|---|---|
| 9 | Design | Horizontal Multistage pump, axial DNs, radial DNd, 1 Slide bearing DNs, 1 Roller bearings DNd | | | | |
| 10 | Execution | AO / DNs - axial, DNd - above | Impeller Ø | Max. | mm | 283 |
| 11 | Lubrication | Grease Lubrication | | designed | mm | 2x 283 mm |
| 12 | Operating speed | rpm 2985 Stages 2 | | Min. | mm | 223 |
| 13 | Flange connections | | Flow | Nominal | m³/h | 612.8 |
| 14 | EN1092-2 / DNs200, PN16 - DNd125, PN25/40 | | | Max- | m³/h | 394.6 |
| 15 | Max. casing pressure | kPa 2500 | | Min- | m³/h | 121.4 |
| 16 | Max. working pressure | kPa 2228.3 | Head | Nominal | m | 205.8 |
| 17 | Impeller type | Radial impeller | | at Qmax | m | 113.6 |
| 18 | Head H(Q=0) | m 230 | | at Qmin | m | 222.8 |
| 19 | Max. shaft power | kW 540 | Shaft power | | kW | 448.7 |
| 20 | Pump weight | kg 430 | Efficiency | | % | 76.4 |
| 21 | Total weight | kg 1,635.4 | NPSH 3% | | m | 4.5 |

## Materials

| | | | | |
|---|---|---|---|---|
| 22 | | Pump | Shaft Seal | |
| 23 | Suction Impeller | Cast Iron, EN-GJL-200, ASTM Class 30 | Single mechanical seal, with shaft sleeve (unbalanced) | |
| 24 | Impeller | Cast Iron, EN-GJL-200, ASTM Class 30 | eMG12 - Ø65mm | BQ7EGG-WA |
| 25 | Diffuser | Cast Iron, EN-GJL-150, ASTM Class 25 | Mechanical seal diameter | 65 mm |
| 26 | Stage Casing | Cast Iron, EN-GJL-250, ASTM Class 35 | 1. Rotating ring | Carbon graphite resin impregnated |
| 27 | Suction Casing | Cast Iron, EN-GJL-250, ASTM Class 35 | 2. Stationary ring | SiC, silicon carbide, sintered press.less |
| 28 | Discharge Casing | Cast Iron, EN-GJL-250, ASTM Class 35 | 3. Secondary seal | Ethylene propylene rubber (EPDM) |
| 29 | Seal Cover | Cast Iron, EN-GJL-250, ASTM Class 35 | 4. Springs | CrNiMo - Steel |
| 30 | Bearing Bracket / Motor Adapter | Cast Iron, EN-GJL-250, ASTM Class 35 | 5. Others | EPDM - WRAS |
| 31 | Pump Foot | Carbon Steel, 1.0038, ASTM Grade C, D | Gaskets of the pump | Ethylene propylene rubber (EPDM) |
| 32 | Wear ring | without [STD] | | |
| 33 | Drum | Stainless Steel, 1.4057, ASTM 431 | | |
| 34 | Drum Bush | Cast Iron, EN-GJL-250, ASTM Class 35 | | |
| 35 | Shaft | Stainless Steel, 1.4057, ASTM 431 | | |
| 36 | Shaft Sleeve | Stainless Steel, 1.4057, ASTM 431 | | |
| 37 | Spacer Sleeve | Stainless Steel, 1.4057, ASTM 431 | | |
| 38 | Shaft Nut | Stainless Steel, 1.4057, ASTM 431 | | |
| 39 | Impeller Nut | A4 | | |
| 40 | | | | |
| 41 | | | | |
| 42 | | | | |
| 43 | | | | |

## Motor data

Electrical and dimensional data refer to IE4 motor

| | | | | |
|---|---|---|---|---|
| 44 | Manufacturer | Lowara | | |
| 45 | Specific design | IE4 3ph Surface Motor - Super Premium Efficiency | | |
| 46 | Type | 3MGS 315 M B3 160 kW E4 | | |
| 47 | Rated power | 160 kW | Item no. | |
| 48 | Nominal speed | 2985 rpm | Service factor | 1 |
| 49 | Frame size | 315 M | Electric data | 400 V 262 A |
| 50 | Weight kg | 955.0 | Shaft diameter | 65.0 mm |

## Coupling

| | | | |
|---|---|---|---|
| Manufacturer | | | FLENDER |
| Series | | | Standard Coupling - N-EUPEX - Type B |
| Shaft diameter | Pump / Motor | mm | 52.0 / 65.0 |
| Frame size | | | 160 |
| Spacer length | | mm | 4 |
| Weight | | kg | 7.8 |
| Coupling protection | e-MP_GR.COUPLGUARD ES42-230-23 A4 | | 3.4 kg |

## Base plate

| | | | |
|---|---|---|---|
| 51 | Name | | FRAME EMP125-B-312 |
| 52 | Weight | kg | 239.2 |

## Remarks

| | | | | | |
|---|---|---|---|---|---|
| Project | Xylect-20156843 | Created by | roumaissa bouras | Last update | 6/11/2024 |
| Block | MPA125A/02A/BD1600/L25VCCC4 | Created on | 6/11/2024 | | |

# MPA125A/02A/BD1600/L25VCCC4

## Performance curve

Company name
Contact
Phone number
e-mail address

| | Ø | Pump capacity Operating range Min. | Max. | η Max. | Pump head H(Q=0) | η Max. | Shaft power P2 P2(Q=0) | Max. | η Max. |
|---|---|---|---|---|---|---|---|---|---|
| | mm | m³/h | m³/h | m³/h | m | m | kW | kW | kW |
| actual | 283 | 138 | 237 | 276 | 228 | 179 | | 540 | 169 |
| Min. | 223 | / | / | 215 | 171 | 139 | | / | 108 |
| Max. | 283 | / | / | 276 | 228 | 179 | | / | 169 |

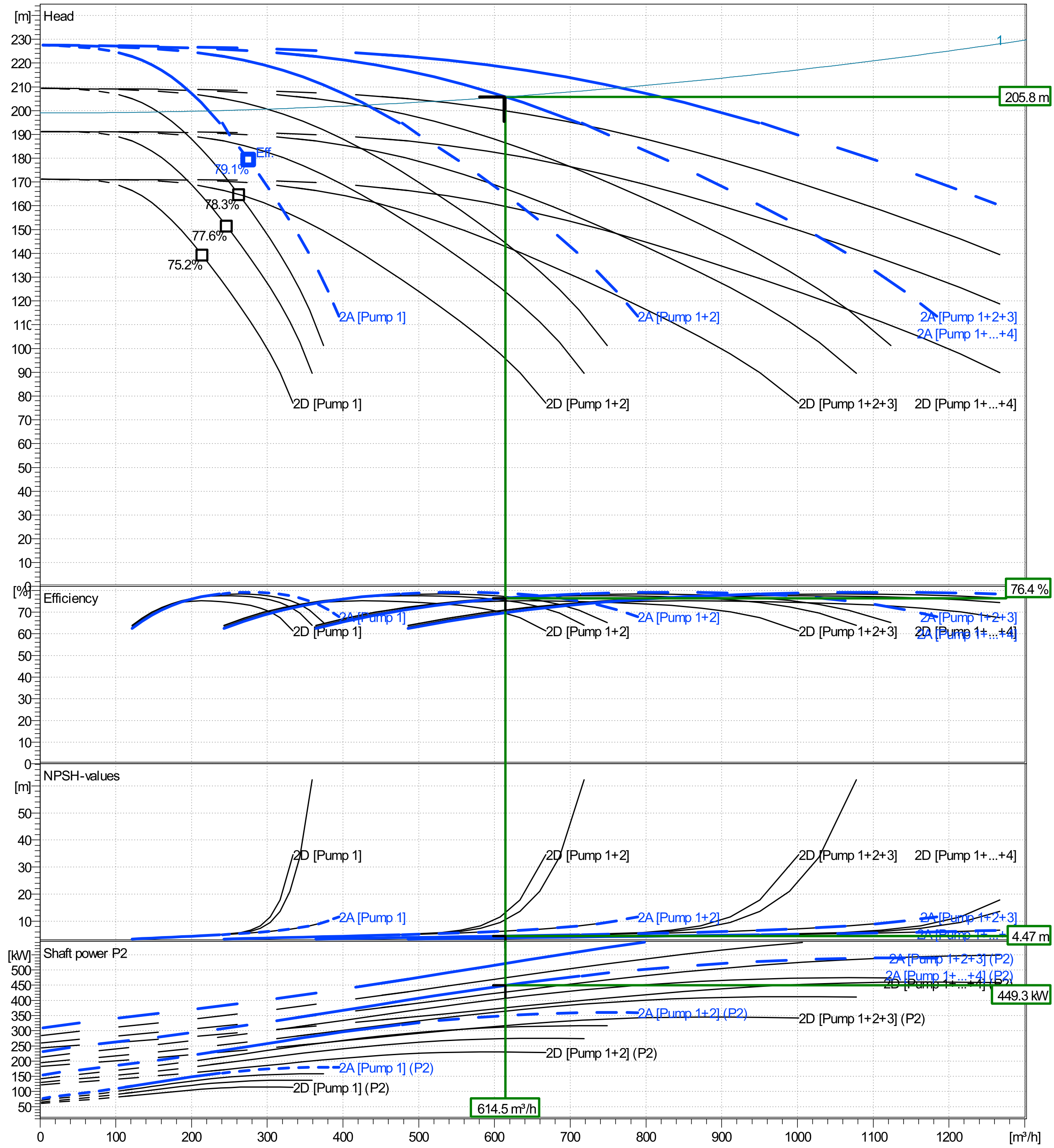
| | | |
|---|---|---|
| Frequency | Hz | 50 |
| Operating speed | rpm | 2985 |
| Nominal flow | m³/h | 612.8 |
| Nominal head | m | 205.8 |
| Inlet pressure | kPa | 0 |
| Static head | m | 199 |

**Power datas refered to:**

Water, pure [100%] ; 20°C; 998kg/m³; 1mm²/s

**hydr. Performance acceptance acc. To EN ISO 9906 Class** Grade 2B

**MEI: N.A - according to Ecodesign Directive 2009/125/EC and Regulation (EU) No.547/2012**




| | | | | | |
|---|---|---|---|---|---|
| **Project** | Xylect-20156843 | **Created by** | roumaissa bouras | **Last update** | 6/11/2024 |
| **Block** | MPA125A/02A/BD1600/L25VCCC4 | **Created on** | 6/11/2024 | | |

| Program version | Data version | User group(s) |
|---|---|---|
| 73.0 - 23/04/2024 (Build 125) | 14/05/2024 09:17 | Xylem:Algeria - EXT |

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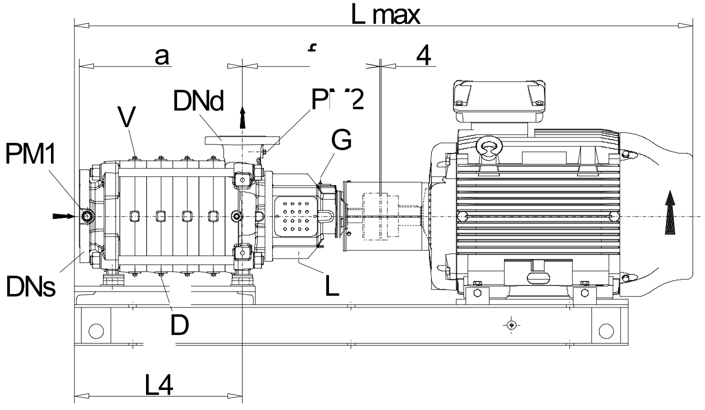
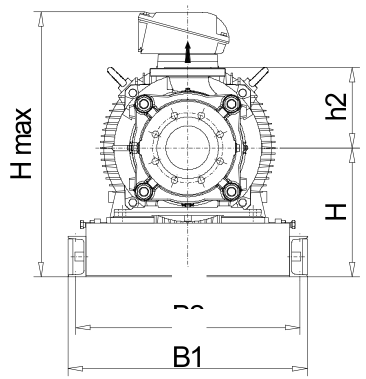
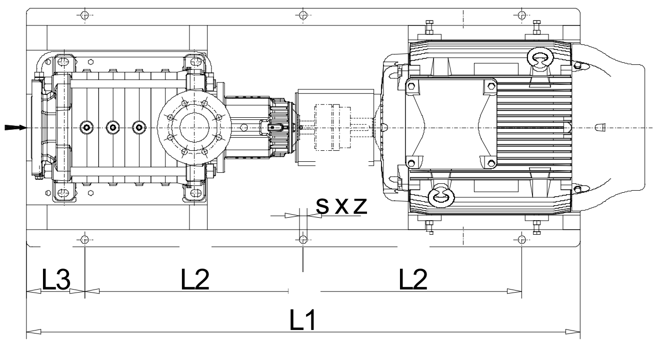
| **MPA125A/02A/BD1600/L25VCCC4** | **Dimensions** | Company name<br>Contact<br>Phone number<br>e-mail address |
|---|---|---|

Complete Unit with Baseplate
AO / DNs - axial, DNd - above
3MGS 315 M B3 160 kW E4

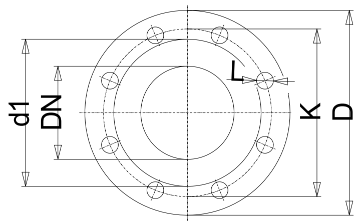
Electrical and dimensional data refer to IE4 motor




PM1...Pressure gauge connector
PM2...Pressure gauge connector
D...Drain
G...Grease nipple
L...Leakage
V...Venting




Note: Value D, C and d may vary from standard

| Dimensions | [ mm ] | | |
|---|---|---|---|
| a | 388 | L4 | 390 |
| B1 | 860 | Lmax | 2008 |
| B2 | 810 | PM1 | G1/4 |
| D | G1/4 | PM2 | G1/4 |
| DNd | 125 | s | 26 |
| DNs | 200 | V | G1/4 |
| f | 488 | Volumen | 1.7839 |
| G | M8 | z | 6 |
| Guard | 254 | | |
| H | 508 | | |
| h2 | 325 | | |
| Hmax | 1033 | | |
| L | G1/2 | | |
| L1 | 1950 | | |
| L2 | 775 | | |
| L3 | 200 | | |

| Weight | (+/- 5%) |
|---|---|
| **Pump** | **430** |
| **Coupling** | **7.8** |
| **Base plate** | **239** |
| **Motor** | **955** |
| **Total weight** | **1,635 kg** |

| Connections | | | |
|---|---|---|---|
| **Suction nozzle** | | **Discharge nozzle** | |
| **DNs 200** | | **DNd 125** | |
| **PN16** | | **PN25/40** | |
| **EN1092-2** | | **EN1092-2** | |
| C | 40 | C | 30 |
| D | 380 | D | 280 |
| d1 | 266 | d1 | 184 |
| K | 295 | K | 220 |
| L | 23 | L | 28 |
| z | 12 | z | 8 |

**Dimensions and weight without obligation**

| | | | | | |
|---|---|---|---|---|---|
| **Project** | Xylect-20156843 | **Created by** | roumaissa bouras | **Last update** | 6/11/2024 |
| **Block** | MPA125A/02A/BD1600/L25VCCC4 | **Created on** | 6/11/2024 | | |

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# MPA150A/02C/BD3150/L25VDNC4

## Technical data

Company name
Contact
Phone number
e-mail address

### Operating data

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Pumpe type | | Single pumps as parallel circuit | Fluid | | Water, pure |
| 2 | No. of pumps | | 3 | Operating temperature t A | °C | 20 |
| 3 | Nominal flow | m³/h | 612.8 | Max / Min Operating Temperature | °C | 140 / -25 |
| 4 | Nominal head | m | 235.85 | Max / Min Operating Temperature mech. Seal | °C | 120 / -10 |
| 5 | Static head | m | 233 | pH-value at t A | | 7 |
| 6 | Inlet pressure / Vapor pressure at t A | kPa | 0 / 100 | Density at t A | kg/m³ | 998 |
| 7 | Environmental temperature | °C | 20 | Kin. viscosity at t A | mm²/s | 1 |
| 8 | Available system NPSH | m | 0 | Altitude | | 0 |

### Pump data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | Design | Horizontal Multistage pump, axial DNs, radial DNd, 1 Slide bearing DNs, 1 Roller bearings DNd | | | | | |
| 10 | Execution | AO / DNs - axial, DNd - above | | Impeller Ø | Max. | mm | 334 |
| 11 | Lubrication | Grease Lubrication | | | designed | mm | 2x 304 mm |
| 12 | Operating speed | rpm 2985 | Stages 2 | | Min. | mm | 265 |
| 13 | Flange connections | | | Flow | Nominal | m³/h | 612.8 |
| 14 | EN1092-2 - DNs250, PN16 - DNd150, PN25/40 | | | | Max- | m³/h | 602.1 |
| 15 | Max. casing pressure | kPa | 4000 | | Min- | m³/h | 253 |
| 16 | Max. working pressure | kPa | 2527.7 | Head | Nominal | m | 235.9 |
| 17 | Impeller type | | Radial impeller | | at Qmax | m | 133.6 |
| 18 | Head H(Q=0) | m | 260 | | at Qmin | m | 245.6 |
| 19 | Max. shaft power | kW | 617.8 | Shaft power | | kW | 538.2 |
| 20 | Pump weight | kg | 701 | Efficiency | | % | 72.6 |
| 21 | Total weight | kg | 2,647.0 | NPSH 3% | | m | 6.7 |

### Materials

| | | | | |
|---|---|---|---|---|
| 22 | Pump | | Shaft Seal | |
| 23 | Suction Impeller | Austenitic Stainless Steel, 1.4408, ASTM CF8M | Single mechanical seal, with shaft sleeve (balanced) | |
| 24 | Impeller | Austenitic Stainless Steel, 1.4408, ASTM CF8M | H75N - Ø75mm | BQ1EGG-WA |
| 25 | Diffuser | Cast Iron, EN-GJL-150, ASTM Class 25 | Mechanical seal diameter | 75 mm |
| 26 | Stage Casing | Ductile Iron, EN-GJS-400-15, ASTM 65-45-12 | 1. Rotating ring | Carbon graphite resin impregnated |
| 27 | Suction Casing | Ductile Iron, EN-GJS-400-15, ASTM 65-45-12 | 2. Stationary ring | SiC, silicon carbide, sintered press.less |
| 28 | Discharge Casing | Ductile Iron, EN-GJS-400-15, ASTM 65-45-12 | 3. Secondary seal | Ethylene propylene rubber (EPDM) |
| 29 | Seal Cover | Ductile Iron, EN-GJS-400-15, ASTM 65-45-12 | 4. Springs | CrNiMo - Steel |
| 30 | Bearing Bracket / Motor Adapter | Cast Iron, EN-GJL-250, ASTM Class 35 | 5. Others | EPDM - WRAS |
| 31 | Pump Foot | Carbon Steel, 1.0038, ASTM Grade C, D | Gaskets of the pump | Ethylene propylene rubber (EPDM) |
| 32 | Wear ring | without [STD] | | |
| 33 | Drum | Stainless Steel, 1.4057, ASTM 431 | | |
| 34 | Drum Bush | Cast Iron, EN-GJL-250, ASTM Class 35 | | |
| 35 | Shaft | Stainless Steel, 1.4057, ASTM 431 | | |
| 36 | Shaft Sleeve | Stainless Steel, 1.4057, ASTM 431 | | |
| 37 | Spacer Sleeve | Stainless Steel, 1.4057, ASTM 431 | | |
| 38 | Shaft Nut | Stainless Steel, 1.4057, ASTM 431 | | |
| 39 | Impeller Nut | A4 | | |
| 40 | | | | |
| 41 | | | | |
| 42 | | | | |
| 43 | | | | |

### Motor data

Electrical and dimensional data refer to IE3 motor

| | | | | |
|---|---|---|---|---|
| 44 | Manufacturer | Lowara | | |
| 45 | Specific design | IE3 3ph Surface Motor - Premium Efficiency | | |
| 46 | Type | 3MGS 355 M B3 315 kW | | |
| 47 | Rated power | 315 kW | Item no. | |
| 48 | Nominal speed | 2985 rpm | Service factor | 1 |
| 49 | Frame size | 355 M | Electric data | 400 V 518 A |
| 50 | Weight kg | 1,547.0 | Shaft diameter | 75.0 mm |

### Coupling

| | |
|---|---|
| Manufacturer | FLENDER |
| Series | Spacer Coupling - N-EUPEX - Type H |
| Shaft diameter Pump / Motor mm | 60.0 / 75.0 |
| Frame size | 200 |
| Spacer length mm | 250 |
| Weight kg | 32.1 |
| Coupling protection | e-MP_GR.COUPLGUARD ES60-310-54 A4 6.3 kg |

### Base plate

| | | | |
|---|---|---|---|
| 51 | Name | | FRAME EMP150-B-S-355 |
| 52 | Weight | kg | 360.6 |

### Remarks

| | | | | | |
|---|---|---|---|---|---|
| Project | Xylect-20156882 | Created by | roumaissa bouras | Last update | 6/11/2024 |
| Block | MPA150A/02C/BD3150/L25VDNC4 | Created on | 6/11/2024 | | |

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# MPA150A/02C/BD3150/L25VDNC4

## Performance curve

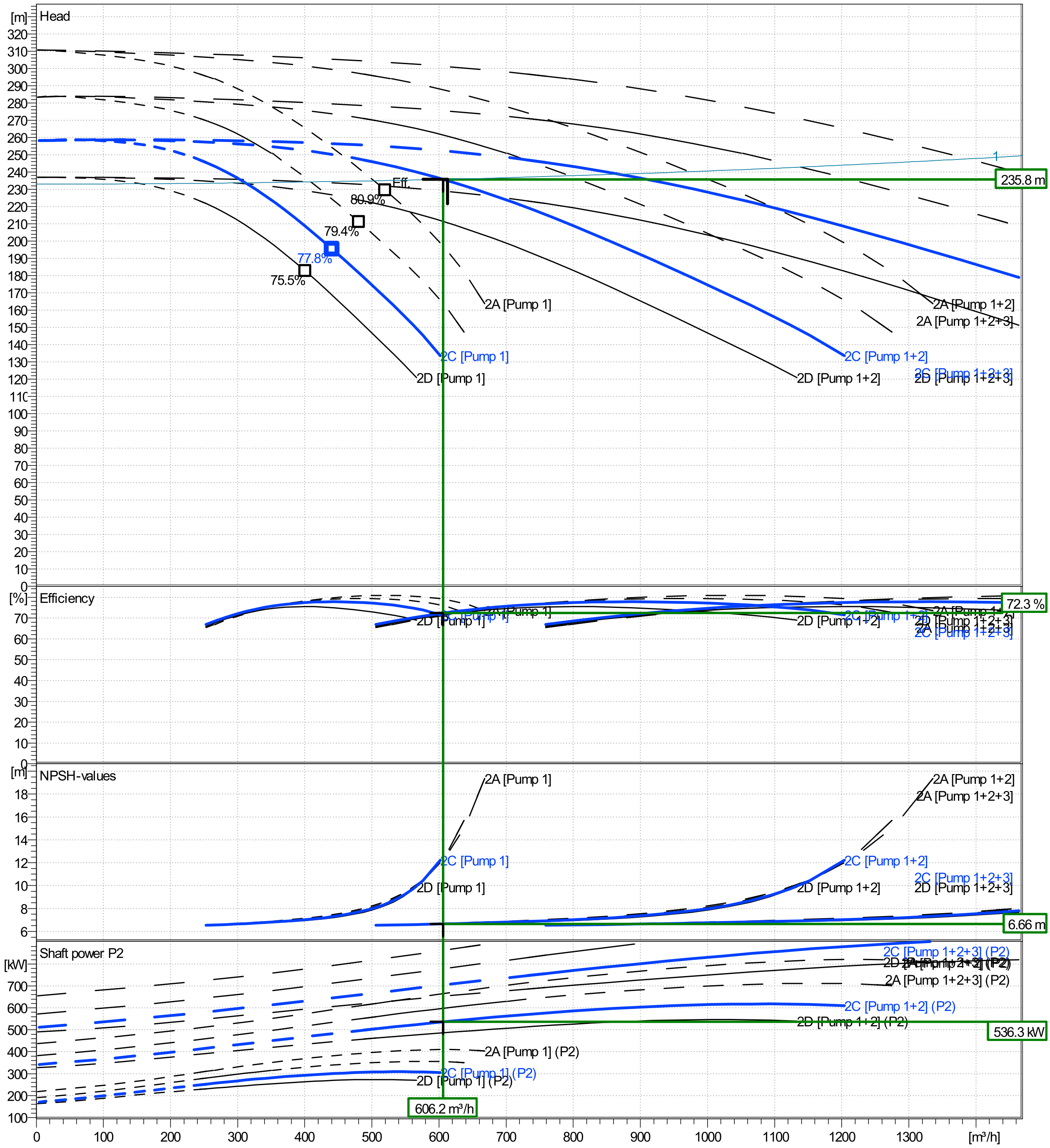
Company name
Contact
Phone number
e-mail address

| | Ø | Pump capacity | | | Pump head | | Shaft power P2 | | | Frequency | Hz | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Operating range Min. | Max. | η Max. | H(Q=0) | η Max. | P2(Q=0) | Max. | η Max. | Operating speed | rpm | 2985 |
| | mm | m³/h | m³/h | m³/h | m | m | kW | kW | kW | Nominal flow | m³/h | 612.8 |
| actual | 304 | 253 | 602 | 441 | 258 | 195 | | 618 | 300 | Nominal head | m | 235.8 |
| Min. | 265 | / | / | 401 | 237 | 183 | | / | 263 | Inlet pressure | kPa | 0 |
| Max. | 334 | / | / | 520 | 311 | 229 | | / | 400 | Static head | m | 233 |

**Power datas refered to:** **hydr. Performance acceptance acc. To EN ISO 9906 Class** Grade 2B

Water, pure [100%] ; 20°C; 998kg/m³; 1mm²/s

MEI: N.A - according to Ecodesign Directive 2009/125/EC and Regulation (EU) No.547/2012




| | | | | | |
|---|---|---|---|---|---|
| Project | Xylect-20156882 | Created by | roumaissa bouras | Last update | 6/11/2024 |
| Block | MPA150A/02C/BD3150/L25VDNC4 | Created on | 6/11/2024 | | |

Program version
73.0 - 23/04/2024 (Build 125)

Data version
14/05/2024 09:17

User group(s)
Xylem: Algeria - EXT

LOWARA
a xylem brand

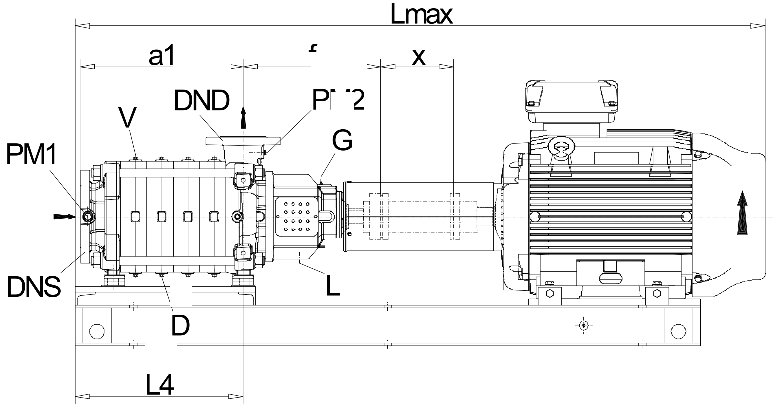
# MPA150A/02C/BD3150/L25VDNC4

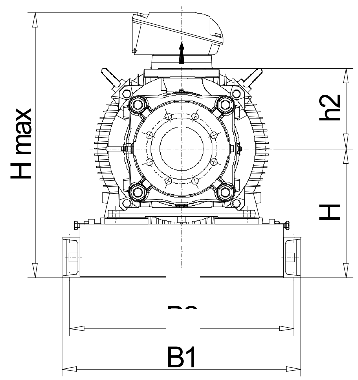
## Dimensions

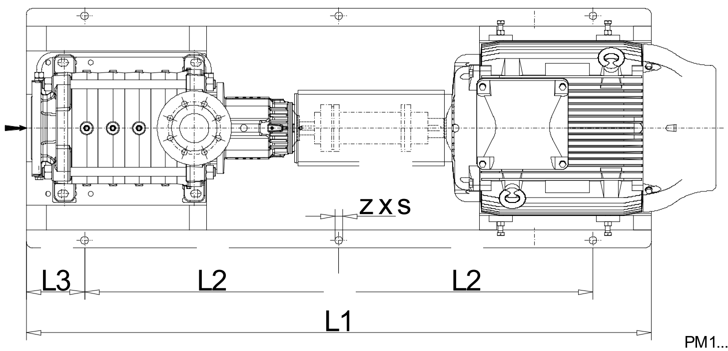
**Company name**
**Contact**
**Phone number**
**e-mail address**

Complete Unit with Baseplate
AO / DNs - axial, DNd - above
3MGS 355 M B3 315 kW

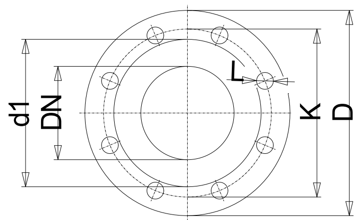
Electrical and dimensional data refer to IE3 motor




PM1...Pressure gauge connector
PM2...Pressure gauge connector
D...Drain
G...Grease nipple
L...Leakage
V...Venting




Note: Value D, C and d may vary from standard

| Dimensions | [ mm ] | | |
|---|---|---|---|
| a | 442 | L4 | 467 |
| B1 | 1000 | Lmax | 2632 |
| B2 | 930 | PM1 | G1/4 |
| D | G1/4 | PM2 | G1/4 |
| DNd | 150 | s | 29 |
| DNs | 250 | V | G1/4 |
| f | 585 | Volumen | 2.9189 |
| G | M8 | x | 250 |
| Guard | 525 | z | 6 |
| H | 583 | | |
| h2 | 400 | | |
| Hmax | 1109 | | |
| L | G1/2 | | |
| L1 | 2500 | | |
| L2 | 1000 | | |
| L3 | 250 | | |

| Weight | (+/- 5%) |
|---|---|
| **Pump** | **701** |
| **Coupling** | **32.1** |
| **Base plate** | **361** |
| **Motor** | **1,547** |
| **Total weight** | **2,647 kg** |

| Connections | | | |
|---|---|---|---|
| **Suction nozzle** | | **Discharge nozzle** | |
| **DNs 250** | | **DNd 150** | |
| **PN16** | | **PN25/40** | |
| **EN1092-2** | | **EN1092-2** | |
| C | 46 | C | 39 |
| D | 450 | D | 355 |
| d1 | 319 | d1 | 216 |
| K | 355 | K | 250 |
| L | 28 | L | 28 |
| z | 12 | z | 8 |

**Dimensions and weight without obligation**

| | | | | | |
|---|---|---|---|---|---|
| **Project** | Xylect-20156882 | **Created by** | roumaissa bouras | **Last update** | 6/11/2024 |
| **Block** | MPA150A/02C/BD3150/L25VDNC4 | **Created on** | 6/11/2024 | | |

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a xylem brand

# MPA125B/02C/BD1600/L25VCCC4

## Technical data

Company name
Contact
Phone number
e-mail address

## Operating data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Pumpe type | | Single pumps as parallel circuit | Fluid | | | Water, pure |
| 2 | No. of pumps | | 4 | Operating temperature t A | | °C | 20 |
| 3 | Nominal flow | m³/h | 612.8 | Max / Min Operating Temperature | | °C | 140 / -25 |
| 4 | Nominal head | m | 199.58 | Max / Min Operating Temperature mech. Seal | | °C | 120 / -10 |
| 5 | Static head | m | 196.8 | pH-value at t A | | | 7 |
| 6 | Inlet pressure / Vapor pressure at t A | kPa | 0 / 100 | Density at t A | | kg/m³ | 998 |
| 7 | Environmental temperature | °C | 20 | Kin. viscosity at t A | | mm²/s | 1 |
| 8 | Available system NPSH | m | 0 | Altitude | | | 0 |

## Pump data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | Design | | Horizontal Multistage pump, axial DNs, radial DNd, 1 Slide bearing DNs, 1 Roller bearings DNd | | | | |
| 10 | Execution | | AO / DNs - axial, DNd - above | Impeller Ø | Max. | mm | 295 |
| 11 | Lubrication | | Grease Lubrication | | designed | mm | 2x 270 mm |
| 12 | Operating speed | rpm | 2985 Stages 2 | | Min. | mm | 235 |
| 13 | Flange connections | | | Flow | Nominal | m³/h | 612.8 |
| 14 | EN1092-2 / DNs200, PN16 - DNd125, PN25/40 | | | | Max- | m³/h | 455.3 |
| 15 | Max. casing pressure | kPa | 2500 | | Min- | m³/h | 161.9 |
| 16 | Max. working pressure | kPa | 2099.4 | Head | Nominal | m | 199.6 |
| 17 | Impeller type | | Radial impeller | | at Qmax | m | 106 |
| 18 | Head H(Q=0) | m | 210 | | at Qmin | m | 206.6 |
| 19 | Max. shaft power | kW | 578.9 | Shaft power | | kW | 459.3 |
| 20 | Pump weight | kg | 430 | Efficiency | | % | 72.4 |
| 21 | Total weight | kg | 1,635.4 | NPSH 3% | | m | 4.8 |

## Materials

| | | | | |
|---|---|---|---|---|
| 22 | Pump | | Shaft Seal | |
| 23 | Suction Impeller | Cast Iron, EN-GJL-200, ASTM Class 30 | Single mechanical seal, with shaft sleeve (unbalanced) | |
| 24 | Impeller | Cast Iron, EN-GJL-200, ASTM Class 30 | eMG12 - Ø65mm | BQ7EGG-WA |
| 25 | Diffuser | Cast Iron, EN-GJL-150, ASTM Class 25 | Mechanical seal diameter | 65 mm |
| 26 | Stage Casing | Cast Iron, EN-GJL-250, ASTM Class 35 | 1. Rotating ring | Carbon graphite resin impregnated |
| 27 | Suction Casing | Cast Iron, EN-GJL-250, ASTM Class 35 | 2. Stationary ring | SiC, silicon carbide, sintered press.less |
| 28 | Discharge Casing | Cast Iron, EN-GJL-250, ASTM Class 35 | 3. Secondary seal | Ethylene propylene rubber (EPDM) |
| 29 | Seal Cover | Cast Iron, EN-GJL-250, ASTM Class 35 | 4. Springs | CrNiMo - Steel |
| 30 | Bearing Bracket / Motor Adapter | Cast Iron, EN-GJL-250, ASTM Class 35 | 5. Others | EPDM - WRAS |
| 31 | Pump Foot | Carbon Steel, 1.0038, ASTM Grade C, D | Gaskets of the pump | Ethylene propylene rubber (EPDM) |
| 32 | Wear ring | without [STD] | | |
| 33 | Drum | Stainless Steel, 1.4057, ASTM 431 | | |
| 34 | Drum Bush | Cast Iron, EN-GJL-250, ASTM Class 35 | | |
| 35 | Shaft | Stainless Steel, 1.4057, ASTM 431 | | |
| 36 | Shaft Sleeve | Stainless Steel, 1.4057, ASTM 431 | | |
| 37 | Spacer Sleeve | Stainless Steel, 1.4057, ASTM 431 | | |
| 38 | Shaft Nut | Stainless Steel, 1.4057, ASTM 431 | | |
| 39 | Impeller Nut | A4 | | |
| 40 | | | | |
| 41 | | | | |
| 42 | | | | |
| 43 | | | | |

## Motor data

Electrical and dimensional data refer to IE4 motor

| | | | | | |
|---|---|---|---|---|---|
| 44 | Manufacturer | Lowara | | | |
| 45 | Specific design | IE4 3ph Surface Motor - Super Premium Efficiency | | | |
| 46 | Type | 3MGS 315 M B3 160 kW E4 | | | |
| 47 | Rated power | 160 kW | Item no. | | |
| 48 | Nominal speed | 2985 rpm | Service factor | 1 | |
| 49 | Frame size | 315 M | Electric data | 400 V | 262 A |
| 50 | Weight kg | 955.0 | Shaft diameter | 65.0 | mm |

## Coupling

| | | | |
|---|---|---|---|
| Manufacturer | | | FLENDER |
| Series | | | Standard Coupling - N-EUPEX - Type B |
| Shaft diameter | Pump / Motor | mm | 52.0 / 65.0 |
| Frame size | | | 160 |
| Spacer length | | mm | 4 |
| Weight | | kg | 7.8 |
| Coupling protection | e-MP_GR.COUPLGUARD ES42-230-23 A4 | | 3.4 kg |

## Base plate

| | | | |
|---|---|---|---|
| 51 | Name | | FRAME EMP125-B-312 |
| 52 | Weight | kg | 239.2 |

## Remarks

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a xylem brand

# MPA125B/02C/BD1600/L25VCCC4

## Performance curve

Company name
Contact
Phone number
e-mail address

| | Ø | Pump capacity | | | Pump head | | Shaft power P2 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Operating range Min. | Max. | η Max. | H(Q=0) | η Max. | P2(Q=0) | Max. | η Max. |
| | mm | m³/h | m³/h | m³/h | m | m | kW | kW | kW |
| actual | 270 | 177 | 226 | 307 | 214 | 171 | | 579 | 181 |
| Min. | 235 | / | / | 290 | 193 | 150 | | / | 153 |
| Max. | 295 | / | / | 348 | 255 | 204 | | / | 234 |

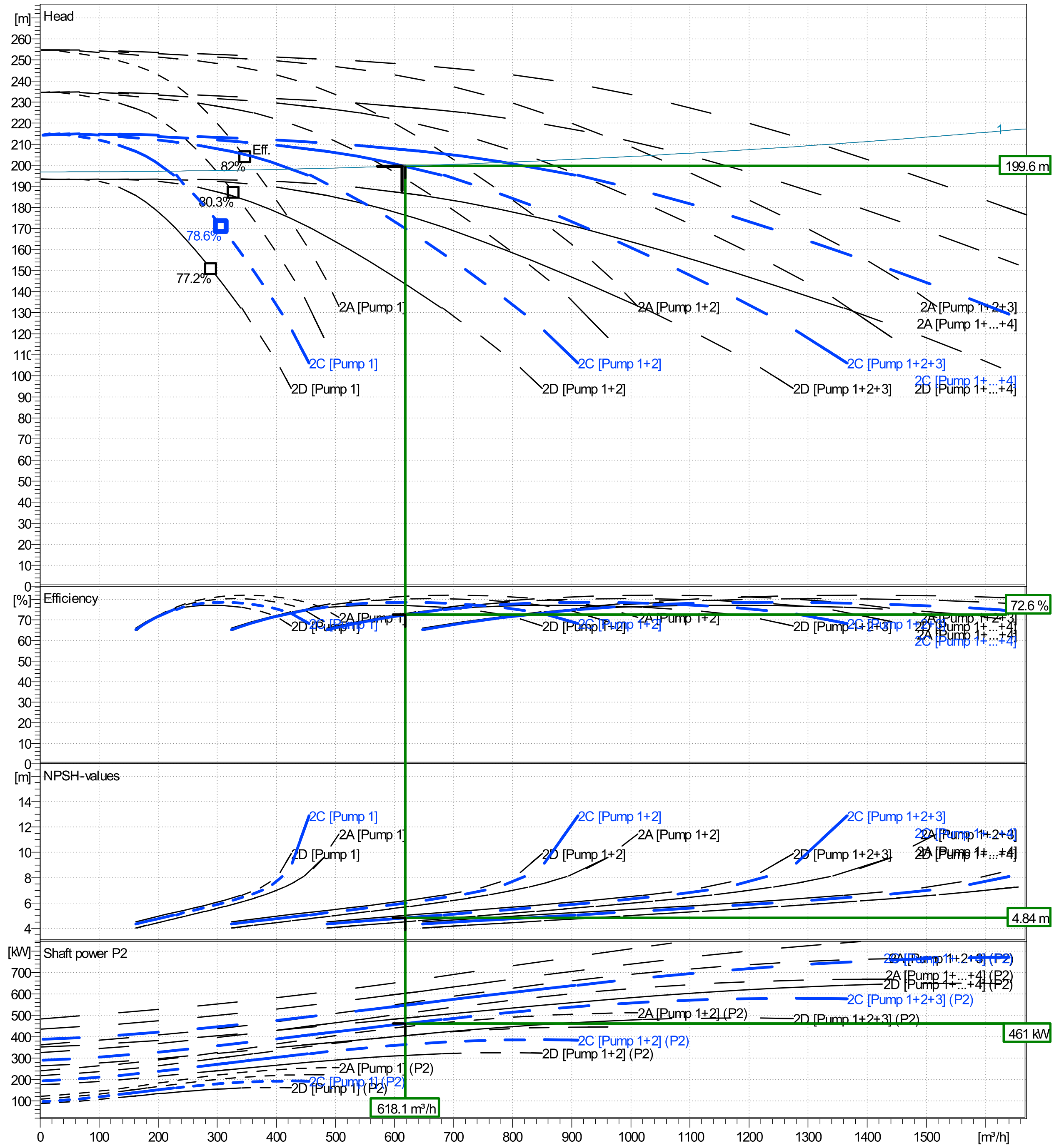
| | | |
|---|---|---|
| Frequency | Hz | 50 |
| Operating speed | rpm | 2985 |
| Nominal flow | m³/h | 612.8 |
| Nominal head | m | 199.6 |
| Inlet pressure | kPa | 0 |
| Static head | m | 196.8 |

**Power datas refered to:**

**hydr. Performance acceptance acc. To EN ISO 9906 Class** Grade 2B

Water, pure [100%] ; 20°C; 998kg/m³; 1mm²/s

MEI: N.A - according to Ecodesign Directive 2009/125/EC and Regulation (EU) No.547/2012




| | | | | | |
|---|---|---|---|---|---|
| Project | Xylect-20156918 | Created by | roumaissa bouras | Last update | 6/11/2024 |
| Block | MPA125B/02C/BD1600/L25VCCC4 | Created on | 6/11/2024 | | |


Program version 73.0 - 23/04/2024 (Build 125)
Data version 14/05/2024 09:17
User group(s) Xylem:Algeria - EXT

**LOWARA**
a xylem brand

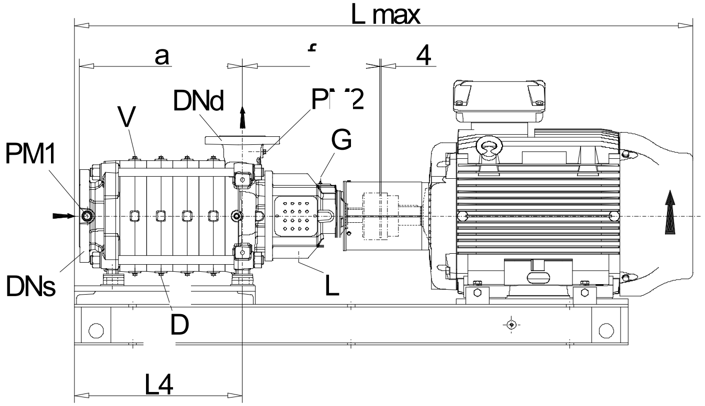
## MPA125B/02C/BD1600/L25VCCC4

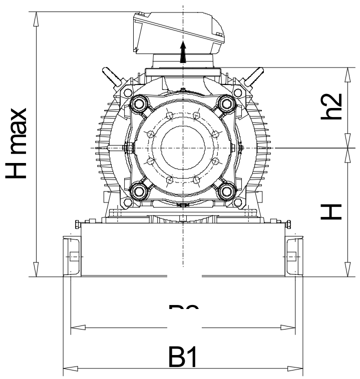
## Dimensions

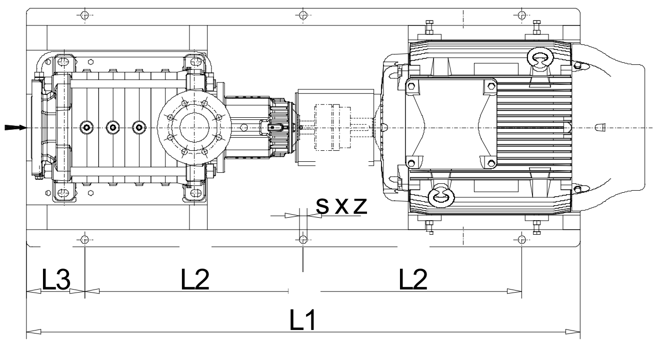
**Company name**
**Contact**
**Phone number**
**e-mail address**

Complete Unit with Baseplate
AO / DNs - axial, DNd - above
3MGS 315 M B3 160 kW E4

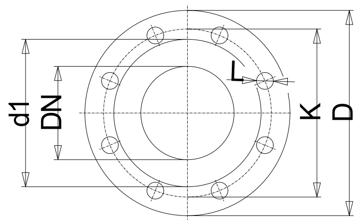
Electrical and dimensional data refer to IE4 motor




PM1...Pressure gauge connector
PM2...Pressure gauge connector
D...Drain
G...Grease nipple
L...Leakage
V...Venting




Note: Value D, C and d may vary from standard

| Dimensions | [ mm ] | | |
|---|---|---|---|
| a | 388 | L4 | 390 |
| B1 | 860 | Lmax | 2008 |
| B2 | 810 | PM1 | G1/4 |
| D | G1/4 | PM2 | G1/4 |
| DNd | 125 | s | 26 |
| DNs | 200 | V | G1/4 |
| f | 488 | Volumen | 1.7839 |
| G | M8 | z | 6 |
| Guard | 254 | | |
| H | 508 | | |
| h2 | 325 | | |
| Hmax | 1033 | | |
| L | G1/2 | | |
| L1 | 1950 | | |
| L2 | 775 | | |
| L3 | 200 | | |

| Weight | (+/- 5%) |
|---|---|
| **Pump** | **430** |
| **Coupling** | **7.8** |
| **Base plate** | **239** |
| **Motor** | **955** |
| **Total weight** | **1,635 kg** |

| Connections | | | |
|---|---|---|---|
| **Suction nozzle** | | **Discharge nozzle** | |
| **DNs 200** | | **DNd 125** | |
| **PN16** | | **PN25/40** | |
| **EN1092-2** | | **EN1092-2** | |
| C | 40 | C | 30 |
| D | 380 | D | 280 |
| d1 | 266 | d1 | 184 |
| K | 295 | K | 220 |
| L | 23 | L | 28 |
| z | 12 | z | 8 |

**Dimensions and weight without obligation**

| | | | | | |
|---|---|---|---|---|---|
| **Project** | Xylect-20156918 | **Created by** | roumaissa bouras | **Last update** | 6/11/2024 |
| **Block** | MPA125B/02C/BD1600/L25VCCC4 | **Created on** | 6/11/2024 | | |

GOULDS WATER TECHNOLOGY
a xylem brand

# PA 154/2-SA111-16004

## Technical data

Company name
Contact
Phone number
e-mail address

### Operating data

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Pumpe type | Single pumps as serial circuit | | Fluid | | Water, pure |
| 2 | No. of pumps | | 4 | Operating temperature t A | °C | 20 |
| 3 | Nominal flow | m³/h | 481.7 | pH-value at t A | | 7 |
| 4 | Nominal head | m | 225.4 | Density at t A | kg/m³ | 998 |
| 5 | Static head | m | 210 | Kin. viscosity at t A | mm²/s | 1 |
| 6 | Inlet pressure | kPa | 0 | Vapor pressure at t A | kPa | 100 |
| 7 | Environmental temperature | °C | 20 | Content of solid% / Solid size | mm | 0 / 0 |
| 8 | Available system NPSH | m | 0 | Altitude | m | 0 |

### Pump data

| | | | | | | |
|---|---|---|---|---|---|---|
| 9 | Pump designation | PA 154/2-SA111-16004 | Impeller Ø | Max. | mm | 370 |
| 10 | Design | Horizontal | | designed | mm | 366.6 |
| 11 | Execution | LO, DNs-left/ DNd-above aggregate (standard) | | Min. | mm | 300 |
| 12 | Operating speed | rpm 1490 | Flow | Nominal | m³/h | 495.3 ( 495.3 ) |
| 13 | Number of stages | 2 | | Max- | m³/h | 696.7 |
| 14 | Suction nozzle | DN 200/ PN10 / EN 1092 | | Min- | m³/h | 101 |
| 15 | Discharge nozzle | DN 150/ PN16 / EN 1092 | Head | Nominal | m | 226.3 |
| 16 | Max. casing pressure | kPa 3500 | | at Qmax | m | 34.3 |
| 17 | Max. working pressure | kPa 1089 | | at Qmin | m | 107.7 |
| 18 | Impeller type | Impeller design: Radial impeller, Closed | Shaft power | | kW | 386.4 ( 128.8 ) |
| 19 | Bearing bracket | | Max. shaft power | | kW | 431.5 |
| 20 | Lubrication | | Efficiency | | % | 79.01 |
| 21 | Constant level Oiler | | NPSH 3% | | m | 6.1 |
| 22 | Pump weight / Total weight | kg / 2103 | Head H(Q=0) | | m | 110 |

### Materials

| | | | | |
|---|---|---|---|---|
| 23 | Pump | | Shaft Seal | |
| 24 | Impeller | Cast iron, 0.6025 | mechanical seal | |
| 25 | suc.-, disch.-, stage casing | Cast iron, 0.6025 | SA = unbalanced, at both sides | BQ1EGG/BQ1EGG |
| 26 | Diffusor | Cast iron, 0.6025 | Suction side | . |
| 27 | lantern | Cast iron, 0.6025 | 1.1 Rotating ring | Carbon, resinimpregnated |
| 28 | Bearing frame | Cast iron, 0.6025 | 1.2 Stationary ring | Silicon carbide pressureless sintered |
| 29 | shaft, shaft sleeve | alloysteel, 1.4021 | 1.3 Secondary seal | EPDM |
| 30 | Wear ring | without | 1.4 Springs | CrNiMo - steel (1.4571) |
| 31 | Elastics | EPDM | 1.5 Others | CrNiMo - steel (1.4571) |
| 32 | | | Discharge side | . |
| 33 | | | 2.1 Rotating ring | Carbon, resinimpregnated |
| 34 | | | 2.2 Stationary ring | Silicon carbide pressureless sintered |
| 35 | | | 2.3 Secondary seal | EPDM |
| 36 | | | 2.4 Springs | CrNiMo - steel (1.4571) |
| 37 | | | 2.5 Others | CrNiMo - steel (1.4571) |

### Motor data / Coupling

| | | | | | | |
|---|---|---|---|---|---|---|
| 38 | Manufacturer | Lowara by Omega | Electric voltage | 400 V | Manufacturer | Flender |
| 39 | Specific design | IE4 3ph Surface Motor - Super Premium Efficiency | | | Series | Standard Coupling - N-EUPEX - Type B |
| 40 | Type | 3MGS 315 M B3 160 kW E4 | | | Type | B 200/4-65/80 |
| 41 | Rated power | 160 kW | Electric current | 280 A | Frame size | 200 |
| 42 | Nominal speed | 1490 rpm | Degree of protection | IP55 | Spacer length mm | 4 |
| 43 | Frame size | 315 M | Explosion protection -- | -- IEC | Weight kg | 16 |
| 44 | Weight | 1068 kg | Shaft diameter | 80 mm | Coupling protection | yes Werkstoff : |

### Base plate / Accessories

| | | | | |
|---|---|---|---|---|
| 45 | Name | DFF | Piping | |
| 46 | Weight kg | 270 | Heizmantel Gehaeuse | ☐ yes / no |

### Remarks

| | | | |
|---|---|---|---|
| | | Heizmantel Gehaeusedeckel | ☐ yes / no |
| 47 | | Constant level Oiler | ☐ yes / no |
| 48 | | Anchorbolts | ☐ yes / no |
| 49 | | | ☐ yes / no |
| 50 | | | ☐ yes / no |

| | | | | | |
|---|---|---|---|---|---|
| Project | Xylect-20156947 | Created by | roumaissa bouras | Last update | 6/11/2024 |
| Block | PA 154/2-SA111-16004 | Created on | 6/11/2024 | | |

GOULDS WATER TECHNOLOGY a xylem brand

# PA 154/2-SA111-16004

## Performance curve

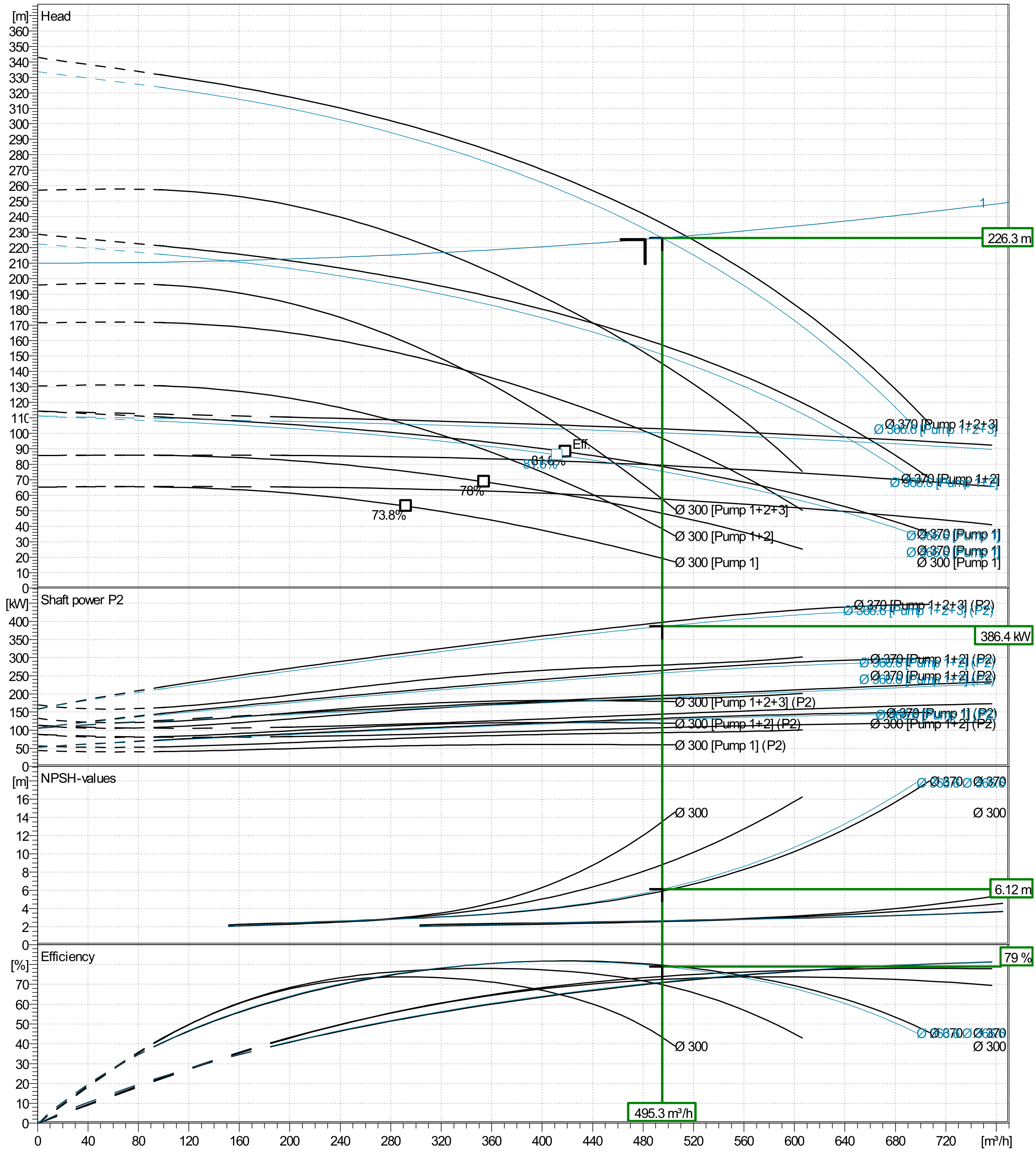
Company name
Contact
Phone number
e-mail address

| Impeller | Ø | Pump capacity Operating range Min. | Max. | η Max. | Pump head H(Q=0) | η Max. | Shaft power P2 P2(Q=0) | Max. | η Max. |
|---|---|---|---|---|---|---|---|---|---|
| | mm | m³/h | m³/h | m³/h | m | m | kW | kW | kW |
| actual | 367 | 101 | 697 | 412 | 111 | 86 | | 431 | 118 |
| Min. | 300 | / | / | 292 | 65.3 | 52.9 | | / | 57 |
| Max. | 370 | / | / | 419 | 114 | 88.1 | | / | 122 |

| | |
|---|---|
| Impeller type | Radial impeller |
| Impeller design | Closed |
| Sense of rotation | Clockwise from the drive end |
| Discharge width mm | 35.0 |
| Free passage mm | |
| Frequency Hz | 50 |
| Duty chart 1450/2 — Operating speed rpm | 1490 |

**Power datas refered to:** **hydr. Leistungspruefung nach EN ISO 9906 Klasse**

Water, pure [100%] ; 20°C; 998kg/m³; 1mm²/s Grade 2B



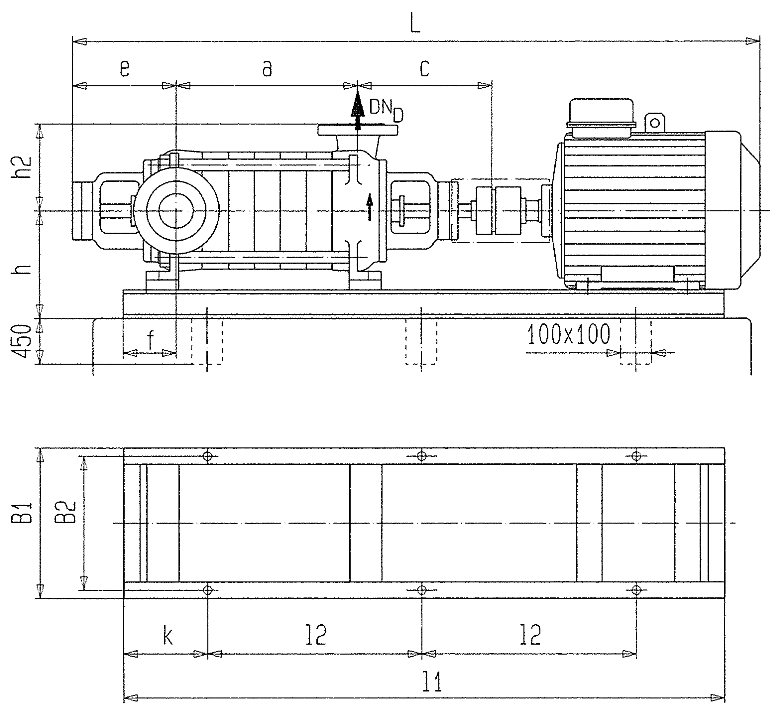

| | | | | | |
|---|---|---|---|---|---|
| Project | Xylect-20156947 | Created by | roumaissa bouras | Last update | 6/11/2024 |
| Block | PA 154/2-SA111-16004 | Created on | 6/11/2024 | | |

## PA 154/2-SA111-16004

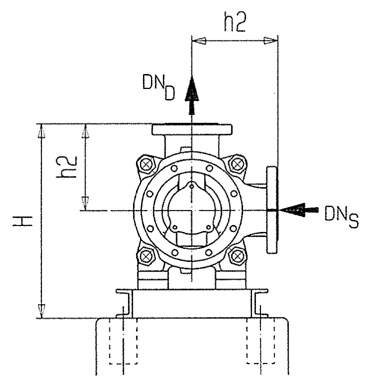
# Dimensions

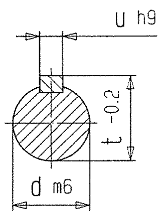

Company name
Contact
Phone number
e-mail address


**Unit with standard motor brand and accessories**




**LO, DNs-left/ DNd-above aggregate (standard)**



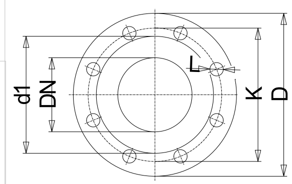

Dimensions and weight without obligation

| Dimensions | [ mm ] |
|---|---|
| a | 425 |
| B1 | 900 |
| B2 | 850 |
| c | 565 |
| d | 65 |
| e | 440 |
| f | 300 |
| h | 518 |
| H | 918 |
| h2 | 400 |
| k | 200 |
| L | 2586 |
| l1 | 2400 |
| l2 | 1000 |
| t | 69 |
| u | 18 |
| Volumen | 2.1366 |

| Weight | | [ kg ] |
|---|---|---|
| Pump | | |
| Coupling | | 16 |
| Base plate | | 270 |
| Motor | | 1068 |
| Total weight | ~ | 2103 |

**Connections** [ mm ]

| Suction nozzle | | Discharge nozzle | |
|---|---|---|---|
| DN 200 | | DN 150 | |
| PN10 | | PN16 | |
| EN 1092 | | EN 1092 | |
| C | 20 | C | 24 |
| d | 268 | d | 212 |
| D | 340 | D | 285 |
| K | 295 | K | 240 |
| L | 23 | L | 22 |
| n | 8 | n | 8 |




| | | | |
|---|---|---|---|
| Project | Xylect-20156947 | Created by | roumaissa bouras |
| Block | PA 154/2-SA111-16004 | Created on | 6/11/2024 |
| | | Last update | 6/11/2024 |

GOULDS WATER TECHNOLOGY
a xylem brand

# MPA65B/04A/BD750/L25VCCC4

## Technical data

Company name
Contact
Phone number
e-mail address

## Operating data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Pumpe type | | Single pumps as parallel circuit | Fluid | Water, pure | | |
| 2 | No. of pumps | | 5 | Operating temperature t A | | °C | 20 |
| 3 | Nominal flow | m³/h | 434.5 | Max / Min Operating Temperature | | °C | 140 / -25 |
| 4 | Nominal head | m | 189.93 | Max / Min Operating Temperature mech. Seal | | °C | 120 / -10 |
| 5 | Static head | m | 175 | pH-value at t A | | | 7 |
| 6 | Inlet pressure / Vapor pressure at t A | kPa | 0 / 100 | Density at t A | | kg/m³ | 998 |
| 7 | Environmental temperature | °C | 20 | Kin. viscosity at t A | | mm²/s | 1 |
| 8 | Available system NPSH | m | 0 | Altitude | | | 0 |

## Pump data

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | Design | Horizontal Multistage pump, axial DNs, radial DNd, 1 Slide bearing DNs, 1 Roller bearings DNd | | | | | |
| 10 | Execution | AO / DNs - axial, DNd - above | | Impeller Ø | Max. | mm | 214 |
| 11 | Lubrication | Grease Lubrication | | | designed | mm | 4x 214 mm |
| 12 | Operating speed | rpm 2985 | Stages 4 | | Min. | mm | 170 |
| 13 | Flange connections | | | Flow | Nominal | m³/h | 431 |
| 14 | EN1092-2 / DNs125, PN10/16 - DNd65, PN25/40 | | | | Max- | m³/h | 151.8 |
| 15 | Max. casing pressure | kPa | 4000 | | Min- | m³/h | 34.4 |
| 16 | Max. working pressure | kPa | 2476.2 | Head | Nominal | m | 189.7 |
| 17 | Impeller type | | Radial impeller | | at Qmax | m | 113.6 |
| 18 | Head H(Q=0) | m | 250 | | at Qmin | m | 252.7 |
| 19 | Max. shaft power | kW | 288.5 | Shaft power | | kW | 279.5 |
| 20 | Pump weight | kg | 189 | Efficiency | | % | 79.4 |
| 21 | Total weight | kg | 970.4 | NPSH 3% | | m | 4.1 |

## Materials

| | | | | |
|---|---|---|---|---|
| 22 | Pump | | Shaft Seal | |
| 23 | Suction Impeller | Cast Iron, EN-GJL-200, ASTM Class 30 | Single mechanical seal, with shaft sleeve (unbalanced) | |
| 24 | Impeller | Cast Iron, EN-GJL-200, ASTM Class 30 | eMG12 - Ø43mm | BQ7EGG-WA |
| 25 | Diffuser | Cast Iron, EN-GJL-150, ASTM Class 25 | Mechanical seal diameter | 43 mm |
| 26 | Stage Casing | Ductile Iron, EN-GJS-400-15, ASTM 65-45-12 | 1. Rotating ring | Carbon graphite resin impregnated |
| 27 | Suction Casing | Cast Iron, EN-GJL-250, ASTM Class 35 | 2. Stationary ring | SiC, silicon carbide, sintered press.less |
| 28 | Discharge Casing | Cast Iron, EN-GJL-250, ASTM Class 35 | 3. Secondary seal | Ethylene propylene rubber (EPDM) |
| 29 | Seal Cover | Cast Iron, EN-GJL-250, ASTM Class 35 | 4. Springs | CrNiMo - Steel |
| 30 | Bearing Bracket / Motor Adapter | Cast Iron, EN-GJL-250, ASTM Class 35 | 5. Others | EPDM - WRAS |
| 31 | Pump Foot | Cast Iron, EN-GJL-250, ASTM Class 35 | Gaskets of the pump | Ethylene propylene rubber (EPDM) |
| 32 | Wear ring | Duplex Stainless Steel, 1.4462, ASTM F51 | | |
| 33 | Drum | Stainless Steel, 1.4057, ASTM 431 | | |
| 34 | Drum Bush | Cast Iron, EN-GJL-250, ASTM Class 35 | | |
| 35 | Shaft | Stainless Steel, 1.4057, ASTM 431 | | |
| 36 | Shaft Sleeve | Stainless Steel, 1.4057, ASTM 431 | | |
| 37 | Spacer Sleeve | Stainless Steel, 1.4057, ASTM 431 | | |
| 38 | Shaft Nut | Stainless Steel, 1.4057, ASTM 431 | | |
| 39 | Impeller Nut | A4 | | |
| 40 | | | | |
| 41 | | | | |
| 42 | | | | |
| 43 | | | | |

## Motor data

Electrical and dimensional data refer to IE4 motor

| | | | | | |
|---|---|---|---|---|---|
| 44 | Manufacturer | Omega | | | |
| 45 | Specific design | IE4 3ph Surface Motor - Super Premium Efficiency | | | |
| 46 | Type | 3MGS 280 S B3 75 kW E4 | | | |
| 47 | Rated power | 75 kW | Item no. | | |
| 48 | Nominal speed | 2985 rpm | Service factor | 1 | |
| 49 | Frame size | 280 S | Electric data | 400 V | 129 A |
| 50 | Weight kg | 596.0 | Shaft diameter | 65.0 | mm |

## Coupling

| | | | |
|---|---|---|---|
| Manufacturer | | | FLENDER |
| Series | | | Standard Coupling - N-EUPEX - Type B |
| Shaft diameter | Pump / Motor | mm | 35.0 / 65.0 |
| Frame size | | | 160 |
| Spacer length | | mm | 4 |
| Weight | | kg | 7.8 |
| Coupling protection | e-MP_GR.COUPLGUARD ES32-190-23 A4 | | 2.4 kg |

## Base plate

| | | | |
|---|---|---|---|
| 51 | Name | | FRAME EMP65-DE-280 |
| 52 | Weight | kg | 175.2 |

## Remarks

| | | | | | |
|---|---|---|---|---|---|
| Project | Xylect-20156968 | Created by | roumaissa bouras | Last update | 6/11/2024 |
| Block | MPA65B/04A/BD750/L25VCCC4 | Created on | 6/11/2024 | | |

# MPA65B/04A/BD750/L25VCCC4

## Performance curve

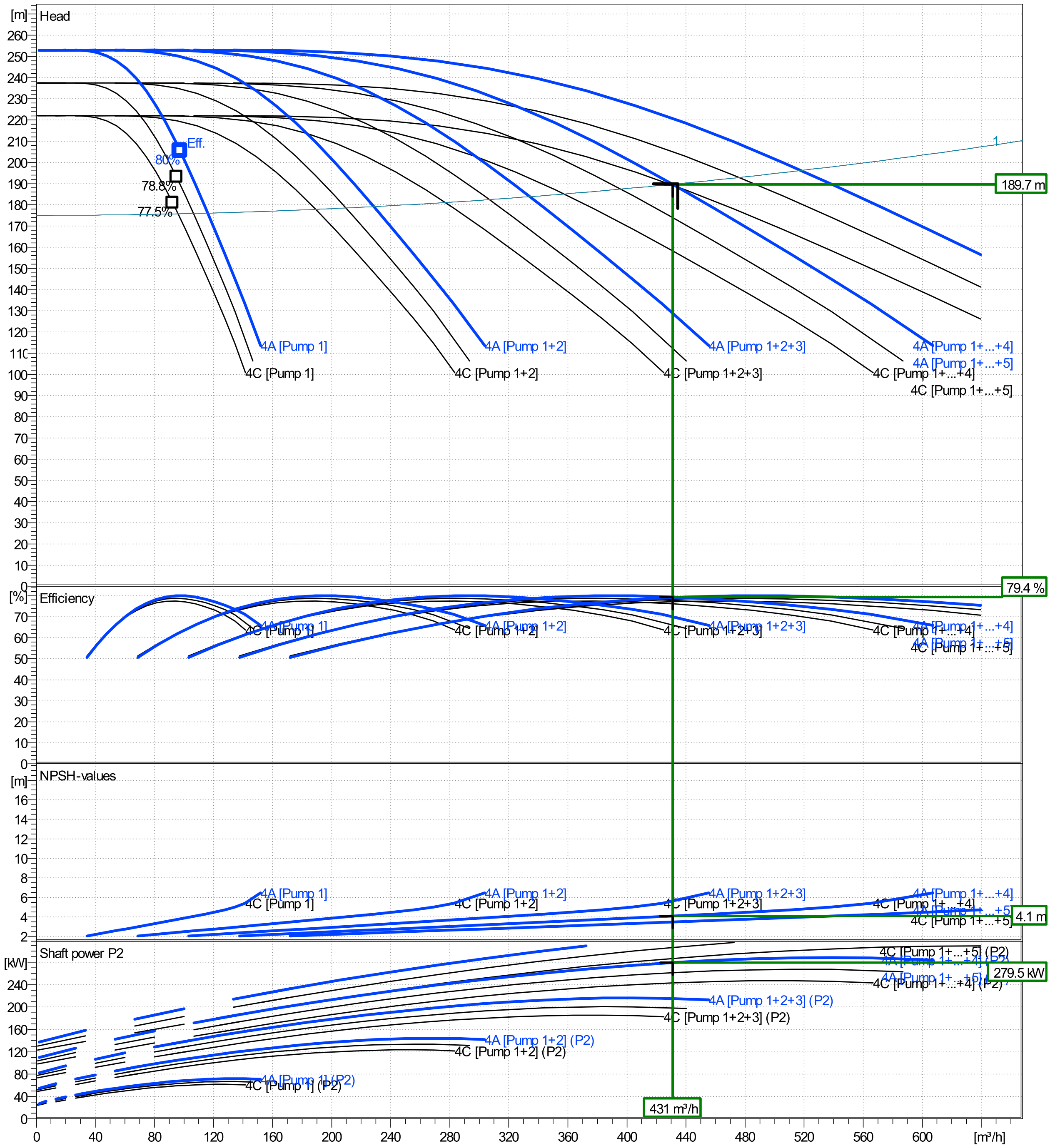
Company name
Contact
Phone number
e-mail address

| | Ø | Pump capacity | | | Pump head | | Shaft power P2 | | | Frequency | Hz | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Operating range Min. | Max. | η Max. | H(Q=0) | η Max. | P2(Q=0) | Max. | η Max. | Operating speed | rpm | 2985 |
| | mm | m³/h | m³/h | m³/h | m | m | kW | kW | kW | Nominal flow | m³/h | 434.5 |
| actual | 214 | 48.1 | 115 | 97.4 | 253 | 206 | | 289 | 67.9 | Nominal head | m | 189.9 |
| Min. | 170 | / | / | 92.4 | 222 | 181 | | / | 58.6 | Inlet pressure | kPa | 0 |
| Max. | 214 | / | / | 97.4 | 253 | 206 | | / | 67.9 | Static head | m | 175 |

**Power datas refered to:** **hydr. Performance acceptance acc. To EN ISO 9906 Class** **Grade 2B**

Water, pure [100%] ; 20°C; 998kg/m³; 1mm²/s

**MEI: N.A - according to Ecodesign Directive 2009/125/EC and Regulation (EU) No.547/2012**




| | | | | | |
|---|---|---|---|---|---|
| **Project** | Xylect-20156968 | **Created by** | roumaissa bouras | **Last update** | 6/11/2024 |
| **Block** | MPA65B/04A/BD750/L25VCCC4 | **Created on** | 6/11/2024 | | |

**GOULDS WATER TECHNOLOGY** a xylem brand

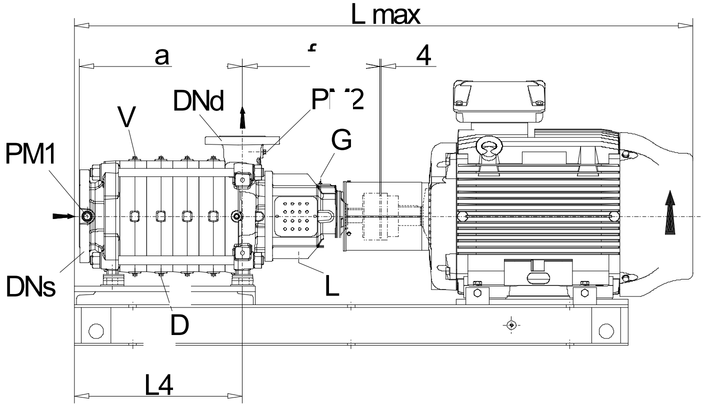
## MPA65B/04A/BD750/L25VCCC4

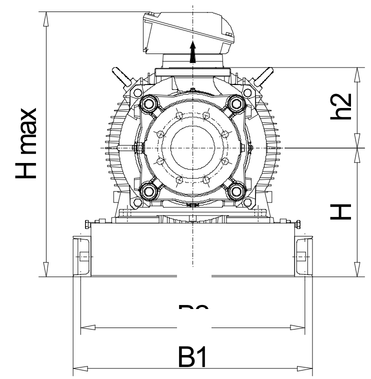
## Dimensions

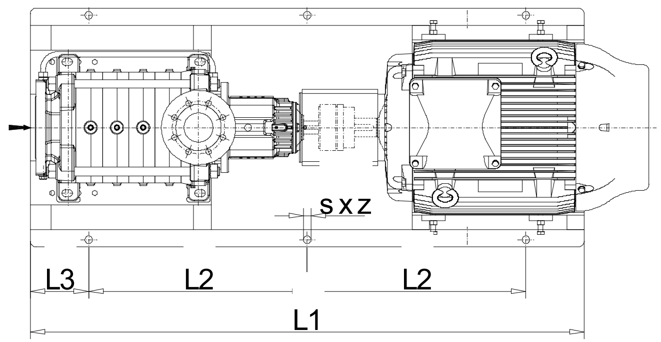
**Company name**
**Contact**
**Phone number**
**e-mail address**

Complete Unit with Baseplate
AO / DNs - axial, DNd - above
3MGS 280 S B3 75 kW E4

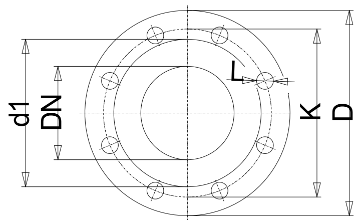
Electrical and dimensional data refer to IE4 motor




PM1...Pressure gauge connector
PM2...Pressure gauge connector
D...Drain
G...Grease nipple
L...Leakage
V...Venting




Note: Value D, C and d may vary from standard

| Dimensions | [ mm ] | | |
|---|---|---|---|
| a | 404 | L4 | 487 |
| B1 | 820 | Lmax | 1840.5 |
| B2 | 770 | PM1 | G1/4 |
| D | G1/4 | PM2 | G1/4 |
| DNd | 65 | s | 26 |
| DNs | 125 | V | G1/4 |
| f | 393 | Volumen | 1.2919 |
| G | M8 | z | 6 |
| Guard | 224 | | |
| H | 443 | | |
| h2 | 225 | | |
| Hmax | 856 | | |
| L | G1/2 | | |
| L1 | 1700 | | |
| L2 | 650 | | |
| L3 | 200 | | |

| Weight | (+/- 5%) |
|---|---|
| **Pump** | **189** |
| **Coupling** | **7.8** |
| **Base plate** | **175** |
| **Motor** | **596** |
| **Total weight** | **970 kg** |

**Connections**

| Suction nozzle | | Discharge nozzle | |
|---|---|---|---|
| **DNs 125** | | **DNd 65** | |
| **PN10/16** | | **PN25/40** | |
| **EN1092-2** | | **EN1092-2** | |
| C | 30 | C | 24 |
| D | 270 | D | 190 |
| d1 | 184 | d1 | 118 |
| K | 210 | K | 145 |
| L | 19 | L | 19 |
| z | 8 | z | 8 |

**Dimensions and weight without obligation**

| | | | | | |
|---|---|---|---|---|---|
| **Project** | Xylect-20156968 | **Created by** | roumaissa bouras | **Last update** | 6/11/2024 |
| **Block** | MPA65B/04A/BD750/L25VCCC4 | **Created on** | 6/11/2024 | | |