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MINISTERE DE L'EAU
ET DE L'HYDRAULIQUE VILLAGEOISE (MEHV)

Société de Patrimoine Eau et Assainissement
en milieu Urbain et semi-Urbain
(SP-EAU)

STUDY OF THE MASTER PLAN FOR DRINKING WATER SUPPLY IN GREATER LOME (PDAEPGL)

Solutions Design
Volume 1 - Infrastructures

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ABSTRACT - SYNTHESIS

The scale of the very short-term investments reflects the delay in the development of Lomé's infrastructure in relation to the strategy for access to drinking water in Togo, which aims to achieve 100% coverage by 2030 for its capital.

The program of mobilization of new resources, as decided in the previous missions, will make it possible to achieve a balanced needs/resources balance at the level of Greater Lomé, taking into account the evolution of the demand retained.

The purpose of this phase of the Study is to develop an investment program to prepare the necessary evolution of the structuring and service infrastructures for the new quantities of water to be distributed.

The proposed program up to 2050 consists of:

- drinking water production units from fresh surface water, from sea water desalination and from groundwater;
- water mains (354 km) and distribution mains (460 km) with diameters ranging from 300 mm to 1400 mm ;
- storage volume on the ground and on a tower, for a cumulative volume of approximately 250,000 m3 ;
- pumping stations essentially linked to the transfer of water resources and provided to Lomé ;
- distribution pipes with diameters of less than 300 mm (~2000 km) and new connections.

The total of the corresponding detailed investments amounts to approximately 1433 billion CFA Francs (excluding taxes) by 2050, they are allocated by year according to their priority and their nature.

TABLE OF CONTENTS

LISTE OF FIGURES

LISTE OF TABLES

LISTE OF RELATED PLANS

1

General context

The Togolese government, following the adoption in September 2015 of the Vision 2030 Program and the National Development Program (PND-2018-2022) integrating the Sustainable Development Goals (SDGs), has prioritized the drinking water sub-sector with the ambition to increase the national drinking water service rate from 53.9% in 2016 to 66% in 2022. The implementation of the Strategy for Accelerated Growth and Employment Promotion (SCAPE) over the period 2013-2017 has made it possible to increase the national coverage rate (42% in 2013 to 53.92% in 2016). From 2013 to 2016, the service rate evolved from 47.31% to 64.36% in rural areas, 42% to 46.4% in semi-urban areas and 40% to 51% in urban areas. In semi-urban and rural areas, more than half of households still do not have access to drinking water.

The government, in response to popular demand, has placed the water sector among the first sectors to be developed. Thus, this PND-Water project initiated by the Togolese government through the ministry in charge of water fits perfectly with the new development reference framework that is the government's roadmap Togo 2025 in its axis 1: "Strengthen social inclusion and harmony and ensure peace" more precisely the priority project P6: "Increase access to drinking water and sanitation". Thus, this roadmap sets as a goal an access rate of 95% in rural areas, 85% in semi-urban areas, 75% in urban areas outside Lomé and 80% for Greater Lomé by 2025.

To achieve this objective, SP-EAU, the state-owned company in charge of managing the drinking water and wastewater assets, has established an Urban and Semi-urban Water Supply Investment Plan for the period 2016-2030. In this framework, the development of a Master Plan for Drinking Water Supply has been included, with the aim of prioritizing investment in a major Drinking Water Supply Program for Greater Lomé. The project is one of the strategic studies (component 4 of the PND-EAU-AFD) financed by a sovereign loan (CTG 1236).

The main objective is to provide the Société Patrimoine (SP-EAU) and the TdE, a tenant company, with a management and planning tool for short, medium and long term investments in order to satisfy the water demand of the population of Grand-Lomé, by steps, until 2050.

In accordance with the Terms of Reference, the purpose of the "design of solutions" is to develop the infrastructure related to the production, transport and supply of drinking water in Greater Lomé, considering the selected objectives.

The report is presented in three volumes:

- Volume 1 presents the infrastructures related to the production, transport and supply of drinking water, excluding the "energy needs" aspect;
- Volume 2 presents the energy requirements associated with the projected infrastructures;
- Volume 3 presents the assessment of the corresponding environmental and social impacts.

This document focuses on water infrastructure as Volume 1 of the "Solution Design".

The development of the Master Plan in its entirety, of which the "solution design" forms one of the volumes of Deliverable No.7 in the terms of the inception report, will be completed by a donors' round table.

1.1 Elaboration of the Master Plan for Drinking Water Supply of the Greater Lomé

The objective of the development of the Greater Lomé drinking water master plan is to match needs with resources, by defining the necessary investments for the period 2025-2050. It includes the following steps :

- Preliminary studies: data collection, perimeter to be served, study horizon, water needs;
- Analysis of resources: current, new to be mobilized or identified and their exposure to climate change and environmental and social constraints;

- Definition of the installations: catchment, treatment, supply, storage, distribution (primary, secondary, tertiary canalisations, connections);

- - Organization of investments: phasing of investments, financing needs, impact on operating costs and tariffs, investment plan, timeline of studies and investments.

1.2 Organization of the Donors' Roundtables

A round table will be organized under the responsibility of the MEHV, by the SP-EAU, with the participation of the Ministry of Finance and the Ministry of Planning, Development and Cooperation.

In support of the SP-EAU, the following tasks will be expected :

- Draft the advocacy documents of the round table, in particular the declination of the priority investment program of the Greater Lomé Drinking Water Supply Master Plan;

- Moderating the round table, in particular with the various Technical and Financial Partners;

- Write the final report of the round table;
- Propose a roadmap for the implementation of the roundtable's conclusions.

2

Introduction

2.1 General context of the study

The previous assignments:

- Preliminary studies;
- Study of the demand;
- Study of the Resource;

have notably made it possible to estimate the evolution of future water needs in Greater Lomé, taking into account the current resource deficit, the projected demographic increase and the necessary increase in the service rate. A scenario staggered over time, of mobilization of new resources is retained.

A detailed analysis of the existing service network was also carried out with the development of a hydraulic model.

2.2 Network modeling and observations

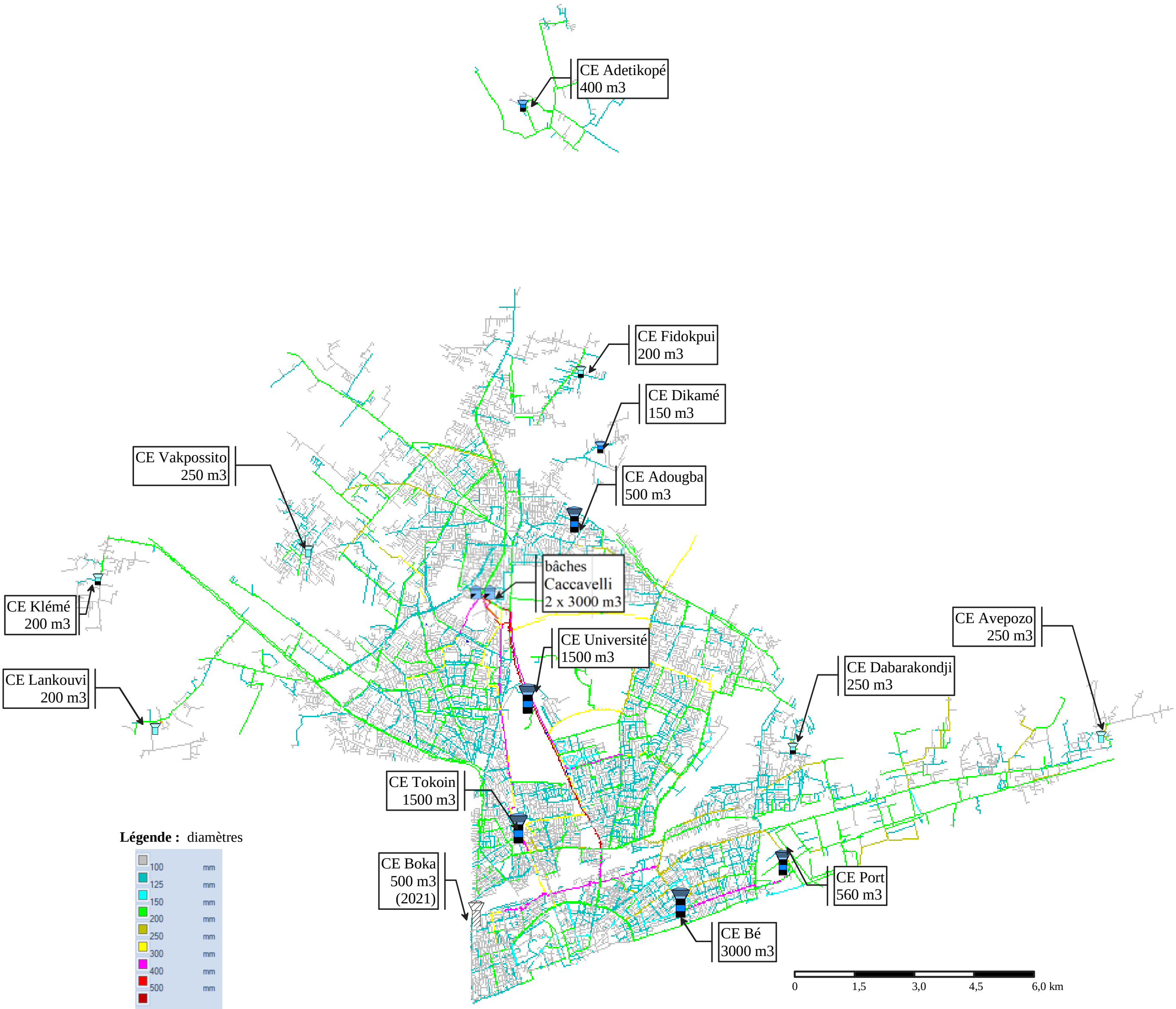
The basic tool is the current modelled network, representing approximately 1900 km of pipes and reproducing the situation observed in terms of service quality.

The hydraulic model is intended to be used as a tool to suggest optimized reinforcement and extension programs according to the constraints and limits that may be set for it :

- **The needs:** the evolution of the consumption variables at the nodes will be a function of the assumptions of improvement in the rate of service and unit consumption allocation per period until 2050.

- **The resources:** the resources injected at the limit of the model will be related to the production capacities and their evolution by 2050.

Figure 1 : Detailed hydraulic model by distribution sector



2.3 Mission objective and content

The purpose of this Mission is to propose solutions for establishing a phased Investment Plan in terms of :

- mobilization and treatment of resources;
- sizing of water supply systems by phase;
- sizing by phase of storage and distribution.

This plan should allow :

- to optimize the quality of the service in terms of pressure and flow, for the population currently served, taking into account the new volumes that could be put into distribution in the very short term (by 2025) ;
- to develop a program to extend and strengthen the backbone network in order to achieve and maintain good service conditions, taking into account the new volumes gradually being produced and the objective of improving the rapid coverage;
- to establish a management and planning tool in the short, medium and long term for investments in order to satisfy the water demand of the population of Greater Lomé.

3

Reminder of the needs/resources balance and their evolution

Water forecasting is strategic both for planning the mobilization of new resources and for planning the investments needed to strengthen and extend the distribution network.

Poor anticipation of the evolution of needs, which must be neither overestimated at the risk of programming premature or inappropriate investments, nor underestimated at the risk of continuing to be affected by chronic deficits in drinking water, which could have significant consequences on public health and economic development.

3.1 Evolution of the retained demand

3.1.1 Demographic trends

Overall, the population would reach 3,300,000 in 2030 and nearly 6,500,000 in 2050, from a current population of about 2,500,000. Population estimates by planning area are necessary because of the importance of the distribution of needs in water supply and distribution projects.

3.1.2 Evolution of the coverage rate and the demand for drinking water

An estimation of the current coverage rate of individuals based on house connections has been made. Its evolution towards a global objective in the long term will participate in the definition of the volume of water resources to be mobilized at intermediate horizons and on the study horizon (2050).

The hypothesis adopted is to achieve an average domestic coverage of 80% in 2025 and universal access to drinking water in 2030 with an average supply of 60 l/capita/d - this supply gradually evolving towards a target of 80 l/capita/d in 2050.

The coverage parameters and their evolution (individualized yield per zone, peak coefficient) are presented in the Demand Study (Deliverable 5) and allow to present the evolution hypotheses of the production needs summarized in the following table and the diagrams per planning zone and per horizon.

Figure 2 : Location of planning areas

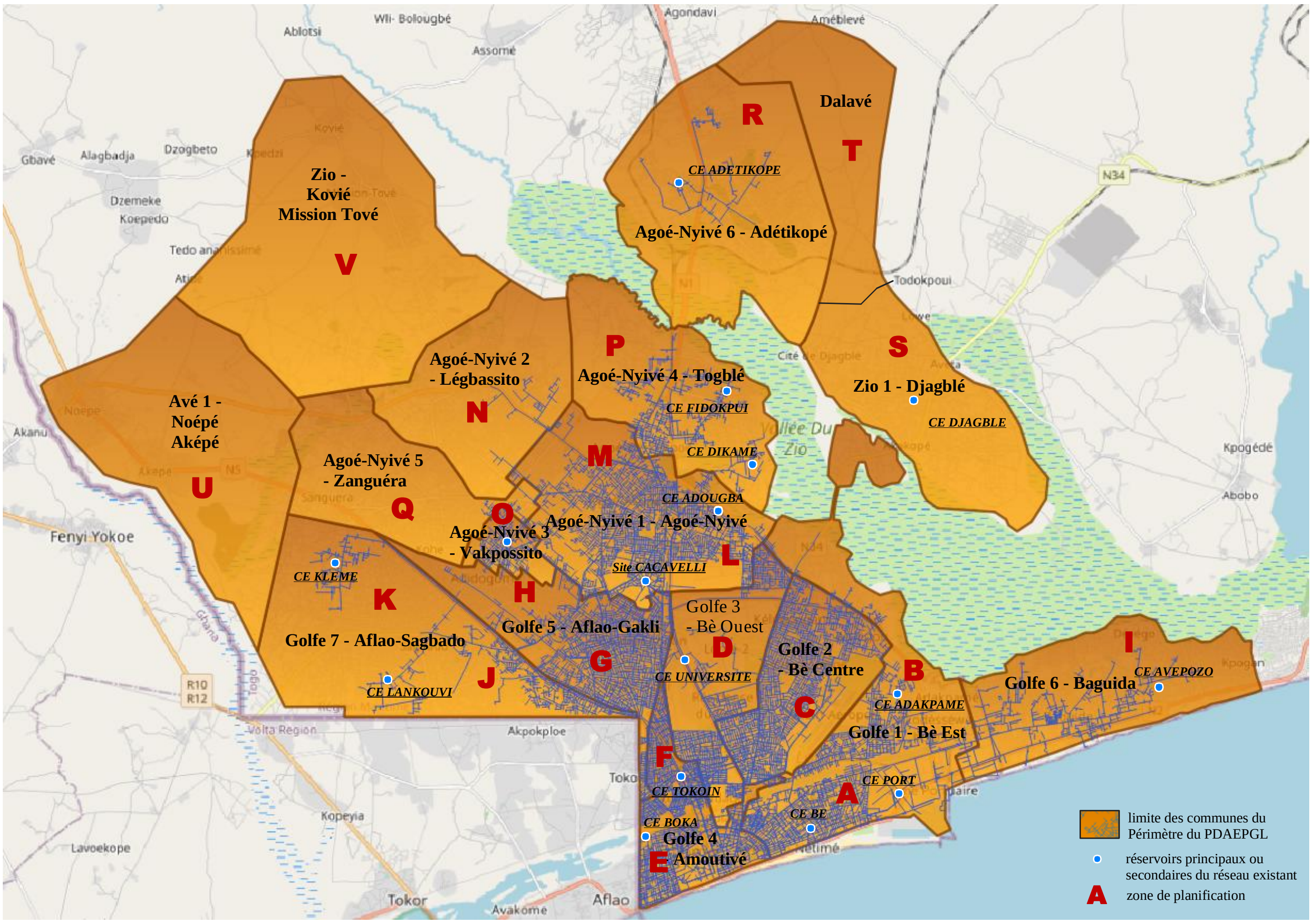


Table 1 : Evolution of needs by planning area

		m3/j	2020	2025	2030	2035	2040	2045	2050
Zone A - Hypothèse MEDIANE	Bè Est - Sud	besoin de consommation	4 292	14 650	21 966	25 916	30 289	35 097	40 347
		rendement technique	74,6 %	75,0 %	77,0 %	78,0 %	79,0 %	80,0 %	80,0 %
		besoin de production	**5 754**	**19 533**	**28 527**	**33 226**	**38 340**	**43 871**	**50 434**
Zone B - Hypothèse MEDIANE	Bè Est - Nord	besoin de consommation	840	9 975	25 275	31 356	38 398	46 405	55 382
		rendement technique	67,7 %	70,0 %	75,0 %	77,0 %	78,0 %	79,0 %	80,0 %
		besoin de production	**1 241**	**14 250**	**33 700**	**40 722**	**49 228**	**58 741**	**69 227**
Zone C - Hypothèse MEDIANE	Bè Centre	besoin de consommation	7 031	13 254	17 524	21 281	25 484	30 116	35 145
		rendement technique	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %
		besoin de production	**8 788**	**16 567**	**21 905**	**26 601**	**31 855**	**37 645**	**43 931**
Zone D - Hypothèse MEDIANE	Bè Ouest	besoin de consommation	2 611	5 213	7 565	9 796	12 547	15 899	19 945
		rendement technique	63,0 %	65,0 %	70,0 %	72,0 %	74,0 %	77,0 %	80,0 %
		besoin de production	**4 145**	**8 019**	**10 807**	**13 606**	**16 955**	**20 648**	**24 931**
Zone E - Hypothèse MEDIANE	Amoutivé - Sud	besoin de consommation	2 792	11 965	19 657	22 919	26 477	30 334	34 488
		rendement technique	59,5 %	65,0 %	70,0 %	72,0 %	74,0 %	77,0 %	80,0 %
		besoin de production	**4 693**	**18 407**	**28 081**	**31 831**	**35 779**	**39 395**	**43 110**
Zone F - Hypothèse MEDIANE	Amoutivé - Nord	besoin de consommation	2 577	6 491	9 755	12 098	14 813	17 898	21 356
		rendement technique	63,0 %	65,0 %	70,0 %	72,0 %	74,0 %	77,0 %	80,0 %
		besoin de production	**4 091**	**9 986**	**13 935**	**16 803**	**20 017**	**23 244**	**26 695**
Zone G - Hypothèse MEDIANE	Aflao-Gakli - Est	besoin de consommation	3 799	7 782	12 691	16 396	20 949	26 480	33 137
		rendement technique	74,9 %	75,0 %	77,0 %	78,0 %	79,0 %	80,0 %	80,0 %
		besoin de production	**5 072**	**10 376**	**16 481**	**21 020**	**26 517**	**33 100**	**41 421**
Zone H - Hypothèse MEDIANE	Aflao-Gakli - Ouest	besoin de consommation	914	4 432	10 953	14 175	18 142	22 971	28 793
		rendement technique	74,9 %	75,0 %	77,0 %	78,0 %	79,0 %	80,0 %	80,0 %
		besoin de production	**1 220**	**5 910**	**14 225**	**18 173**	**22 965**	**28 714**	**35 991**
Zone I - Hypothèse MEDIANE	Baguida	besoin de consommation	71	5 487	20 617	28 398	38 642	51 984	69 183
		rendement technique	76,2 %	77,0 %	78,0 %	78,0 %	79,0 %	79,0 %	80,0 %
		besoin de production	**93**	**7 126**	**26 432**	**36 408**	**48 914**	**65 802**	**86 479**
Zone J - Hypothèse MEDIANE	Aflao-Sagbado - Est	besoin de consommation	2 137	7 452	13 720	17 769	22 762	28 847	36 192
		rendement technique	74,9 %	75,0 %	77,0 %	78,0 %	79,0 %	80,0 %	80,0 %
		besoin de production	**2 853**	**9 935**	**17 818**	**22 781**	**28 812**	**36 058**	**45 241**
Zone K - Hypothèse MEDIANE	Aflao-Sagbado - Ouest	besoin de consommation	478	2 321	4 650	6 669	9 426	13 152	18 126
		rendement technique	79,3 %	79,3 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %
		besoin de production	**602**	**2 927**	**5 812**	**8 336**	**11 783**	**16 440**	**22 658**
Zone L - Hypothèse MEDIANE	Agoé-Nyivé - Est	besoin de consommation	2 315	5 654	9 425	12 261	15 774	20 076	25 294
		rendement technique	81,2 %	81,0 %	80,5 %	80,5 %	80,0 %	80,0 %	80,0 %
		besoin de production	**2 850**	**6 980**	**11 708**	**15 231**	**19 718**	**25 095**	**31 617**
Zone M - Hypothèse MEDIANE	Agoé-Nyivé - Ouest	besoin de consommation	5 618	18 801	35 804	45 623	57 524	71 801	88 779
		rendement technique	81,2 %	81,0 %	80,5 %	80,5 %	80,0 %	80,0 %	80,0 %
		besoin de production	**6 919**	**23 211**	**44 477**	**56 675**	**71 905**	**89 752**	**110 974**
Zone N - Hypothèse MEDIANE	Legbassito	besoin de consommation	103	1 486	5 171	7 119	9 679	13 011	17 302
		rendement technique	85,2 %	85,0 %	84,0 %	83,0 %	82,0 %	81,0 %	80,0 %
		besoin de production	**121**	**1 748**	**6 156**	**8 577**	**11 804**	**16 064**	**21 627**
Zone O - Hypothèse MEDIANE	Vakpossito	besoin de consommation	289	1 458	3 300	4 173	5 222	6 470	7 941
		rendement technique	85,2 %	85,0 %	84,0 %	83,0 %	82,0 %	81,0 %	80,0 %
		besoin de production	**339**	**1 716**	**3 929**	**5 028**	**6 368**	**7 987**	**9 927**
Zone P - Hypothèse MEDIANE	Togblé	besoin de consommation	563	3 100	8 107	11 176	15 220	20 494	27 302
		rendement technique	80,4 %	81,0 %	80,5 %	80,5 %	80,0 %	80,0 %	80,0 %
		besoin de production	**700**	**3 827**	**10 071**	**13 883**	**19 025**	**25 617**	**34 127**
Zone Q - Hypothèse MEDIANE	Zanguéra	besoin de consommation	21	1 829	6 761	9 306	12 652	17 005	22 608
		rendement technique	79,3 %	79,3 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %
		besoin de production	**26**	**2 306**	**8 451**	**11 633**	**15 815**	**21 256**	**28 260**
Zone R - Hypothèse MEDIANE	Adétikopé	besoin de consommation	92	5 955	14 065	19 253	25 350	32 597	41 246
		rendement technique	78,2 %	79,0 %	79,5 %	79,5 %	80,0 %	80,0 %	80,0 %
		besoin de production	**118**	**7 538**	**17 692**	**24 218**	**31 687**	**40 746**	**51 557**
Zone S - Hypothèse MEDIANE	Djagblé	besoin de consommation	167	957	3 649	5 377	7 836	11 275	16 030
		rendement technique	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %
		besoin de production	**209**	**1 197**	**4 562**	**6 722**	**9 795**	**14 094**	**20 038**
Zone T - Hypothèse MEDIANE	Dalavé	besoin de consommation	0	545	2 619	3 875	5 658	8 118	11 455
		rendement technique	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %
		besoin de production	**0**	**681**	**3 273**	**4 844**	**7 072**	**10 148**	**14 318**
Zone U - Hypothèse MEDIANE	Aképé	besoin de consommation	0	534	2 568	3 800	5 548	7 961	11 233
		rendement technique	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %
		besoin de production	**0**	**668**	**3 210**	**4 750**	**6 935**	**9 951**	**14 041**
Zone V - Hypothèse MEDIANE	Mission Tové - Kovié	besoin de consommation	0	975	4 688	6 938	10 129	14 534	20 507
		rendement technique	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %	80,0 %
		besoin de production	**0**	**1 219**	**5 860**	**8 672**	**12 661**	**18 167**	**25 633**
	besoin de consommation (jour moyen annuel)	**m3/j**	**36 711**	**130 316**	**260 529**	**335 674**	**428 518**	**542 525**	**681 790**
	besoin de production (jour moyen annuel)	**m3/j**	**49 836**	**174 128**	**337 113**	**429 739**	**543 950**	**682 536**	**852 237**
	besoin de production (jour de pointe)	**m3/j**	**59 803**	**208 954**	**404 536**	**515 687**	**652 740**	**819 043**	**1 022 685**

Figure 3 : Evolution of global production needs by zone and by horizon 2025-2035

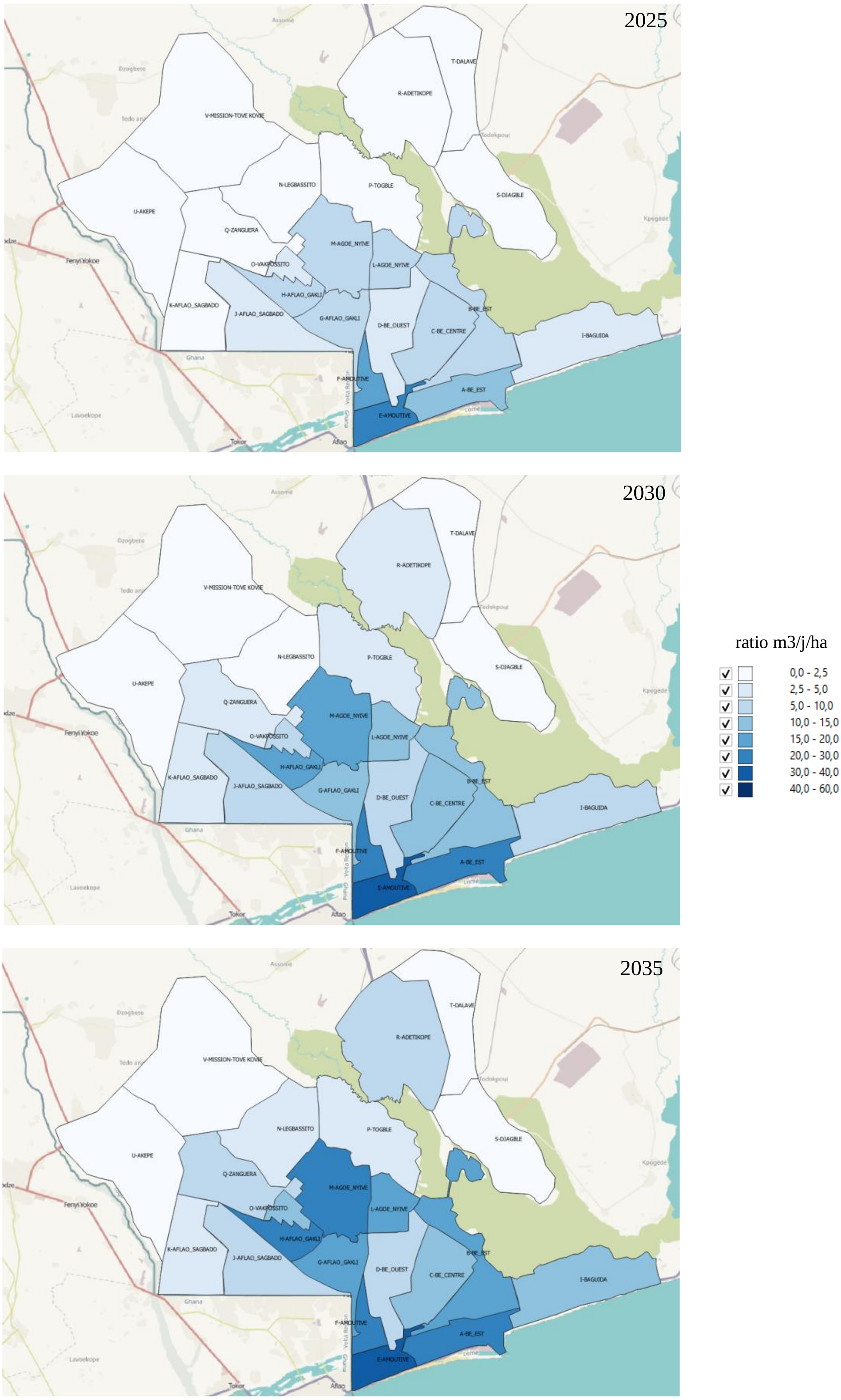


Figure 4 : Evolution of global production needs by zone and by horizon 2040-2050

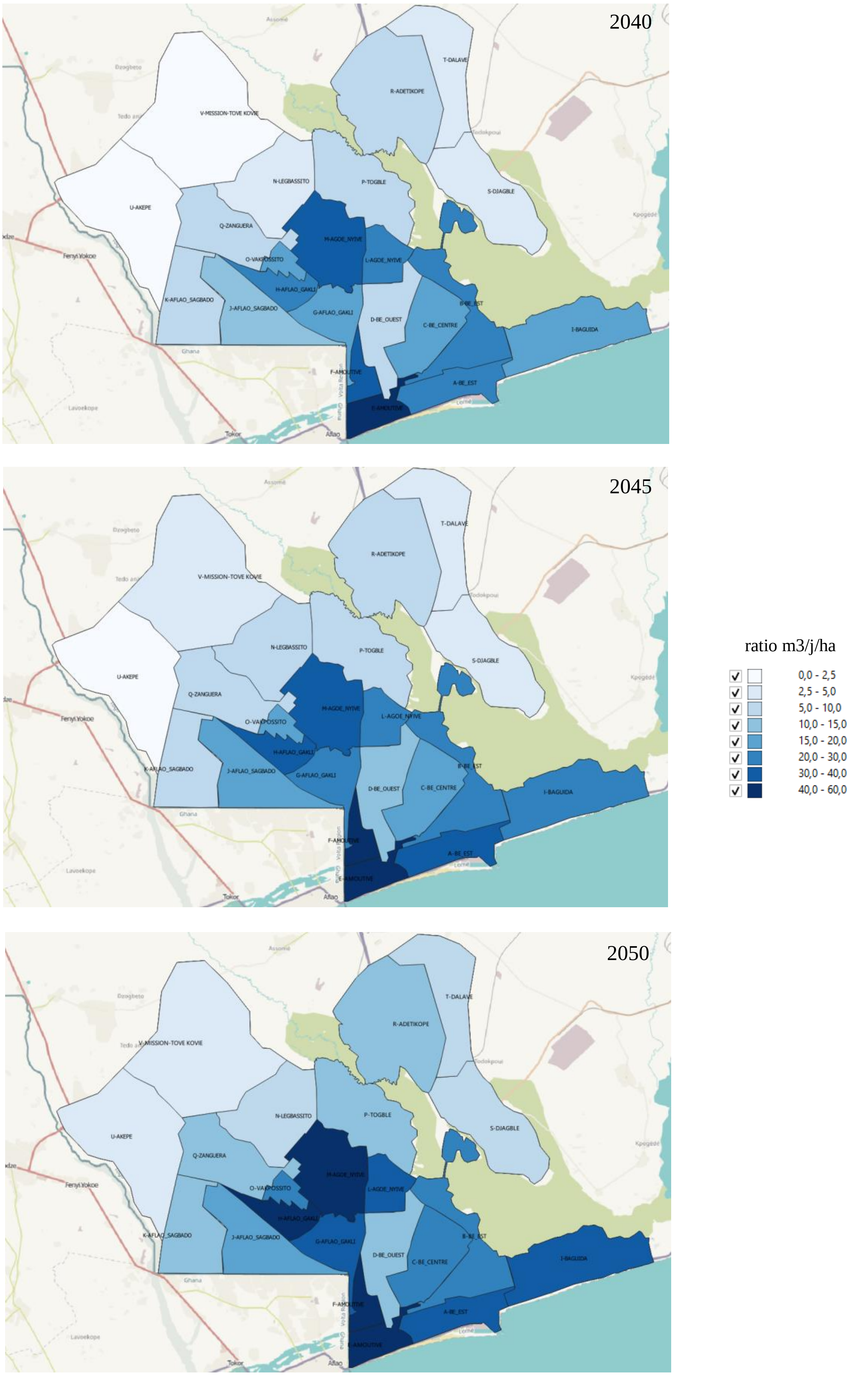
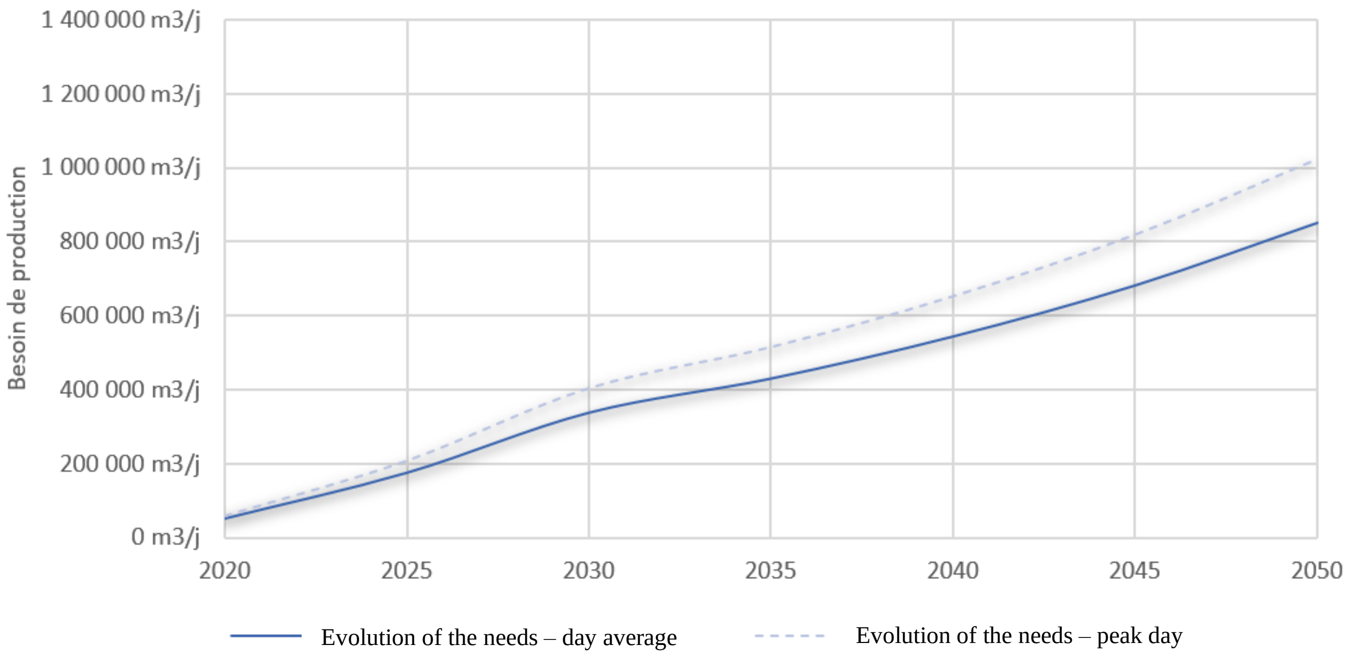


Figure 5 : Evolution of global production needs by horizon



3.2 Resources mobilization

3.2.1 Current resources

The only water resources used to supply water to the city of Lomé currently come from groundwater taken from three aquifers :

- Continental Terminal (sandy),
- Paleocene (limestone, limestone + sand, limestone + sandstoned limestone)
- Maestrichtian (sand, sand + sandstoned limestone).

The current average flow rate is about 31,800 m3/d from the Continental Terminal, 22,000 m3/d from the Paleocene and 3,700 m3/d from the Maestrichtian, that is 57,500 m3/d.

There are 46 boreholes in operation (18, 16 and 12 boreholes respectively in the Continental Terminal, in the Paleocene and in the Maestrichtian). 10 additional boreholes, drilled as part of the PURISE project, are currently being equipped in the Paleocene by the AEP Lomé phase II project.

In spite of these new drillings, and as the Resource Study (deliverable 6) points out, it is advisable to be cautious with regard to the sustainability of the hydrogeological resources exploited in the immediate environment of Greater Lomé.

3.2.2 Resources to be mobilised

In order to meet changing needs, existing underground resources in the Greater Lomé area will continue to be taken into account and exploited within the limits of the current average productivity. The aquifers to the east and north/east of Lake Togo could have a production potential estimated at 40,000 m3/d, which could be mobilized rapidly.

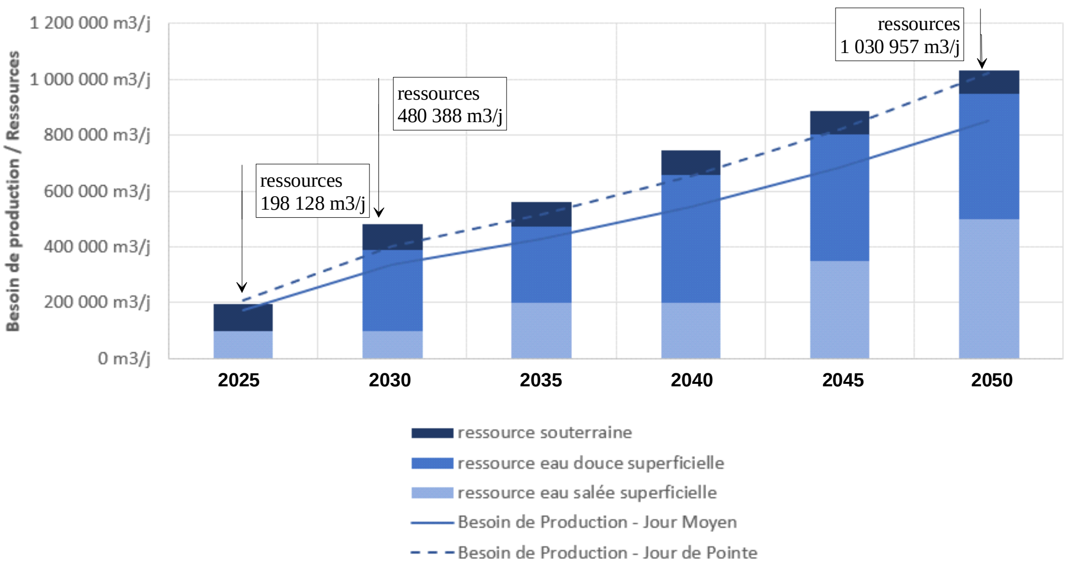
Nevertheless, it is inevitable to consider a massive recourse to surface water resources.

The following table proposes the timeline for mobilizing the various resources in accordance with the assumption made in the Resource Study (Deliverable 6).

Table 2 : Timeframe for resource mobilization

Capacité de production	2023 - 2025	2025 - 2030	2030	2035	2040	2045	2050
hydrogéologie -forages actuels et en cours	58 128 m3/j	55 050 m3/j	51 972 m3/j	49 391 m3/j	46 810 m3/j	44 634 m3/j	42 457 m3/j
champ captant est	40 000 m3/j	40 000 m3/j	40 000 m3/j	40 000 m3/j	40 000 m3/j	40 000 m3/j	40 000 m3/j
Mono			200 000 m3/j	200 000 m3/j	400 000 m3/j	400 000 m3/j	400 000 m3/j
Zio		87 708 m3/j	88 416 m3/j	72 958 m3/j	57 500 m3/j	53 000 m3/j	48 500 m3/j
dessalement	100 000 m3/j	100 000 m3/j	100 000 m3/j	200 000 m3/j	200 000 m3/j	350 000 m3/j	500 000 m3/j
	198 128 m3/j	**282 758 m3/j**	**480 388 m3/j**	**562 349 m3/j**	**744 310 m3/j**	**887 634 m3/j**	**1 030 957 m3/j**

Figure 6 : Global balance of needs/resources



The projects of reinforcement of the resource must allow to consider the progression of the coverage while keeping a global surplus of needs/resources, on the scale of the Greater Lomé.

The objective in the very short term is to improve access to drinking water for the population currently connected, and then, while maintaining the good conditions of access to drinking water for the connected population, to increase the coverage rate.

The conclusion that there is a balance or a surplus in the overall needs/resources balance at the Greater Lomé level is insufficient. The topography naturally separates Greater Lomé into a lower zone (~levels<35m) and a upper zone (~levels>35m). The structuring infrastructures to be planned must make it possible to balance the needs/resources balances of each of the two large zones at the different horizons.

Figure 7 : Future channelized areas (lower and upper)

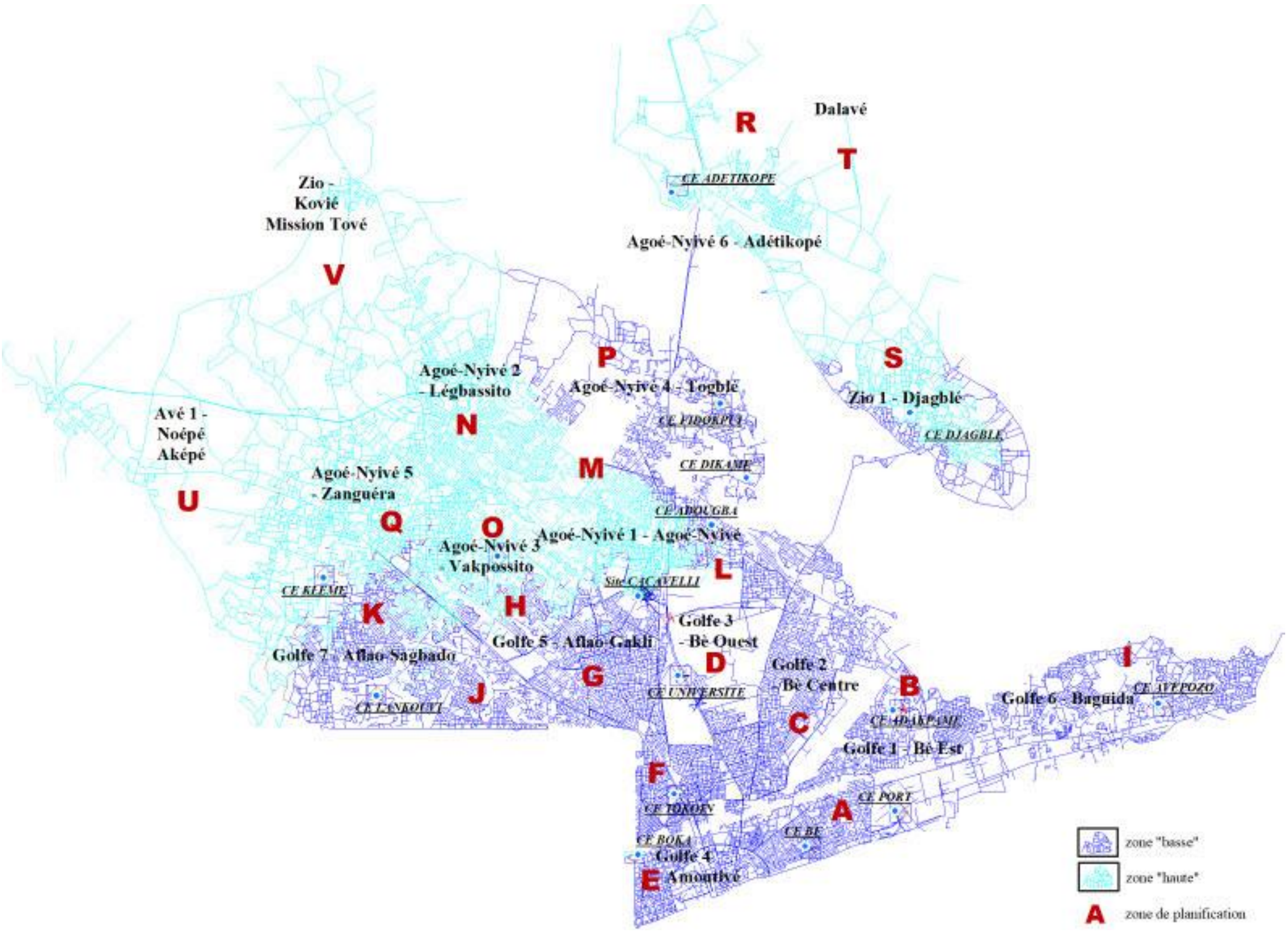


Table 3 : Distribution of production needs

Besoin de production Jour Moyen annuel m3/j	2025		2030		2035		2040		2045		2050	
- Zone Haute	54 352	*31%*	123 199	*37%*	164 281	*38%*	216 703	*40%*	282 350	*41%*	365 015	*43%*
- Zone Basse	119 776	*69%*	213 914	*63%*	265 458	*62%*	327 247	*60%*	400 186	*59%*	487 222	*57%*
	174 128	*100%*	337 113	*100%*	429 739	*100%*	543 950	*100%*	682 536	*100%*	852 237	*100%*

3.3 Needs/Resources Balance by Zone

Pending the mobilization of resources from the "north" (Zio River and Mono River), the "Upper Lome" coverage area will have a deficit: a backflow capacity will have to be planned from the south to the north - the "Lower Lome" coverage area being in surplus. The station will be located on the site of the Kégué Stadium storage complex (East water tower) and will be sized for a flow rate of 66,000 m3/d. In the following years, when the resources of the Zio and Mono rivers will be operational, the situation will be reversed and the "Upper Lome" coverage area will participate in the coverage of the "Lower Lome" area by gravity.

Table 4 : Evolution of production transfers between "Upper-Lomé" and "Lower-Lomé"

Lomé Haut		**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Besoin de production	Jour Moyen	54 352 m3/j	123 199 m3/j	164 281 m3/j	216 703 m3/j	282 350 m3/j	365 015 m3/j
	Jour de Pointe	65 222 m3/j	147 839 m3/j	197 137 m3/j	260 044 m3/j	338 820 m3/j	438 018 m3/j
Ressources	Zio	0 m3/j	88 416 m3/j	72 958 m3/j	57 500 m3/j	53 000 m3/j	48 500 m3/j
	Mono	0 m3/j	200 000 m3/j	200 000 m3/j	400 000 m3/j	400 000 m3/j	400 000 m3/j
excédent (+) ou déficit (-)	**Jour Moyen**	**-54 352 m3/j**	**165 217 m3/j**	**108 677 m3/j**	**240 797 m3/j**	**170 650 m3/j**	**83 485 m3/j**
	Jour de Pointe	**-65 222 m3/j**	**140 577 m3/j**	**75 821 m3/j**	**197 456 m3/j**	**114 180 m3/j**	**10 482 m3/j**

Lomé Bas		**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Besoin de production	Jour Moyen	119 776 m3/j	213 914 m3/j	265 458 m3/j	327 247 m3/j	400 186 m3/j	487 222 m3/j
	Jour de Pointe	143 732 m3/j	256 697 m3/j	318 550 m3/j	392 696 m3/j	480 223 m3/j	584 667 m3/j
Ressources	hydrogéologie Cacavelli	58 128 m3/j	51 972 m3/j	49 391 m3/j	46 810 m3/j	44 634 m3/j	42 457 m3/j
	champ captant Est	40 000 m3/j	40 000 m3/j	40 000 m3/j	40 000 m3/j	40 000 m3/j	40 000 m3/j
	Dessalement	100 000 m3/j	100 000 m3/j	200 000 m3/j	200 000 m3/j	350 000 m3/j	500 000 m3/j
excédent (+) ou déficit (-)	**Jour Moyen**	**78 352 m3/j**	**-21 942 m3/j**	**23 933 m3/j**	**-40 437 m3/j**	**34 448 m3/j**	**95 235 m3/j**
	Jour de Pointe	**54 396 m3/j**	**-64 725 m3/j**	**-29 159 m3/j**	**-105 886 m3/j**	**-45 589 m3/j**	**-2 210 m3/j**

Capacité de transfert d'équilibre		**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
gravitaire Haut vers Bas	**Jour Moyen**	-	21 942 m3/j	-	40 437 m3/j	-	-
	Jour de Pointe	-	64 725 m3/j	29 159 m3/j	105 886 m3/j	45 589 m3/j	2 210 m3/j
pompage Bas vers Haut	**Jour Moyen**	54 352 m3/j	-	-	-	-	-
	Jour de Pointe	65 222 m3/j	-	-	-	-	-

Figure 8 : Needs/Resources balance diagram before 2030

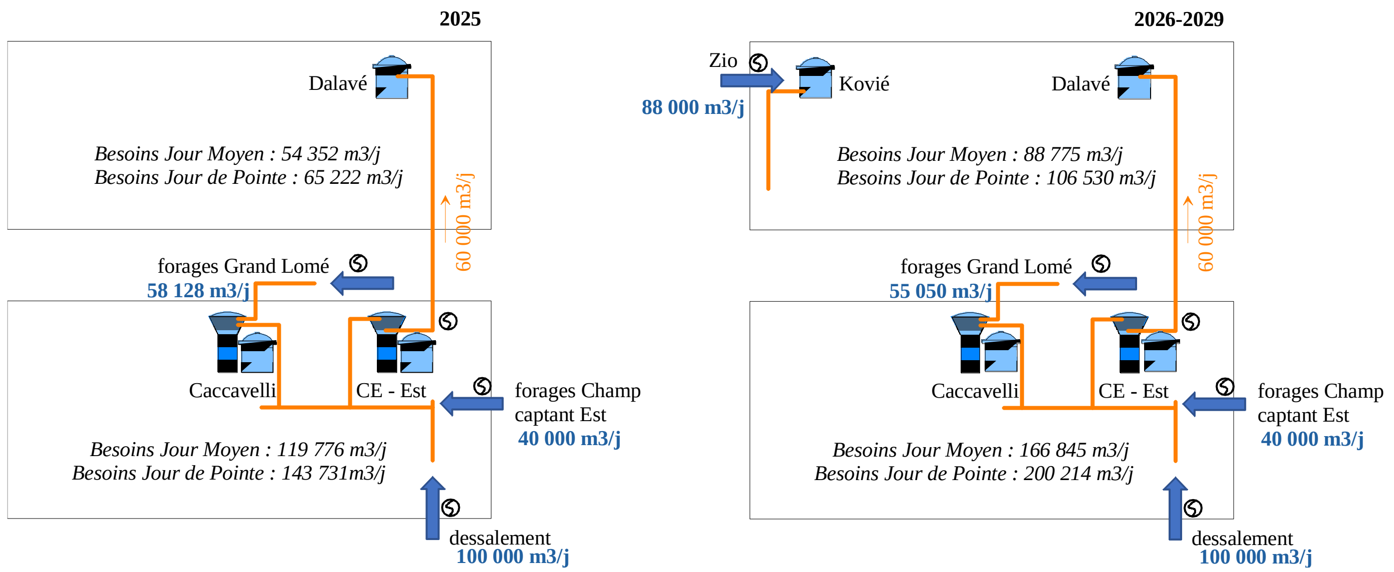
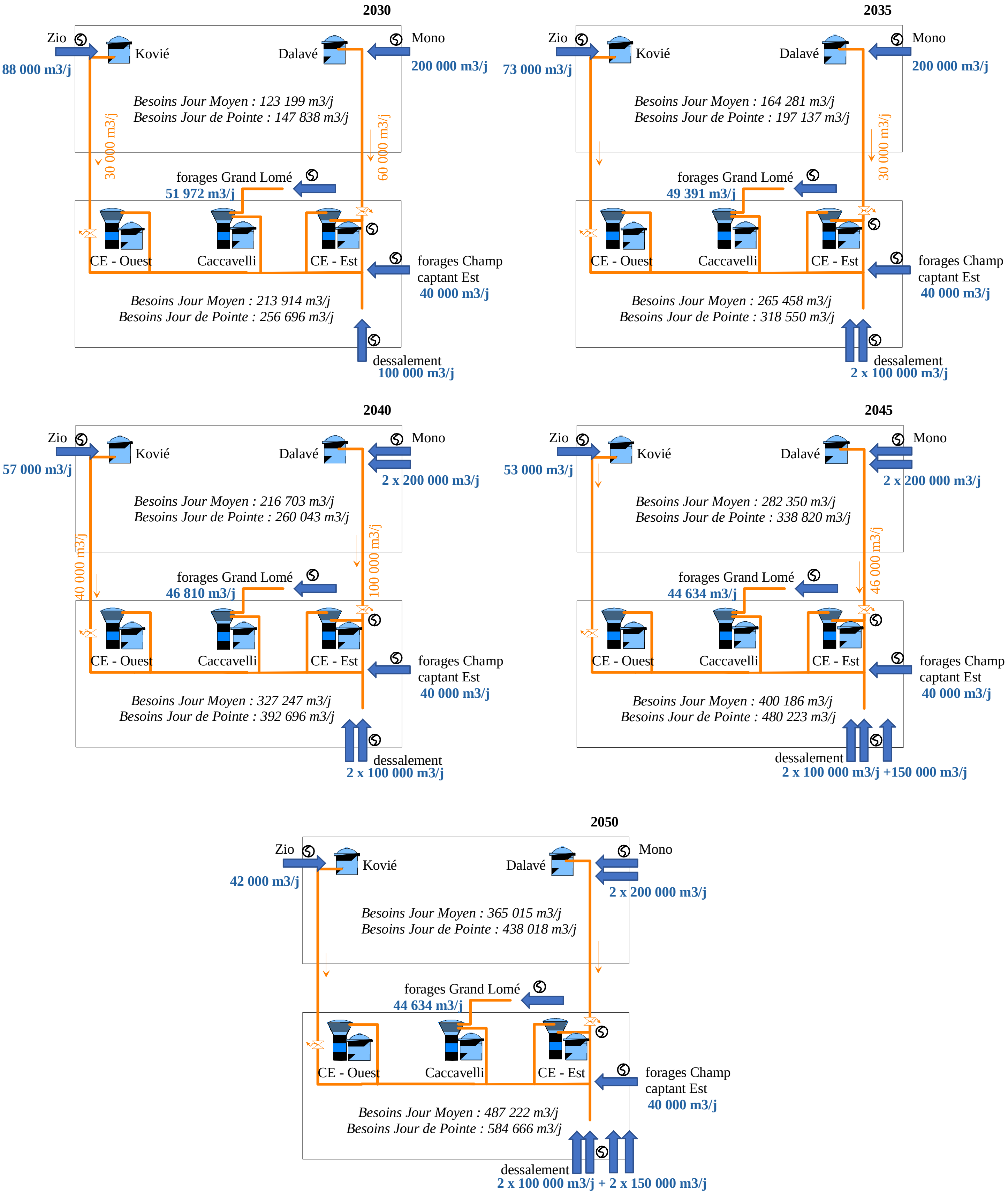


Figure 9 : Needs/Resources balance diagram after 2030



The preceding diagrams illustrate the interchange capacities between the infrastructure to be planned for the supply and the two main coverage areas, for the next horizons in average and peak day.

These capacities are designed for peaks, for the operator they also represent back-up capacities between the southern and northern sectors, in the event of degraded operation. It should be noted that when the Mono resource is mobilized, the production capacity from the North-East will undoubtedly be required on the way to supply major towns (Tabligbo, Tsévié, etc.). The South-North interconnection pumping station located at the Stade Kégué storage site will help to balance the needs/resource balances of the southern and northern sectors in line with the changes in needs to be met and the mobilization of resources to be planned.

4

Infrastructures related to water supply

4.1 Adopted principles

The conveyances pipe must bring the new resources to key points distributed over the territory concerned by the current and future network in order to serve it. These sites will have to be equipped with the necessary storage infrastructures, evolving by horizon.

The main supply systems will be sized for the seasonal peak, for the average daily flow (average hour), the coverage network will be sized for the daily peak flow (peak hour) of the network's needs. The interface between the water supply and coverage systems is the reservoirs, the volume of which must be sufficient to store the hourly modulation of needs.

The methodology chronologically consists in:

- Assign changes in system water requirements in the hydraulic model according to the assumptions of the selected demand model;
- Locate the storage sites in accordance with the topography for an optimal coverage of the territory to be served on the selected horizons by associating the available volumes to the various horizons;
- Sizing and proposing the layout of the interconnection pipes between the resources to be developed and the storage sites, with the necessary pumping installations;
- - Work on the hydraulic model in order to allow the distribution of the available volumes at the head of the stage - reinforcements/extensions of the structuring pipes in order to reach a minimum objective of approximately 1 bar in peak period.

The objective is to be able to guarantee, at all times, a minimum pressure of 1 bar on all points of the network. As for the maximum pressure in the network, it should not exceed 5 bars for the two zones Upper Lome and Lower Lome, in order to minimize leaks.

There is no absolute rule for the maximum flow velocity in the pipes of a drinking water network. The following guide values are indicative and correspond to a head loss of about 4 to 5 m/km.

-200 mm	0,7 m/s	-300 mm	1,0 m/s	-400 mm	1,2 m/s
-500 mm	1,3 m/s	-600 mm	1,5 m/s	-800 mm	1,8 m/s

A too low flow velocity can affect the water quality, the minimum velocity should not be less than 0.5 m/s at peak.

4.2 Storage requirements and their evolution

4.2.1 The functions of a reservoirs

A drinking water tank is designed to perform different functions, the three main ones being:

4.2.1.1 The production controls

The peak water supply is in theory spread out and quasi-constant over a 24-hour cycle. The storage volume can then be used to supply the peak water demand during peak hours.

On days of lower consumption, it would be possible to use the available storage capacity to reduce pumping times during the day.

4.2.1.2 The distribution Safety

The following are mentioned here:

- safety related to an incident at the level of the production installations. This of course refers to an incident other than a deterioration of the resource (pollution) requiring a long-term stoppage, the safety function then being more in the field of diversification of the resource than the storage capacity.

- We can also mention fire safety, which requires a volume to be made available to the Civil Protection services according to the risks and needs assessed by these services.

The production stoppages related to the safety function can be:

- a power failure,

- a partial or total technical failure on the treatment sites or on the supply lines,

- the rupture of a main line located either upstream or downstream of the storage installations,

- a brief accidental pollution of the resource.

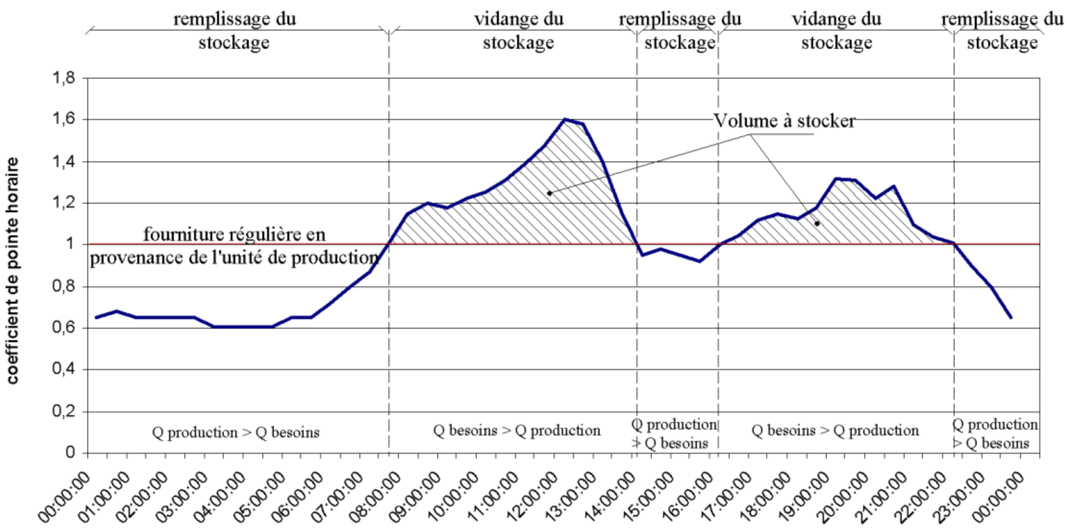
4.2.1.3 The distributed water quality

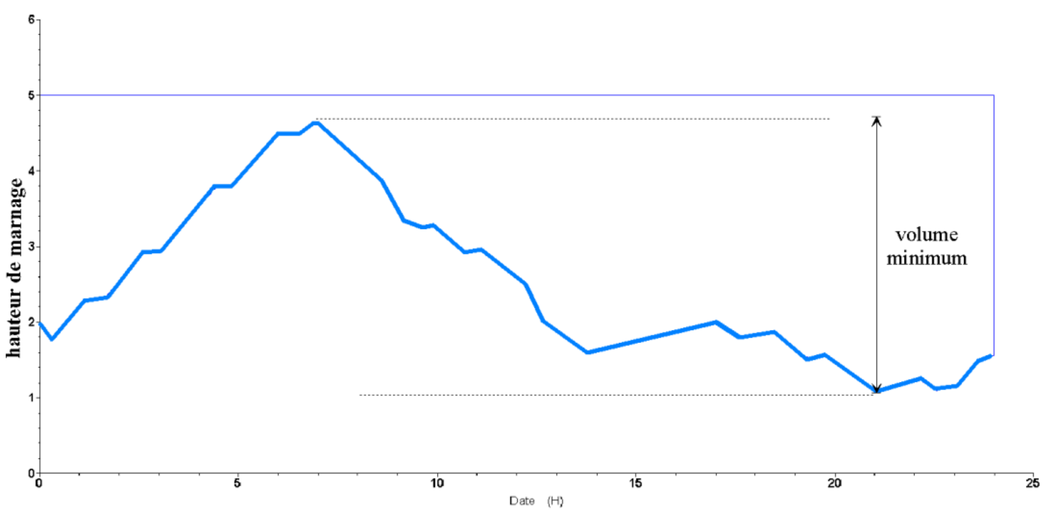
In theory, it is necessary to keep a qualitative storage volume at the bottom of the tanks to avoid completely emptying the installations. Otherwise, deposits would be carried along and the quality of the water distributed would deteriorate.

4.2.2 Storage capacity requirements

The typical hourly modulation curve considered (1.6 hourly peak defined in the Demand study) is shown in the following figure. It indicates the principle of calculation of the minimum necessary storage volume: this volume does not ensure safety in case of any failure of the production system.

Figure 10 : Principle of storage volume calculation





We propose as an objective, a minimum storage volume corresponding to the minimum volume due to the hourly modulation. An additional minimum security volume is added, corresponding to 2 to 3 hours of average production needs to constitute a reserve in case of various incidents on the inlet infrastructures.

The following table details the storage volumes proposed for reinforcement by horizon, to reach approximately 25% of daily requirements, in accordance with the specifications :

Table 5 : Storage capacity needs

Lomé Haut		**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	
Besoin de production	Jour Moyen	54 352 m3/j	123 199 m3/j	164 281 m3/j	216 703 m3/j	282 350 m3/j	365 015 m3/j	
	Jour de Pointe	65 222 m3/j	147 839 m3/j	197 137 m3/j	260 044 m3/j	338 820 m3/j	438 018 m3/j	
	modulation horaire	8 153 m3	18 480 m3	24 642 m3	32 506 m3	42 352 m3	54 752 m3	
	2 à 3 heures de besoins	6 794 m3	15 400 m3	20 535 m3	27 088 m3	35 294 m3	45 627 m3	
	volume global de réserve	**14 947 m3**	**33 880 m3**	**45 177 m3**	**59 593 m3**	**77 646 m3**	**100 379 m3**	
	ratio stockage/besoin ~	25%	25%	25%	25%	25%	25%	
implantation	Site stockage Dalavé -au sol	20 000 m3		20 000 m3		40 000 m3		cumul : 100 000 m3
	Site stockage Kovié -au sol		20 000 m3					

Lomé Bas			**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	
Besoin de production	Jour Moyen		119 776 m3/j	213 914 m3/j	265 458 m3/j	327 247 m3/j	400 186 m3/j	487 222 m3/j	
	Jour de Pointe		143 732 m3/j	256 697 m3/j	318 550 m3/j	392 696 m3/j	480 223 m3/j	584 667 m3/j	
	modulation horaire		17 966 m3	32 087 m3	39 819 m3	49 087 m3	60 028 m3	73 083 m3	
	2 à 3 heures de besoins		14 972 m3	26 739 m3	33 182 m3	40 906 m3	50 023 m3	70 647 m3	
	volume global de réserve		**32 939 m3**	**58 826 m3**	**73 001 m3**	**89 993 m3**	**110 051 m3**	**143 731 m3**	
	ratio stockage/besoin ~		25%	25%	25%	25%	25%	25%	
implantation	Site Est (Stade)	au sol	20 000 m3			20 000 m3			cumul : 150 000 m3
		sur tour	5 000 m3			5 000 m3			
	Cacavelli	au sol	20 000 m3		20 000 m3				
		sur tour	5 000 m3		5 000 m3				
	Site Ouest (bd 30 août)	au sol		20 000 m3			20 000 m3		
		sur tour		5 000 m3			5 000 m3		

Note: in the storage balance, only the storage capacities, on the ground or on a tower, serving the floor gravitationally are taken into account. The ground storage capacities on the sites (Stade, Caccavelli and bd 30 août) can only be retained for pumping capacities fully assisted by generator. For Lower Lomé, the coverage flows must pass through tower tanks, at a level compatible with a gravity coverage, the volumes on the tower will correspond at least to about 1 hour of peak consumption.

4.3 The water conveyance systems

The conveyance systems installation will have to be anticipated in order to be operational with the availability of the treated resources. It is planned to treat the resources at the water intake - the conveyances pipes will transport treated water.

In coherence with the mobilization of the resources, the water conveyances systems are projected to be operational in the following time frames:

Table 6 : Chronology of water conveyance system implementation

horizon	id adduction	désignation
2025	(1)	champs capatnt Est, traitement et adduction
	(2a)	dessalement et adduction
	(3)	liaison étage haut Adéticopé/Dalavé
2028	(4)	**barrage**, prise d'eau Zio, traitement et adduction
	(6)	liaison étage haut Noépé/Sanguéra
2030	(5)	prise d'eau Mono, traitement et adduction
2035	(2a)	**doublement** dessalement et adduction
2040	(5)	**doublement** prise d'eau Mono, traitement et adduction
2045	(2b)	nouvelle unité de dessalement et adduction
2050	(2b)	**doublement** nouvelle unité de dessalement et adduction

Figure 11 : Water conveyance location

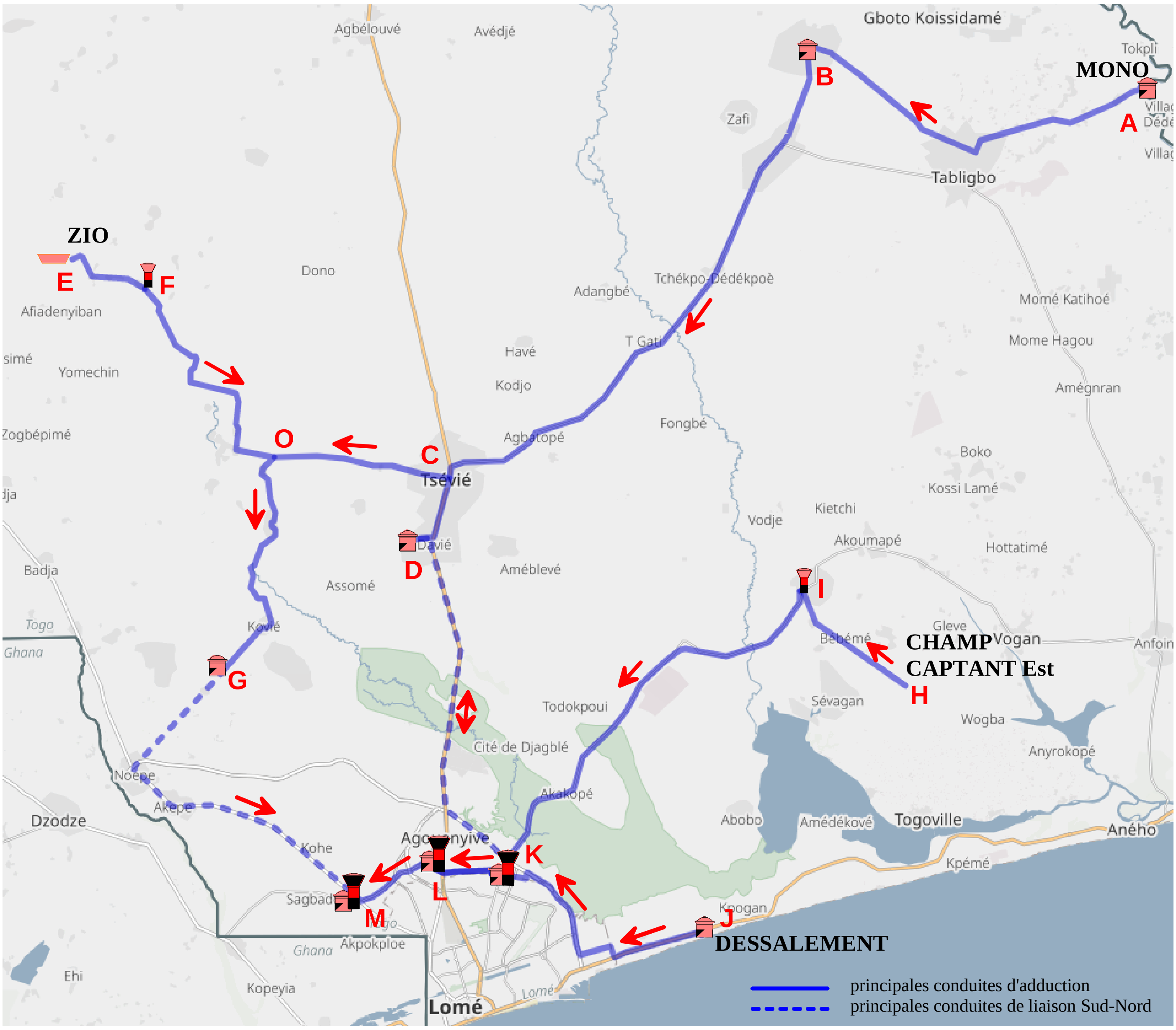


Table 7 : Approximative locations of the main sites

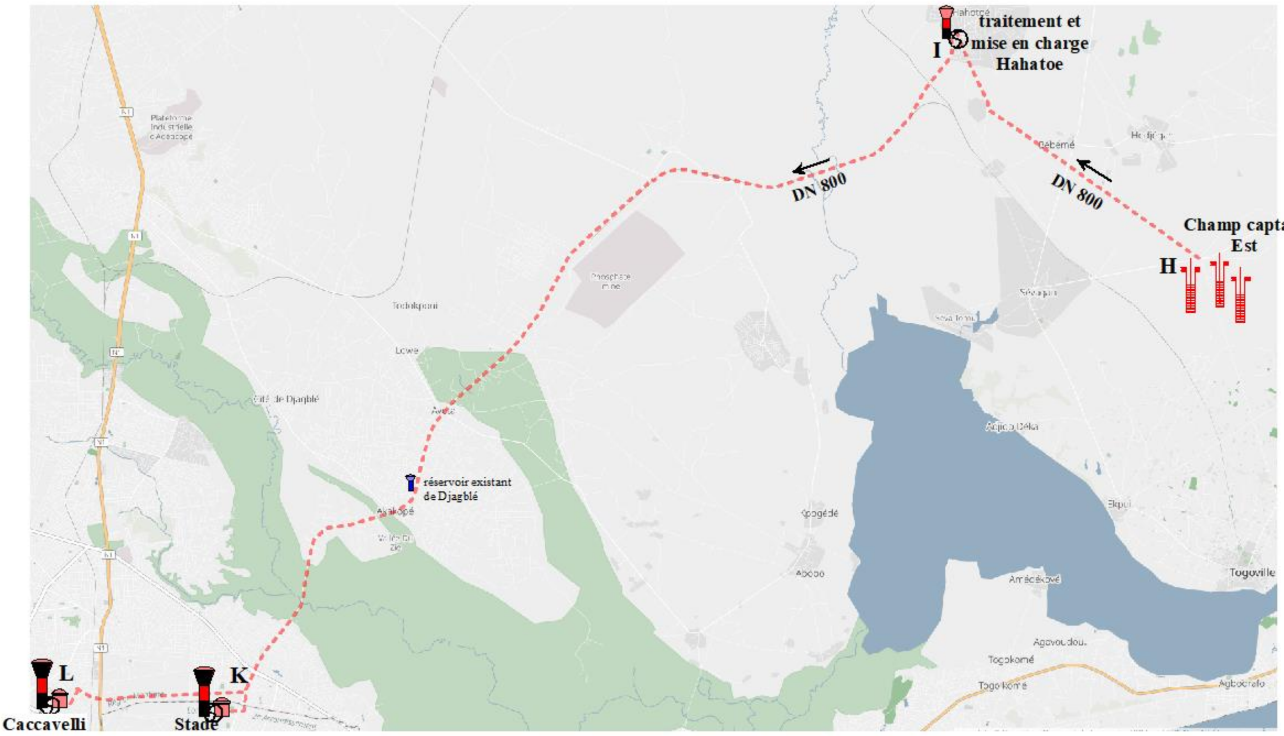
id	repère	nœud	désignation	x	y	~z
(1)	ligne Champ Captant	H	ligne eau brute	330441	697514	26 m
	Est	I	traitement/mise en charge	323796	703561	61 m
		K	site Stade	304964	686069	30 m
		L	stockage Caccavelli	300913	686459	40 m
(2)	ligne Dessalement	J	traitement/refoulement	317827	682 214	8 m
		K	site Stade	304964	686069	30 m
		L	stockage Caccavelli	300913	686459	40 m
		M	site bd 30 Août	296928	684370	31 m
(3)	liaison Adeticopé	D	stockage Lomé haut Dalavé	299833	706717	88 m
		K	site Stade	304964	686069	30 m
(4)	ligne Zio	E	refoulement Zio	279786	722815	67 m
		F	Traitement/mise en charge CE	283701	721923	89 m
		O	by-pass adduction Mono	291497	711724	39 m
		G	stockage Lomé haut Kovié	288276	698642	87 m
(5)	ligne Mono	A	traitement/refoulement Mono	345136	734294	18 m
		B	mise en charge Kouvé	324485	735978	150 m
		C	by-pass adduction Zio	302322	710411	99 m
		D	stockage Lomé haut Dalavé	299833	706717	88 m
(6)	liaison Noépé Sanguéra	G	stockage Lomé haut Kovié	288276	698642	87 m
		M	site bd 30 Août	296928	684370	31 m

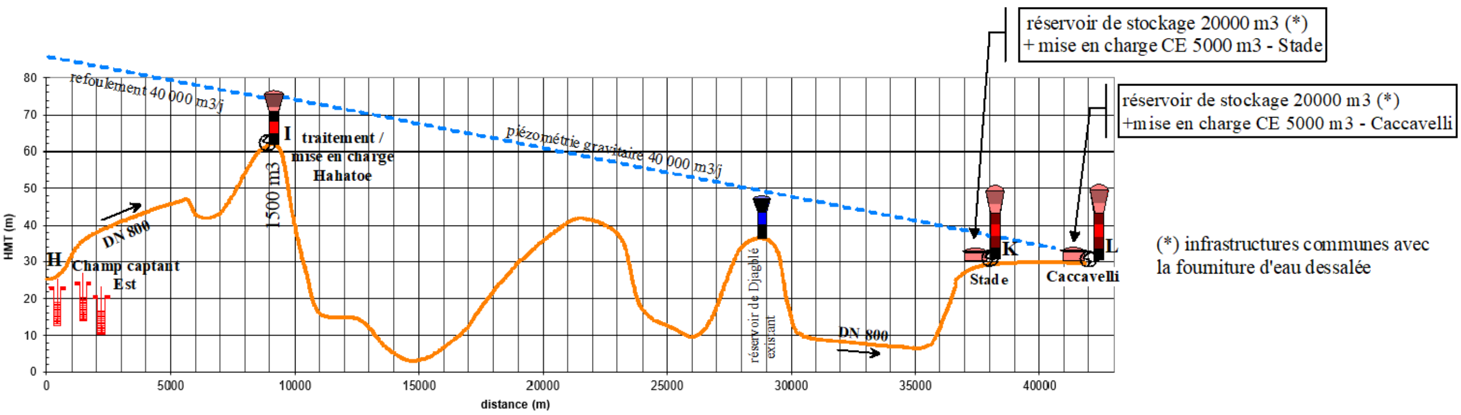
Coordonnées projection transverse de Mercator UTM WGS 84 31N Togo

4.3.1 East wellfield connection

The definition of the wellfield will be the subject of further investigations at the end of this Master Plan study, as described in the Resource Study. The boreholes will deliver the raw water to a treatment site planned at the high point (Hahotoé) from where the resource will reach the storage sites in lower Lomé by gravity via the Vogan-Lomé road, crossing Djagblé. There are no plans to reinforce this line at a later date.

Figure 12 : Transfer pipe from the well field to the storage facilities (lower stage)

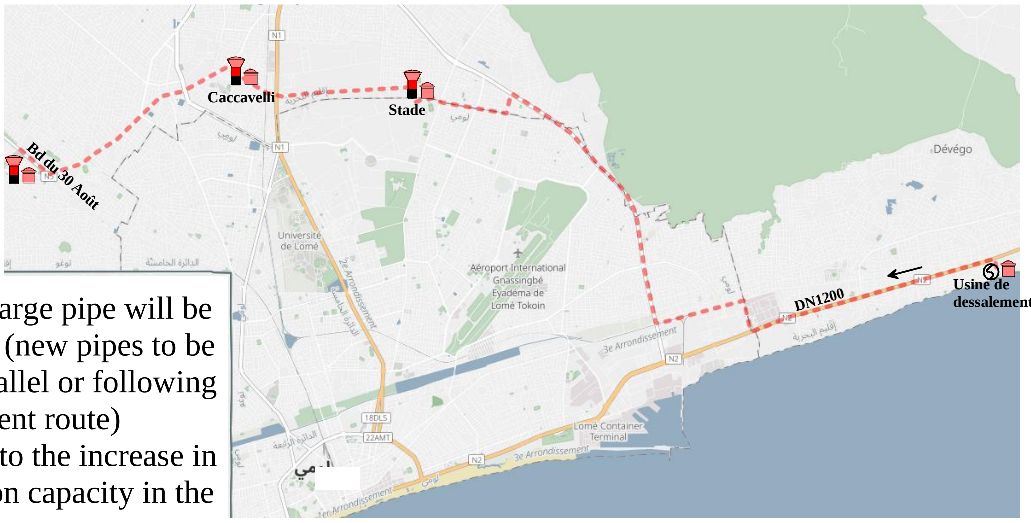




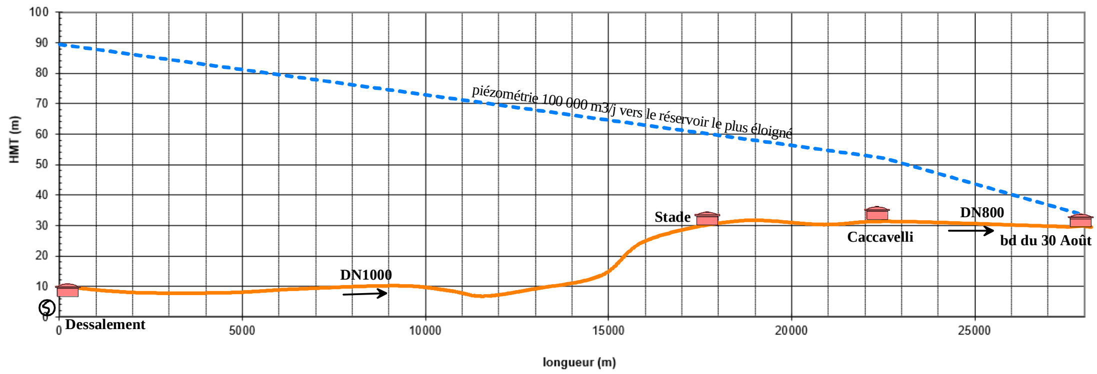
4.3.2 Liaison dessalement

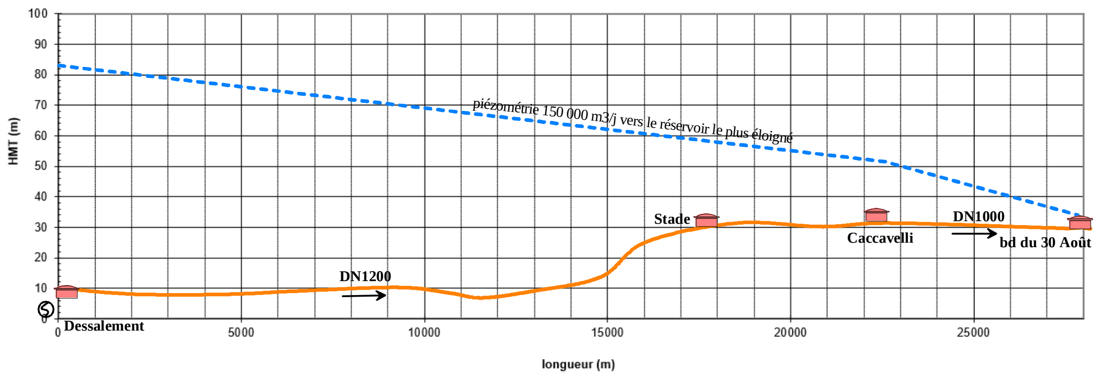
From the coastal desalination site ("Tropicana" land), the treated water will be pumped to the storage sites planned for the Lower-Lome area (the pipeline will be able to serve the AVEPOZO and ADAKPAME reservoirs on the road). The route will follow the coastal road from Baguida, then the right-of-way of the bypass boulevard (expressway) until it approaches the stadium storage site. The backflow pipe route continues to the north of Lomé 2, crosses the Eyadema Boulevard and reaches the Caccavelli storage site. The line of the force main finally reaches the storage site on Boulevard du 30-Août, following the right-of-way of Boulevard Adjidoadin.

Figure 13 : Discharge pipe from Desalination to storage (low stage)



The discharge pipe will be reinforced (new pipes to be laid in parallel or following an equivalent route) according to the increase in desalination capacity in the future.



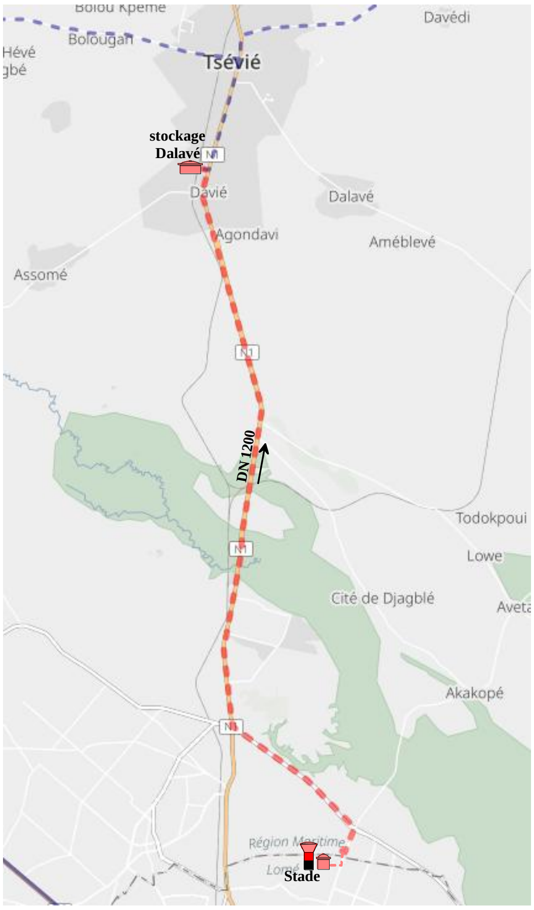


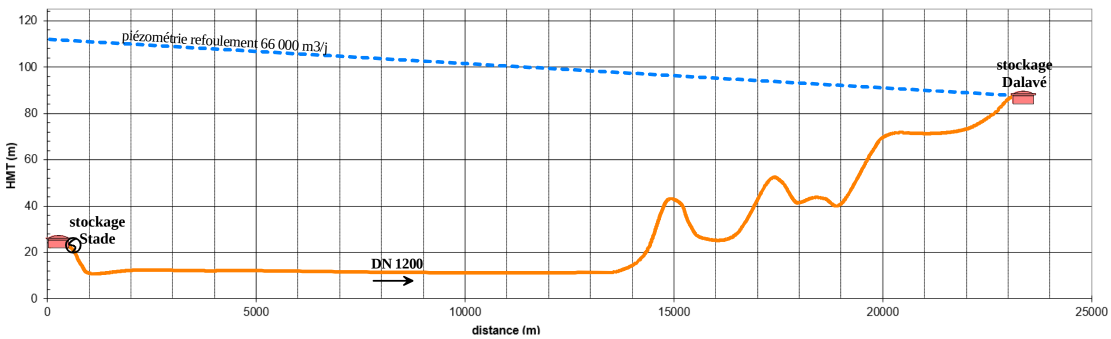
4.3.3 Adétikopé - Dalavé high floor connection

The link to Adétikopé and Dalavé is intended, while waiting for the arrival of the resource from the Mono, to backflow (backflow-distribution) from the storage site of the Stade Kégué storage complex, the resource needed in the north of Lomé to the projected reservoir at Dalavé. At the very least, this link must be operational between the Stade Kégué storage complex and Adétikopé in 2025 - see the Investment Plan in ***Appendix 2*** and ***Plan 1-Adductions 2025.***

At the arrival of the Mono resource, this link could also operate, according to the needs, gravitationally towards Lomé bas, as a supplement.

Figure 14 : Connection pipe Adétikopé - Dalavé (high floor)



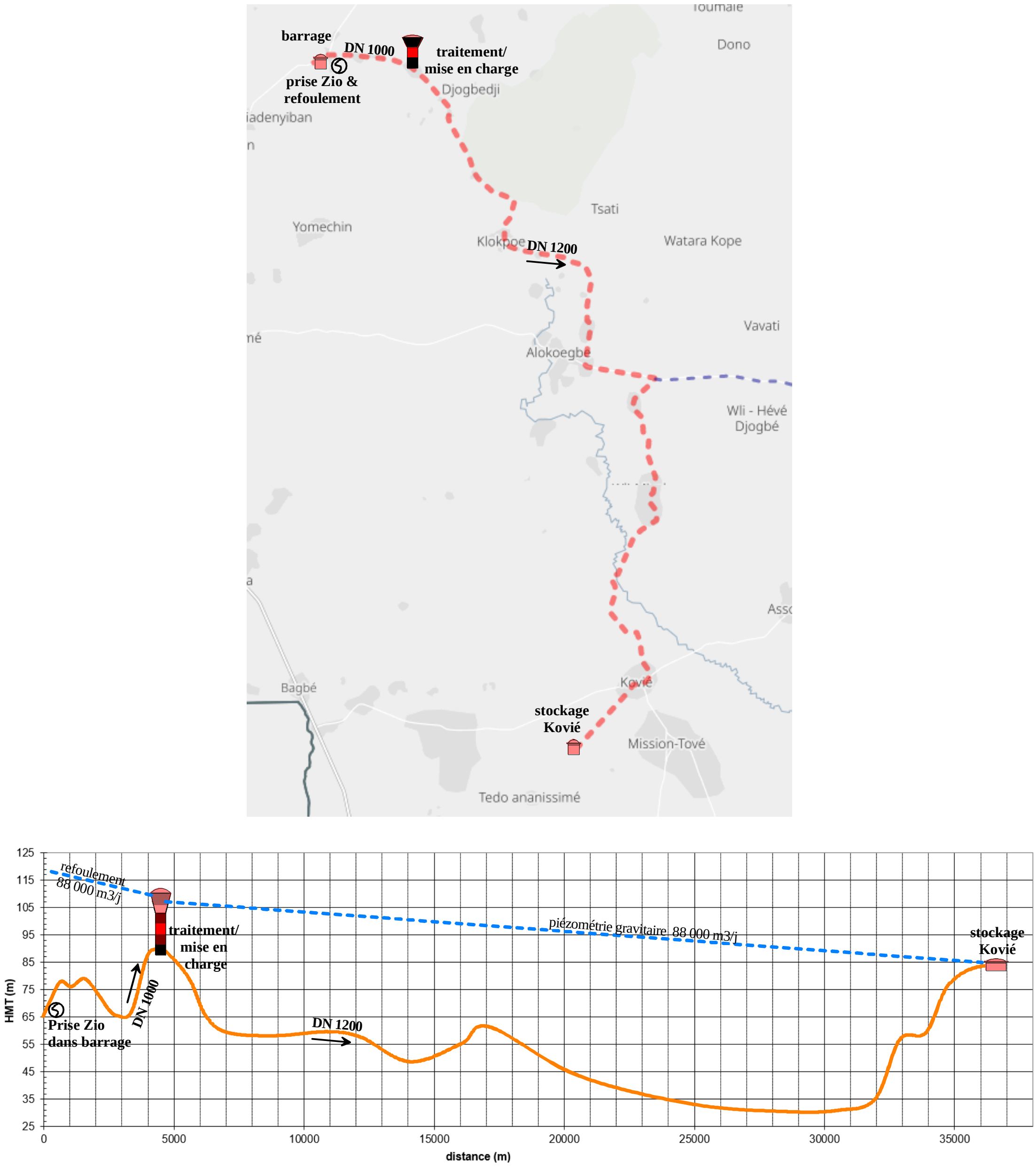


4.3.4 Zio connection

From the dam, the water will be pumped to a topographically high site where it will be treated and loaded from a water tower. The hydraulic link will feed the ground storage, planned in Kovié, by gravity[1].

The 1500 m3 loading tank will be used to regulate the operation of the lift pumps. It is not planned to reinforce this link at a later date, given the expected evolution of the exploitable flows.

Figure 15 : Transfer pipe from Zio to Kovié storage (upper floor)



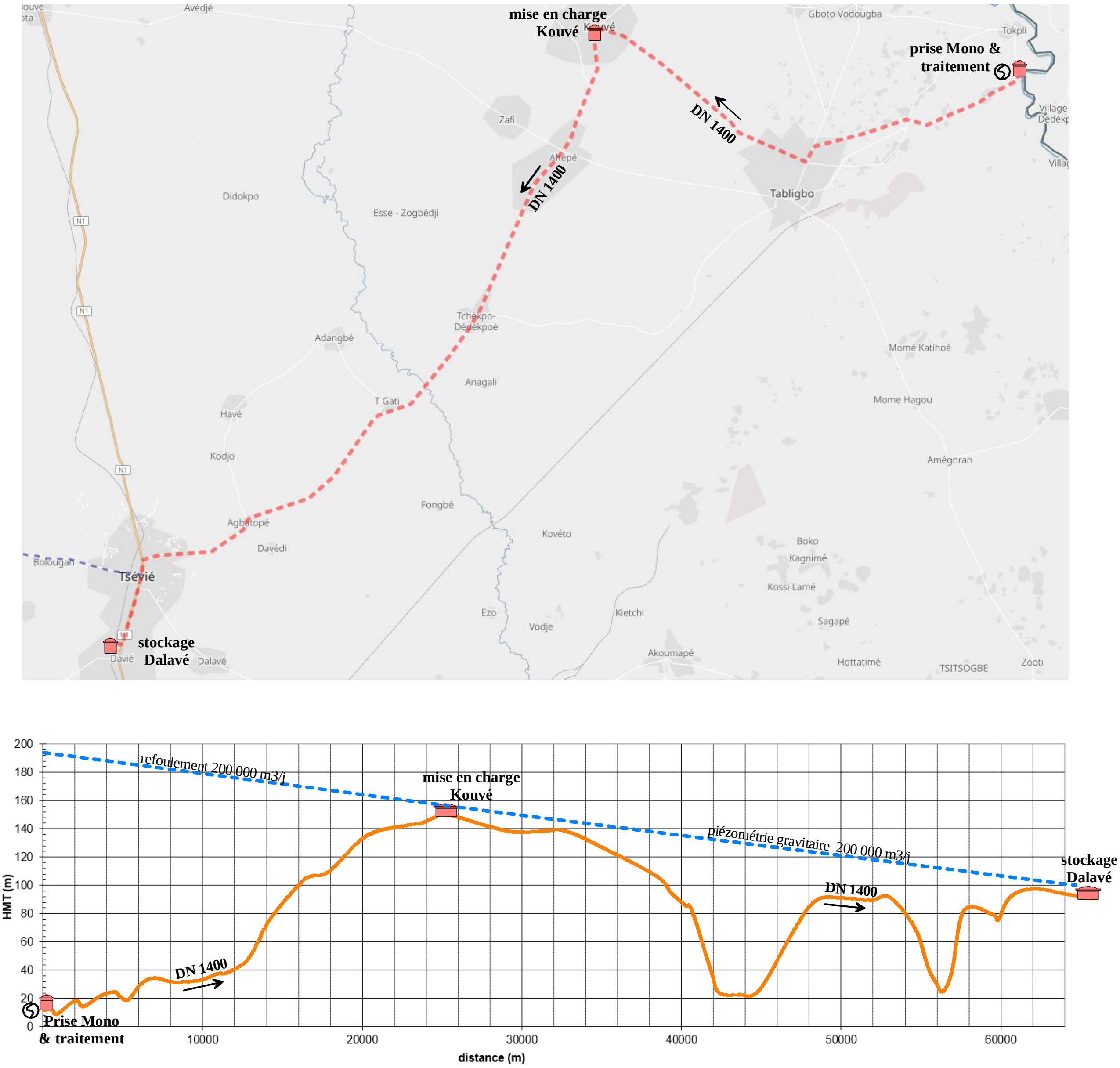
1 A gravity coverage will allow an easy distribution of the needs along the road

4.3.5 Mono connection

From the treatment to be installed near the water intake in the Mono, the hydraulic link will supply the ground storage, planned in Dalavé. by gravity from a loading tank to be installed in Kouvé.

The 5,000 cubic meters of loading storage will be used to regulate the operation of the lift pumps. It is planned to double the connection between the water intake and Lomé over time.

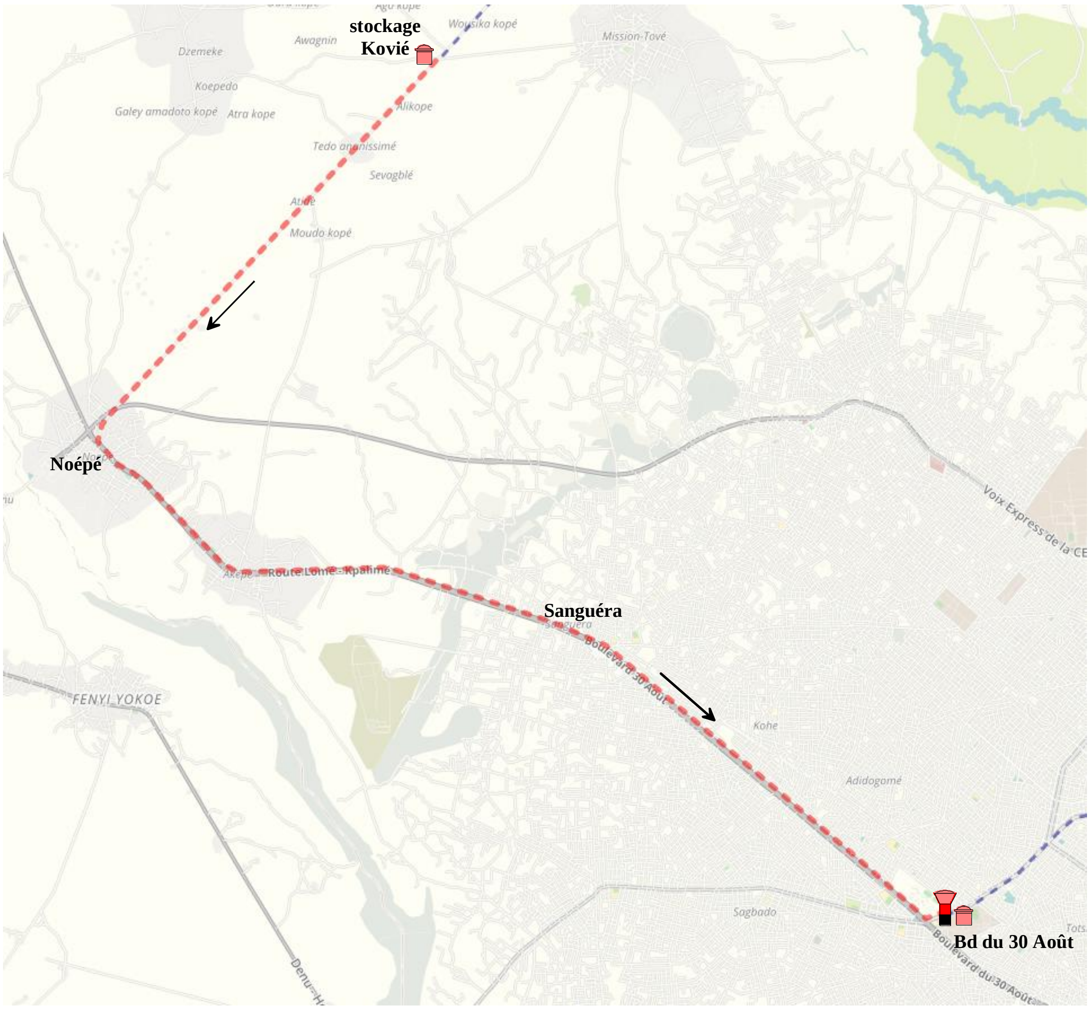
Figure 16 : Transfer pipe from Mono to Dalavé storage (high floor)

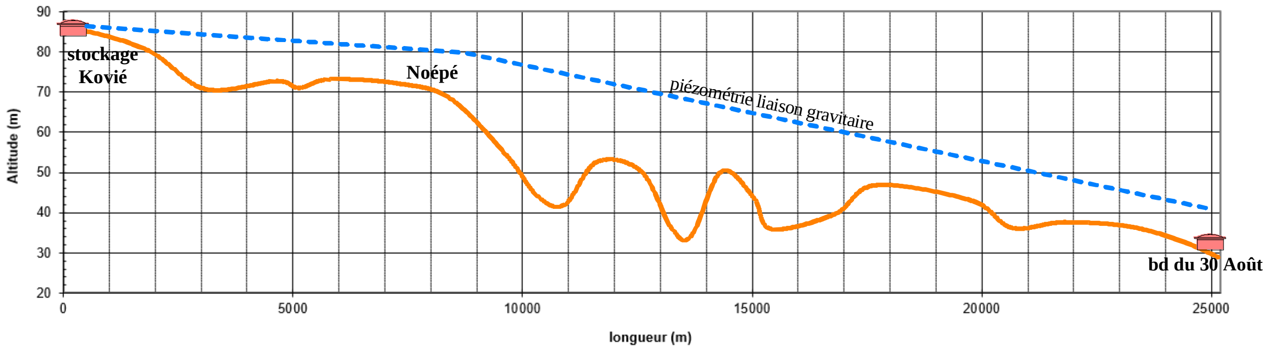


4.3.6 Kovié-Sanguéra high floor connection

The gravity link from the Kovié storage facility constitutes the primary coverage framework for the West of Upper-Lomé and allows for a gravity transfer to Lower-Lomé, via the storage site planned for Bd du 30 août. The reinforcement of this link will be planned according to the evolution of the needs - This link participates directly in the coverage of the north-west of Greater Lomé, and will be considered in the detail of the investments as a structuring pipe of distribution.

Figure 17 : Connection pipe Kovié - Noépé - Sanguéra (high floor)





4.3.7 Sizing and implementation

The plans associated with the report show the projected water supply installations by horizon, and the nomenclature of the installations shown corresponds to the lines of the investment plans presented in Chapter 7.

Plan 1: Conveyance from the projected new resources (horizon 2025)
Plan 2: Conveyance from projected new resources (to 2028)
Plan 3: Conveyance from projected new resources (to 2030)
Plan 4: Conveyance from projected new resources (to 2035)
Plan 5: Conveyance from projected new resources (horizon 2040)
Plan 6: Conveyance from projected new resources (Horizon 2045)
Plan 7: Conveyance from projected new resources (horizon 2050)
Plan 8: Functional synoptic diagram

4.3.7.1 The conveyance pipes

The installation of the pipes is done along public rights-of-way. The sizing are based on a roughness value of 1 mm to take into account the specific load losses and their aging. The modeling is done dynamically on the hydraulic model, considering an operation of the pumping stations during 22h/24h. The calculations presented in ***Appendix 1***, integrate the protection against the transients as requested in the Terms of Reference. The definition of protection measures against breakage, important for this type of long gravity conveyance (overspeed valves, relief valves) will be taken into account at the preliminary design stage.

4.3.7.2 The treatment stations

A. East wellfield traetment unit (40,000 m3/d)

Additional studies must specify the conditions for exploiting the Continental aquifer in this area, which is already exploited by the company that manages the extraction and processing plant for the Hahotoé-Kpogamé phosphates.

Taking into account the water losses of the treatment unit, estimated at 3% of the raw water volume, the flow rate to be extracted will be approximately 2,000 m3/h. Assuming a unit flow rate of 100 m3/h, about 20 boreholes will be necessary. They will deliver the raw water to the plant in a municipal DN 800 pipe.

Assuming that the raw water is not salty but high in iron, the principle of a biological deferrisation process is retained as it exists in Caccavelli, including the following installations:

- Aeration cascade ;
- Sand filtration and lime remineralization;
- Chlorination and storage tank for treated water

The proposed site for the treatment is located on a topographically high point, on the site of the loading water tower, in Hahotoé. An area of approximately 5,000 m2 will be required for this site.

Figure 18 : Projected traetment site in Hahotoé

B. Desalination unit (four tranches 2 x 100,000 m3/d then 2 x 150,000 m3/d)

B1. Raw water conveyance and brine rejection

The solution is based on the implementation of a reverse osmosis treatment on specific membranes. A pre-treatment step is necessary to guarantee the durability and integrity of the membranes.

In addition to the conversion rate of the membranes, representing the flow of water produced on the flow of concentrates produced, the various process stages generate water losses due to washing in particular, which must be integrated into the volumes to be treated.

The assumptions taken into account for the hydraulic sizing take into account a water loss of the order of 100% linked to the conversion rate of the membranes (of the range of 45 to 50%) and to the water losses on the pre-treatment stage (of about 3 to 5%). A hydrodynamic dilution model will have to be carried out in the pre-desalination studies to confirm the lengths of the outfalls.

The raw water flows retained are therefore the following:

- Per 100,000 m3/d : 10 000 m3/h.
- Per 150,000 m3/d : 15 000 m3/h.

For each 100,000 m3/d, it is planned to :

An offshore outfall to capture raw water offshore, whose main characteristics are:
Offshore immersion depth (offshore): - 10 m.
- Length: 1,200 ml.

- Ø : 1500 mm.
- Installation at the plant site: pumping well 10 m deep.

A raw water pumping station for a total flow of 10,000 m3/h

A brine discharge pipe with a maximum flow rate of 5,000 m3/h. The pipe is longer in order to reach a depth of -15 m and thus promote the release of brines at depth; the objective is not to contaminate the raw water outfall inlet. Depth of immersion in the sea (offshore): - 15 m.

- Length : 2000 ml.
- Ø : 1300 mm.
- Starting installation: Suction tank on the plant site.

For each 150,000 m3/d it is planned:

An outfall at sea to collect raw water, whose main characteristics are:
Depth of immersion at sea (offshore): - 10 m

- Length : 1,200 ml.
- Ø : 1,800 mm.
- Arrival installation: pumping well of 10 m depth.

A raw water pumping station for a total flow of 15,000 m3/h

A brine rejection pipe with a maximum capacity of 7500 m3/h:
Depth of immersion in the sea (offshore): - 15 m.

- Length : 2,000 ml.
- Ø : 1,500 mm.
- Starting installation: Suction tank on the plant site.

B2. Desalination treatment

Datas on water quality

The project is characterized by:

- A production of 100,000 m3/d based on Reverse Osmosis desalination technology, followed by three other tranches of respectively, one of 100,000 m3/d and two of 150,000 m3/d;
- An offshore catchment;
- A rejection of the brines in the natural environment, offshore;
- Direct supply of the produced water and storage in the various existing and planned reservoirs.

Subject to verification during the necessary complementary surveys to be planned in the studies prior to desalination, we shall retain for the coastal waters of the littoral, the presence of a significant pollution:

- A high turbidity of marine waters and a high concentration of SS;
- Heavy metal pollution of marine waters and sediments.

Specific pollution due to port activities and urban discharges, as well as a risk of hydrocarbon pollution, will probably be added. In order to control this last risk and to limit potential damage to the installed equipment, a hydrocarbon detection system should be installed at the entrance to the treatment plant. A hydrocarbon pollution will lead to the stopping of the production of drinking water.

The quality of the raw water is a fundamental component for the production of osmosis water, additional analyses near Lomé and the sampling outlet will be required.

<u>General description of the channel</u>

The process includes a pre-treatment stage to achieve a maximum turbidity of 0.1 NTU at the membrane inlet :

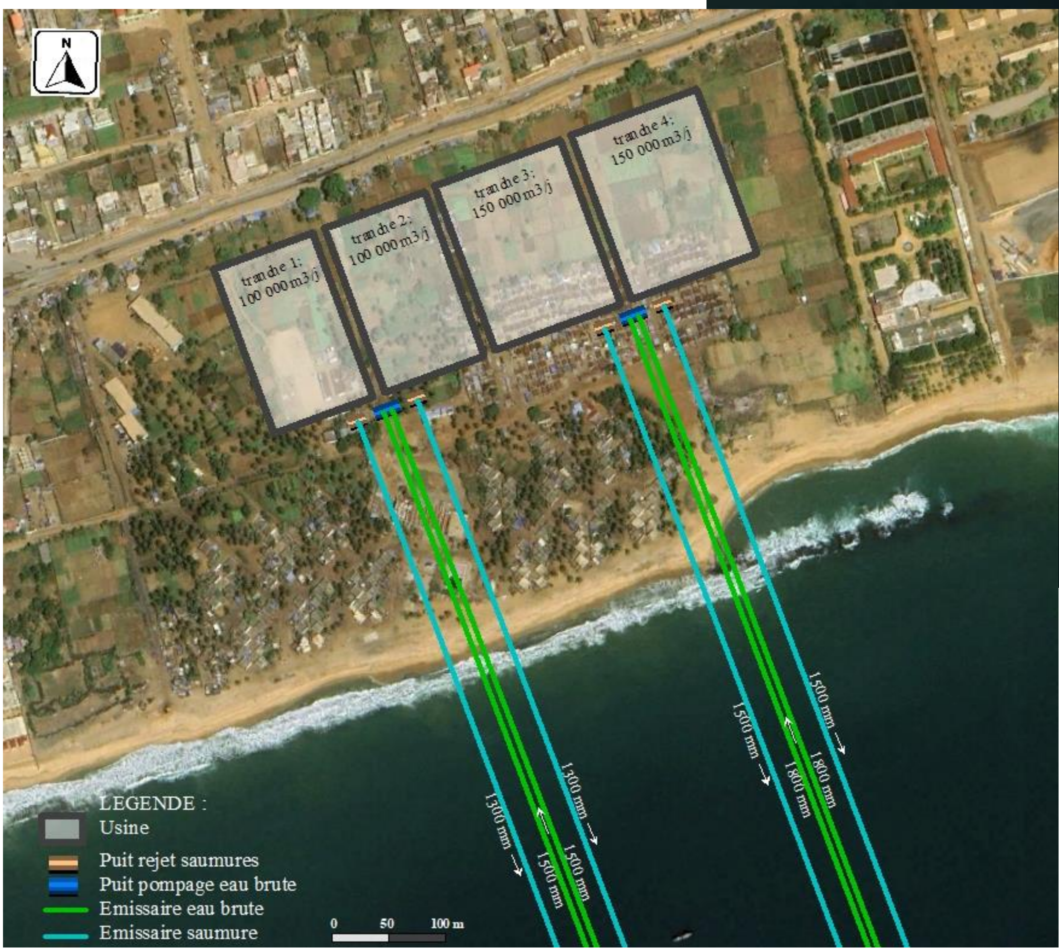
- Raw water collection by sea outfall feeding a pumping well located on the plant site;
- A screening chamber with two stages in series of 6 mm then 2 mm;
- A coagulation and flocculation stage;
- A dissolved air flotation stage;
- Two filtration stages in series: horizontal bi-layer filters under pressure;
- A set of cartridge filters (filtration threshold 5 µm);
- A pumping tank for the feeding of the reverse osmosis membranes;
- A reverse osmosis stage including a CIP and energy recovery device;
- A water remineralization device by adding lime + CO2;
- A chlorination and pumping tank for the treated water;
- A storage tank for brine and discharge of brine into the sea through a dedicated outfall
- A dehydration device for sludge from the pre-treatment stage;
- It is specified that the separation of the algae is ensured by a specific stage of flotation with dissolved air.

B3. Implementation

The implantation is envisaged on the coastal parcel of the "Site of Tropicana" in Baguida, with a surface of more than 28 ha, it allows to set up the evolution of the process according to the various defined stages; the needs in space are defined as follows :

- approximately 15,000 m2 for every tranche of 100,000 m3/d ;
- approximately 20,000 m2 for each tranche 150,000 m3/d.

Figure 19 : Project for the establishment of the successive stages



C. Zio treatment unit (~88 000 m3/d)

C1. Raw water conveyance

The exploitation of the ZIO involves the construction of a dam. The treatment unit will be supplied from a pumping station to be built near the reservoir. Considering the water losses of the treatment unit, estimated at 5% of the raw water volume, the total flow to be taken will be about 4,725 m3/h ; The principle of conveyance is the following :

- Installation of a dewatering station from an intake in the dam;
- Establishment of the treatment plant at the high point, about 5 km from the dam.

C2. Traetment

The hypotheses are based on water containing iron, manganese, nitrogen, organic matter, low to medium turbidity and occasionally pesticides. It should be noted that in a context of global warming, eutrophication and the presence of algae associated with this phenomenon should be taken into account. It is assumed that the water is weakly mineralized and that a complete remineralization is carried out.

The planned process is as follows on two lines of 45,000 m3/d in parallel :

- Aeration waterfall ;
- Coagulation/flocculation installations ;
- Flotation installations ;
- Sand filtration ;
- Activated carbon filtration ;
- Remineralization with lime + CO2 ;
- Chlorination ;
- Storage tank for treated water.

C3. Establishment

The establishment of the treatment plant is planned at the level of the topographic high point, at about 5 km from the dam; a surface of about 20,000 m2 will be necessary.

Figure 20 : the Zio near the future dam

D. Mono treatment unit (production capacity of 400,000 m3/d in two tranches of 200,000 m3/d each)

D1. Raw water conveyance

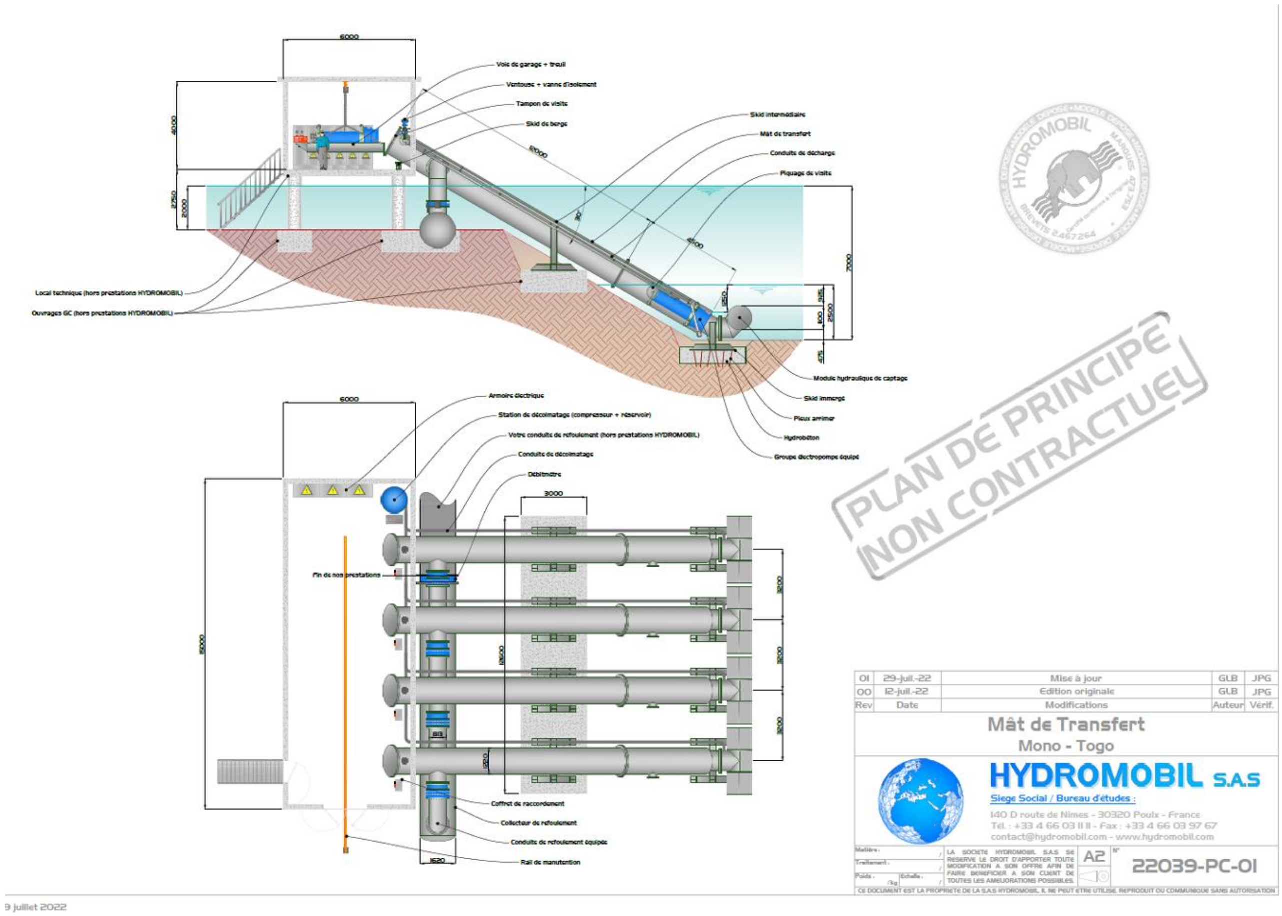
The hydrological regime of the Mono is regulated by the Nangbeto dam. On its downstream river course (Tététou), the Mono is marked by a flood season between July and October and by a relatively regular regime from December to June. This does not prevent the Mono from experiencing severe multi-year low flows, which lead to much lower flows in the dry season.

At this stage it is planned to :

- Construction of a water intake in the river;
- Pumping of raw water by three pumps + 1 emergency pump of 3,500 m3/h unit;
- 4 discharge pipes of DN 800 joining the discharge collector in DN 1400.

The water intake may be of the "hydromobil" type, composed of tubular structures that allow the electric pump units to be positioned below the lowest water level.

Figure 21 : Schematic drawing of the water intake



On this type of water intake, the transfer masts are used as discharge pipes, as a guide when handling the units and as protection against floating bodies.

The pumps mounted on hydrochars are accessible from the bank, thus facilitating maintenance. The pipes, valves, various equipment and the electrical cabinet are installed nearby.

D2. Traetment

The assumptions are based on water containing iron, manganese, nitrogen, organic matter as well as a more or less important turbidity depending on the season.

It is also assumed that the water is weakly mineralized and that a complete remineralization is performed.

The process envisaged is as follows for two lines of 100,000 m3/d in parallel and for each 200,000 m3/d tranche:

- Aeration waterfall ;
- Coagulation/flocculation installations ;
- Settling installations ;
- Sand filtration ;
- Remineralization with Lime ;
- Chlorination system ;
- Chlorinated water storage tank.

Figure 22 : Principle plan of the treatment establishment

D3. Traetment

The plant will be located slightly away from the water intake so that it is outside the floodplain and close to the existing track.

A total area of about 30,000 m2 will be required for each 200,000 m3/d production unit.

4.3.7.3 Case of the Dam on the Zio River

The feasibility of building the Zio dam was studied in 1991, during the previous Drinking Water Master Plan. It was designed for a storage volume of 50 million m3, this volume was confirmed by the Resource Study (Deliverable 6). The elevation of the normal reservoir is 71 m, level of Togo.

The geological and geotechnical surveys carried out showed that:

- The construction of an embankment dam does not pose any particular difficulty in terms of foundation and watertightness;

- there is sufficient material in the reservoir right-of-way that is suitable for the construction of earth dike, and this material is sufficiently plastic to guarantee the watertightness of the dam.

For the normal reservoir level, the dike will be about 1,280 m long, with a maximum height of 12.5 m and an upstream flooded area of about 11 km2.

Figure 23 : Flooded area

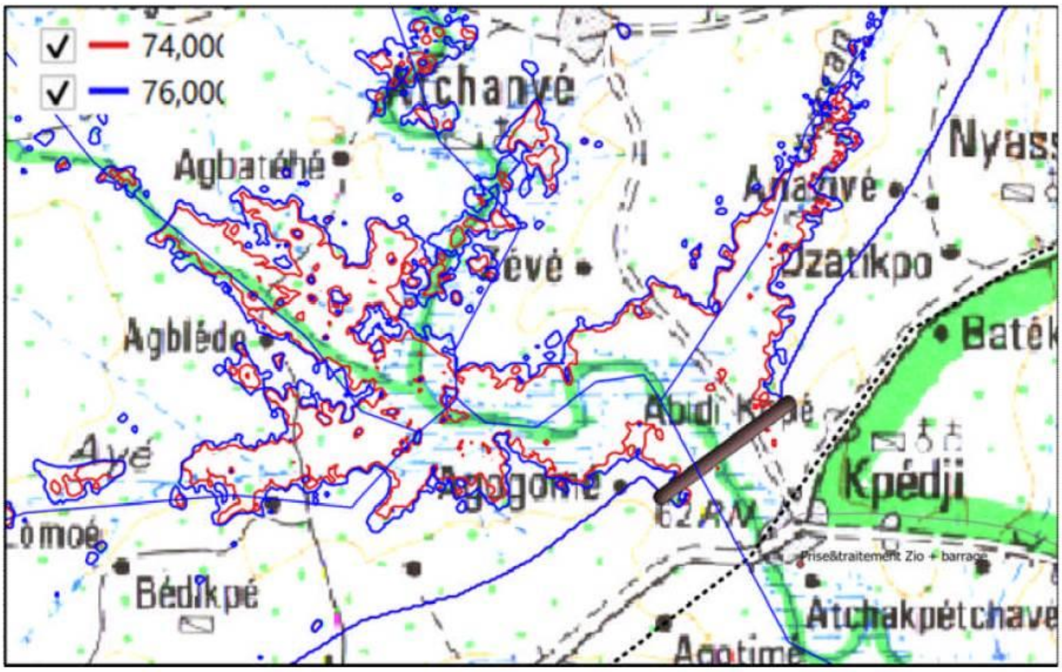
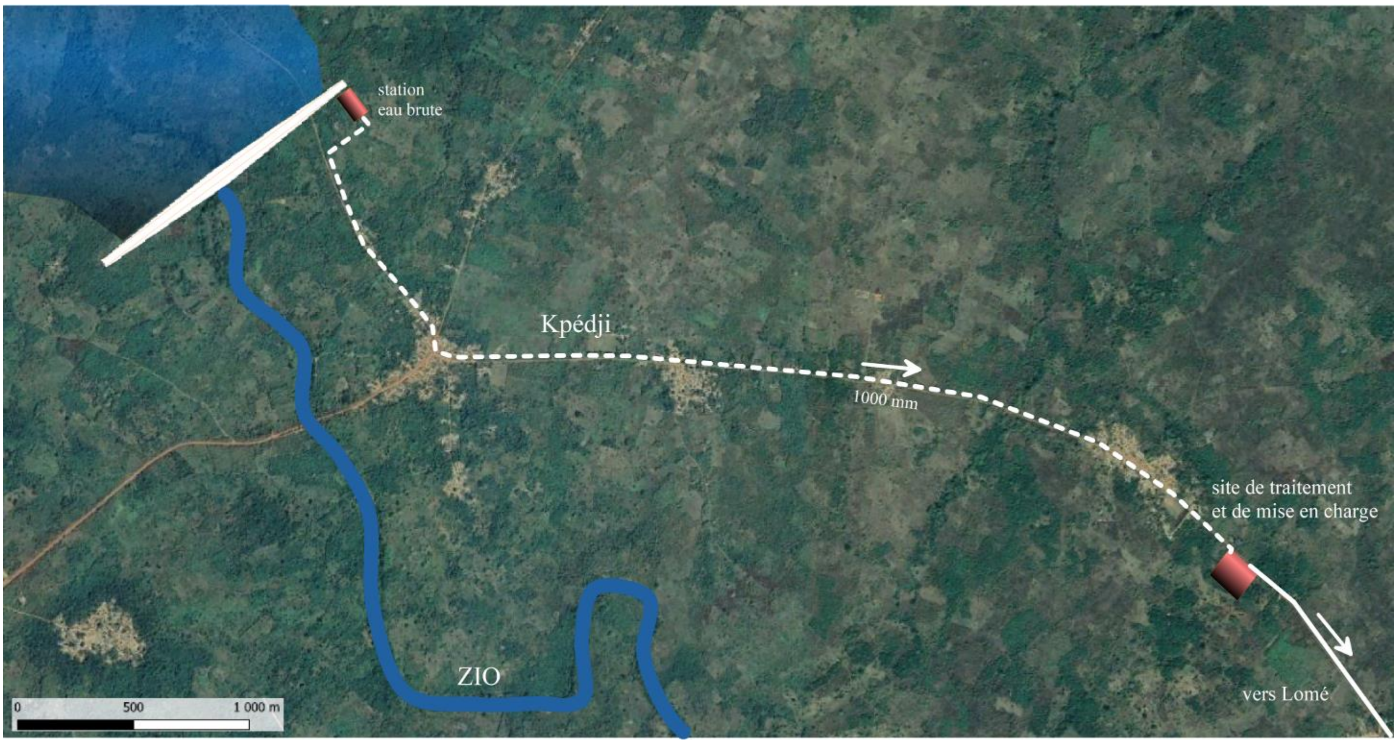


Figure 24 : Schematic location of the infrastructures



4.3.7.4 Case of the eastern wellfield

The following figure shows the location of the boreholes in the Vogan sector. There are 12 installations operated by the Togolese national phosphate company (SNPT).

It is necessary to carry out a complementary study in order to define how the existing withdrawals can be articulated with the new withdrawals envisaged for the supply of Lomé, i.e. 40 000 m3/d.

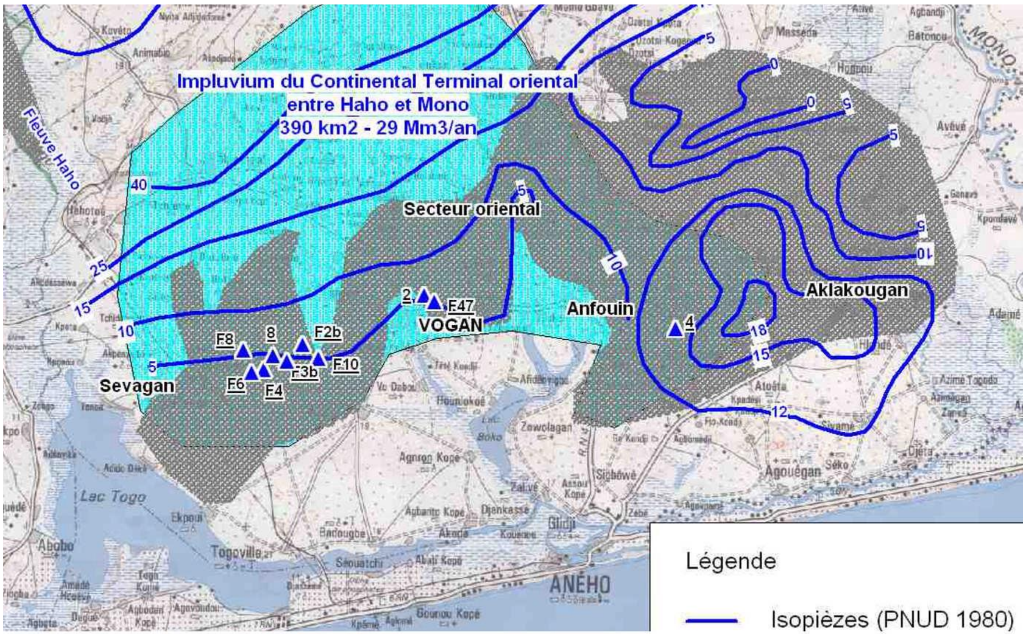
It is recommended that two reconnaissance boreholes be drilled with a design close to the final boreholes. This step seems essential to verify the durability of the resource as well as the quality of the water exhaled during the exploitation phase.

These installations will allow :

- to carry out pumping tests of long duration (48 to 72 hours) to estimate the permeability of the aquifer;
- to check the sustainability of the resource and its quality at the beginning and at the end of the pumping tests in representative pumping conditions;
- to dimension the interactions between the wells. The definition of a minimum distance between wells is necessary. The use of a groundwater model is desirable.

The Continental Terminal groundwater should be targeted as a priority. However, it would be useful to take advantage of reconnaissance drilling to investigate the Paleocene locally. A specific protocol would then be proposed.

Figure 25 : Location of existing boreholes - general piezometry



4.3.7.5 Storage and pumping facilities

The pumping stations and storage facilities involved in the transfer of raw or treated water were presented as part of the conveyance system description.

The storage facilities and pumping stations at the interface between the supply and the coverage contribute to the storage balance, as presented on the ***Table 5***.

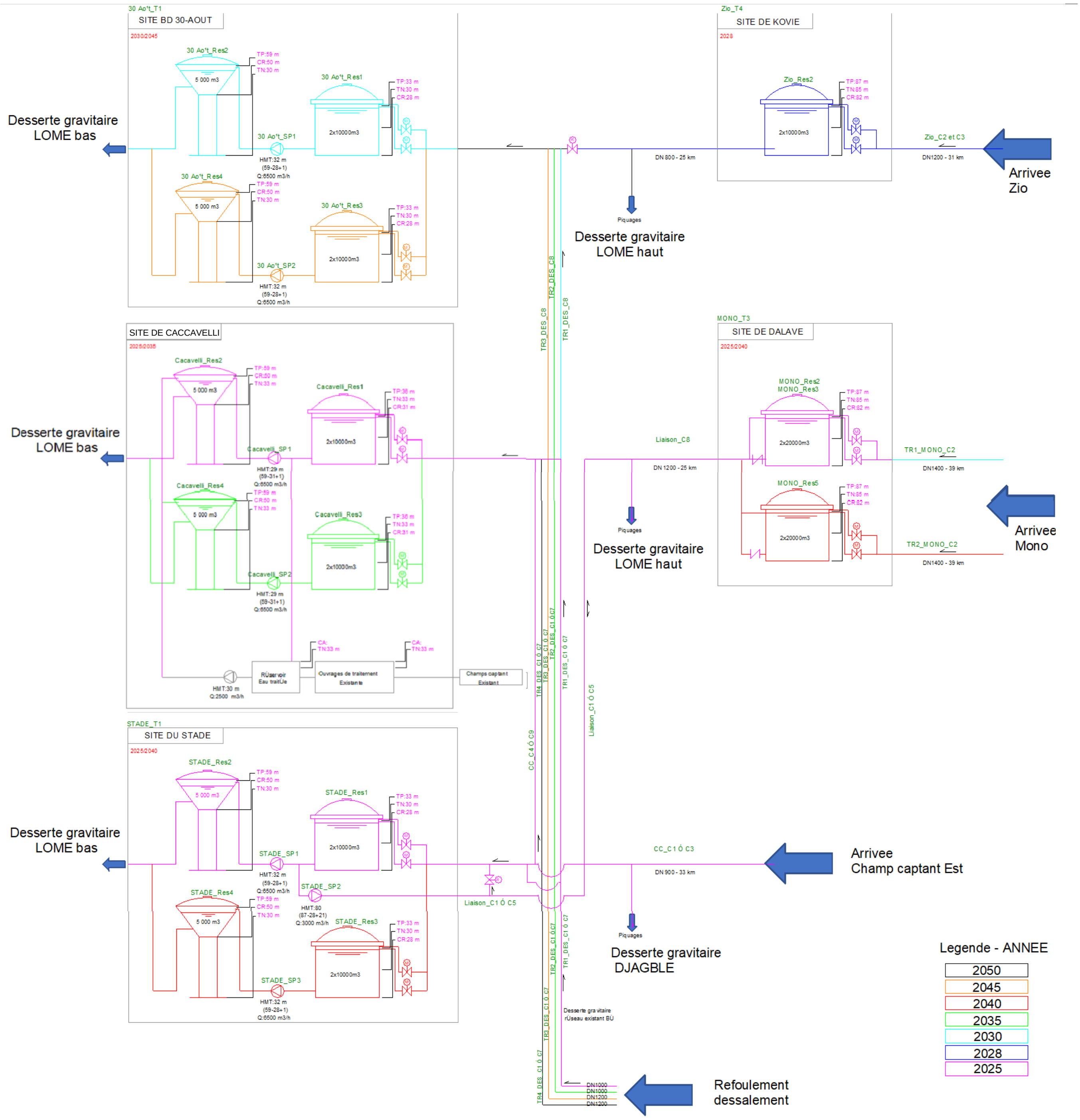
Five sites are planned to receive these infrastructures:

- Dalavé ground storage site (Mono resource) – 4 x 20,000 m3 at the end for gravity-fed coverage of Upper East-Lomé and exchanges with Lower-Lomé (Stade site);
- Kovié ground storage site (Zio resource) and possible top-up from the Mono in the long term - 20,000 m3, for gravity-fed coverage of Upper West-Lomé and exchanges with Lower-Lomé (Bd 30-août site);
- Ground storage site at the Stade 2 x 20,000 m3 + water towers for gravity supply to lower-Lomé 2 x 5,000 m3 at term. The water towers are supplied from the ground reserves by two pumping stations - one pumping station also allows for delivery to the Dalavé storage site, in accordance with the exchange needs between floors, presented above ;
- Ground storage site of Caccavelli 2 x 20,000 m3 + water towers for gravity coverage of Lomé Bas 2 x 5,000 m3 in at term. The water towers are supplied from the ground reserves by two pumping stations - the existing pumping

station associated with the treated water from the existing boreholes is connected to the water towers for loading into the coverage network ;

- Ground storage site on the 30 Août boulevard with 2 x 20,000 m3 + water towers for gravity coverage of Lower-Lomé with 2 x 5000 m3 at term. The water towers are supplied from the ground reserves by two pumping station.

Figure 26 : Extract from the functional synoptic of the conveyance systems - Plan 8 flow rates and altimeter values



The concerned sites will have to be acquired or reserved in the very short term, taking into account the urbanization. It should be possible to install the installations on the Caccavelli site in the existing enclosure, provided that the F9 and F13 boreholes operated there are taken out of service. The need/resource balance takes into account this provision.

Figure 27 : Planned installations - Caccavelli site

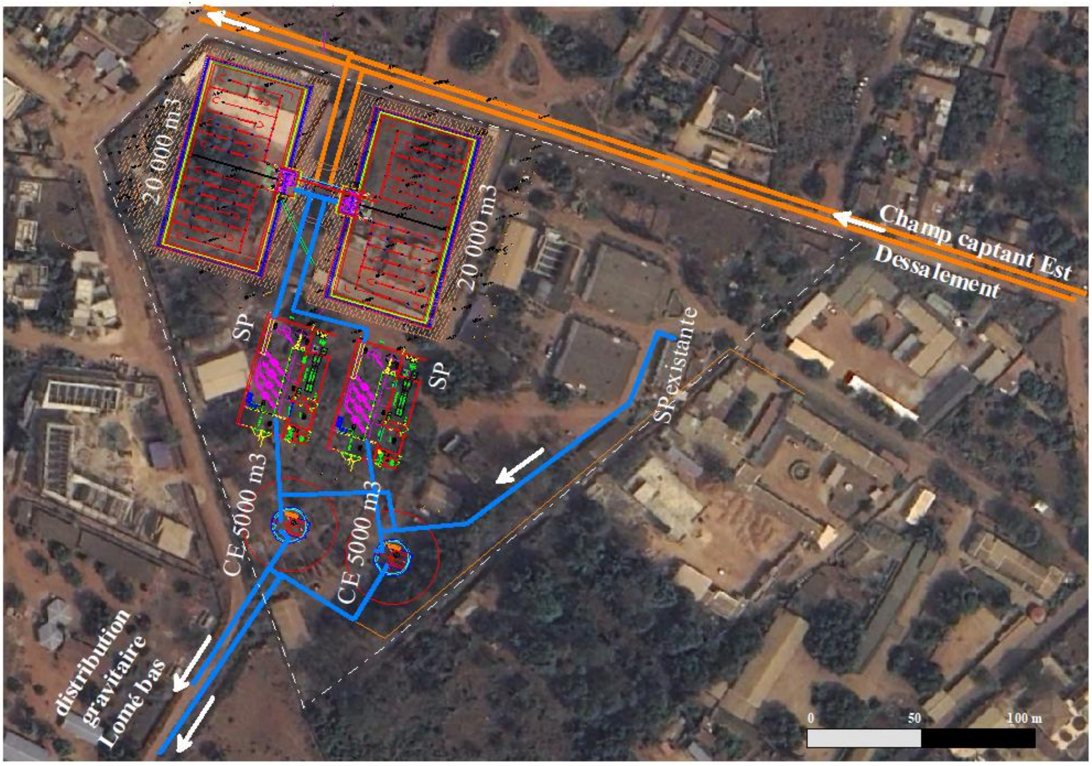


Figure 28 : Planned installations - Stadium site (~45,000 m2)

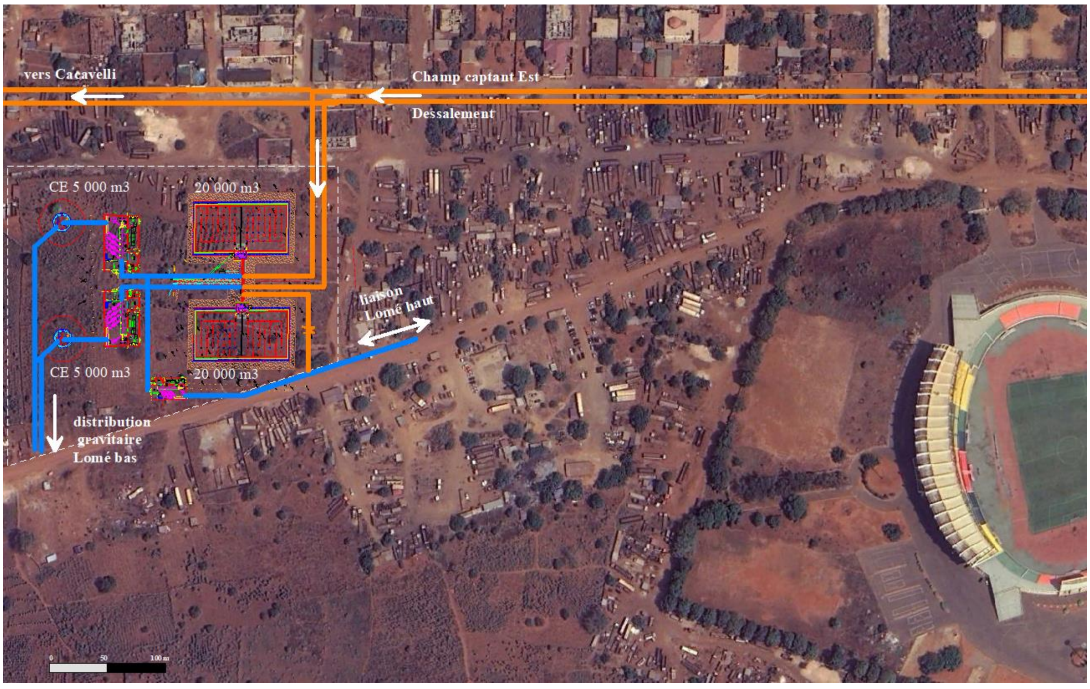


Figure 29 : Planned installations - Site of the bd du 30-août (~45,000 m2)

Except for Caccavelli, the sites presented here indicate schematically the rights-of-way necessary for the planned installations. They have not been the subject of a land survey. Alternative locations may be sought in a nearby area.

Figure 30 : possible alternative sites near bd 30-août

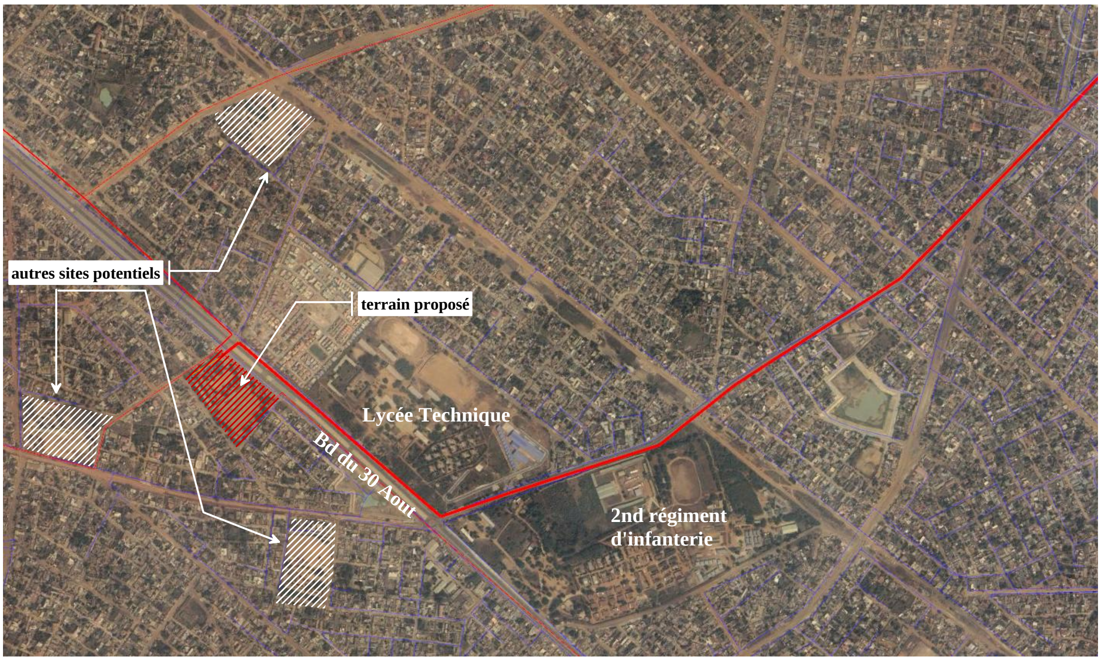


Figure 31 : Planned installations - Dalavé site (~60,000 m2)

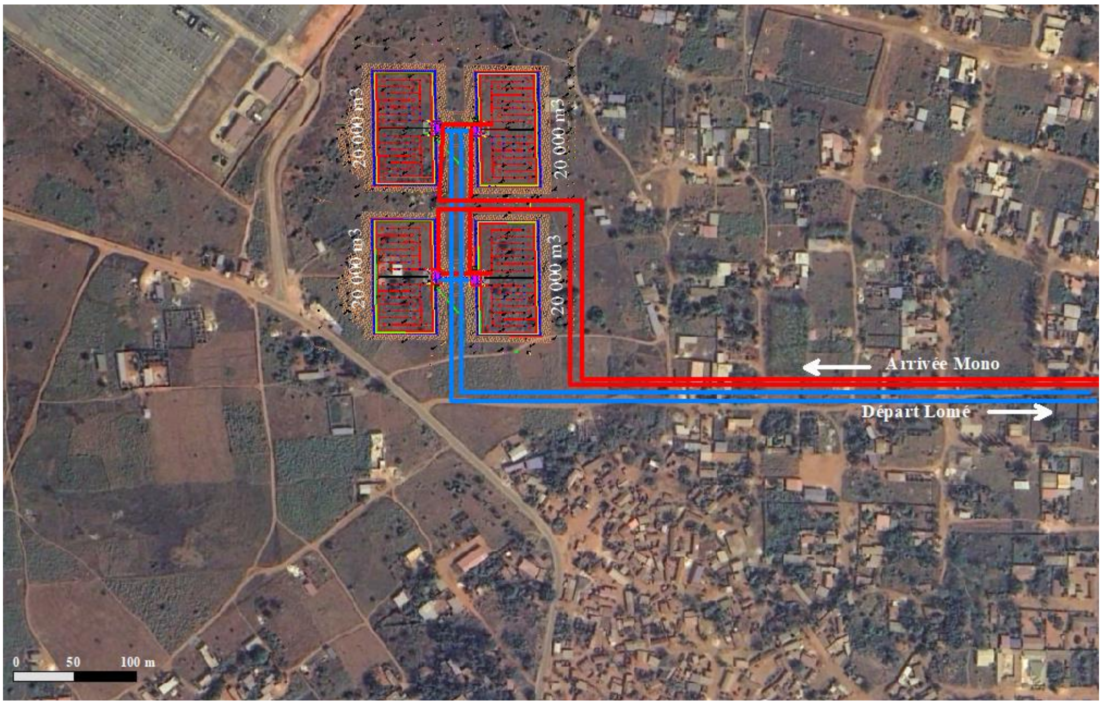


Figure 32 : Projected installations - Kovié site (~15,000 m2)

5

Distribution-related infrastructures

5.1 Restructuring of the coverage network

Today, the resource comes from existing groundwater and is injected into the distribution network by pumping, after treatment, from the Caccavelli pumping station. Within the framework of the PURISE project, local distributions have been created on the outskirts of the Lomé network to extend the coverage area, using boreholes and small water towers for loading.

The new resources and their conveyances will make it possible to structure the distribution network on a large scale, giving priority to a gravity-fed coverage mode. The infrastructures created and operational within the framework of the PURISE project will be preserved, as well as the complementary infrastructures currently being equipped - the coverage areas concerned being naturally sectorized - the supply of the small water towers will be systematically secured by a connection to the new structuring network

5.2 Two pressure stages

As mentioned earlier in the report, the variation in topography between the north and south of Greater Lomé justifies the separation of the geographical area to be served with drinking water into two main pressure levels.

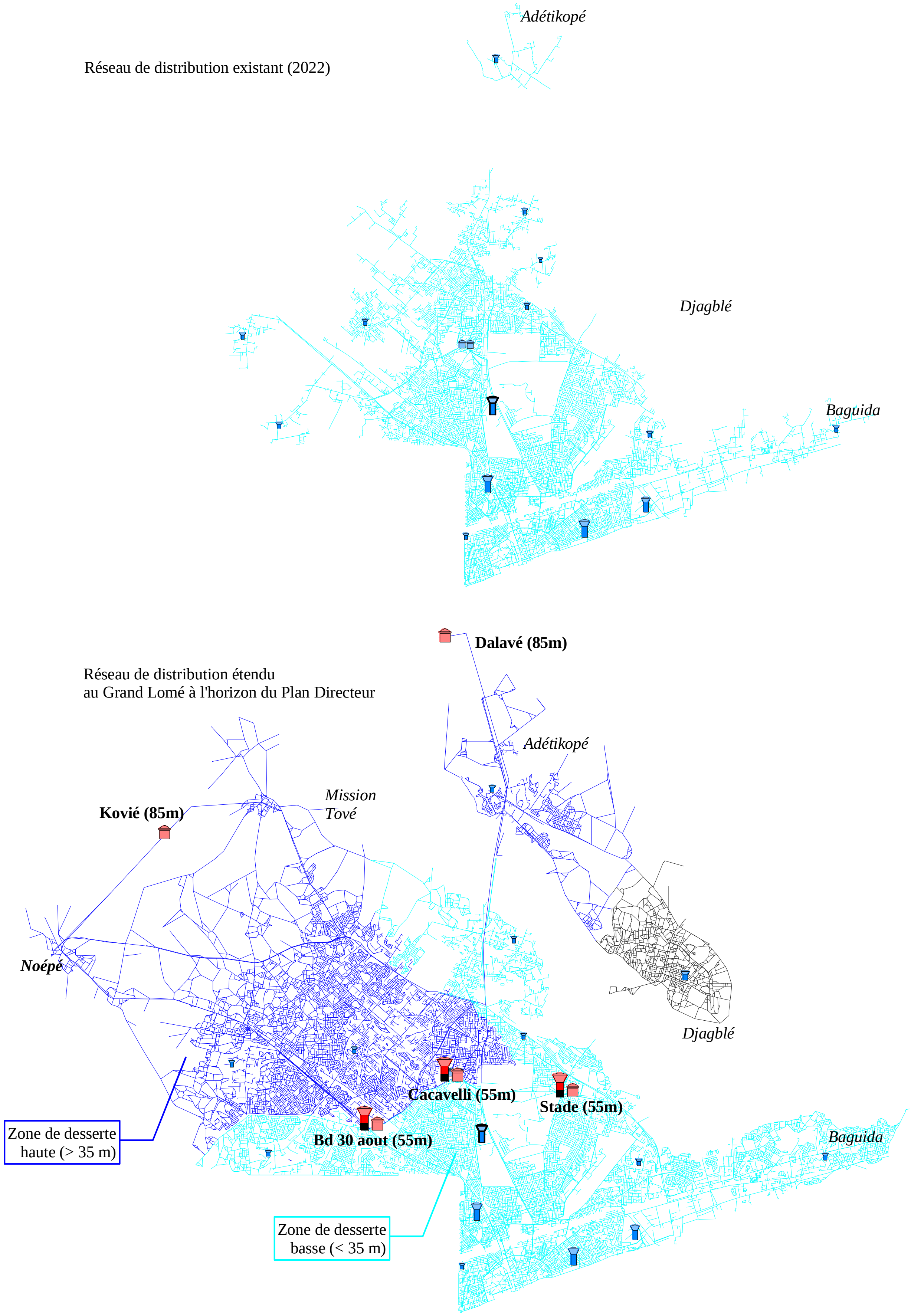
The following figure represents:

- on the one hand, the extent of the current network, forming an interconnected assembly;
- on the other hand, the extension of the network extended to the project horizon, divided into two zones.

In the eventual configuration, the Upper-Lomé zone will be supplied by loading from the ground storage tanks (elevation ~85 m) planned at Dalavé and Kovié. The Lower-Lomé zone will be served by a loading from the water towers (elevation ~55m) planned on the three sites of Caccavelli, Stade and Bd du 30-août.

The case of Djagblé-Sud is particular, in current operation, the coverage could be done by road, from the planned water supply from the wellfield to be developed in the East. In case of interruption of this conveyance, a gravity coverage from Adétikopé will be provided.

Figure 33 : Sectorization Upper-Lome/Lower-Lome



5.3 Upper/lower zone sectorization

The connection of the new structural service pipes to be supplied from the new resources will have to be accompanied by the materialization of a watertight "border" between the zones of Upper-Lome and Lower-Lome, for the future service network and taking into account the existing network.

The proposed border follows the ECOWAS expressway from the north, crosses the Agoé-Kitidjan neighborhood from north to south, crosses the Gnassingbé-Eyadema boulevard from east to west, in front of the Togolese Armed Forces grounds, and circumvents the Caccavelli site from the north. The border then follows the Adjidoadin boulevard right-of-way to the west, crosses the 30-August boulevard, and then follows the road right-of-way to Segbé.

Figure 34 : Materialization of the upper/lower zone boundary

5.4 Reinforcement and extension of the structuring network in the lower zone

The low area to be served extends from east to west, for more than 30 km. The Caccavelli site has the advantage of being central, of being the point of convergence of the production of the currently operated wells and of being the starting point of the pipes of the current structuring network.

The Caccavelli site will remain an important site in the planned infrastructure, with the arrival of new surface resources to complement the groundwater resources, with new storage and loading capacities, as described in the chapter related to conveyances. The existing delivery pumps, given their characteristics (flow rate/Hmt) will be connected to the first water tower for loading to be planned on the site in the short term.

With the arrival of new resources, the Caccavelli loading site must be reinforced to the east (Stade site) and to the west (bd 30-août site) by two other loading sites, in order to balance the coverage piezometry. **The structuring coverage network will be built progressively from these three loading points**.

5.4.1 Structuring axes of the lower zone

From the Caccavelli site, the central axis to be strengthened is the one that follows the right-of-way of Eyadema Boulevard to Colombe-de-la-Paix, by taking over the piquages on the road, particularly towards the East (Bé). The University reservoir, if it is to be used, will only be used for the University's own needs; the structuring network on Eyadema Boulevard will bypass this reservoir.

Two structuring axis will have their departure from the site of the Stadium, by the bd Jean-Paul II :

- One towards the south, along the bypass (Expressway) until the lagoon (East lake), this axis will then take the direction of Baguida towards the East;
- One towards the north, always along the bypass (Expressway) until it intersects the route of the Eyadéma Boulevard, this axis will then take the direction of Adétikopé.

From the 30-août site, the structuring axis will follow the right-of-way of the 30-août boulevard, then the right-of-way of the Victory boulevard to the Armed Forces boulevard, in the north of the lagoon.

The mesh of these three structuring axes is made along the bd des Armées, in the north of the lagoon. From this mesh, four outlets feed the south lagoon :

- Bd de la Victoire ;
- Av. Maman N'Danida ;
- Av. Augustino de Souza ;
- Rue Abloda.

Coverage antennas are connected to each of the existing tanks on Lower Lomé.

5.4.2 Case of the old Lomé sectorization

The design of the outlets based on the network of the main axes and the main coverage antennas proposed make it possible to divide the southern zone into 8 sectors. Where reservoirs exist, they are used to charge and regulate the pressure of the sectors to which they belong. Where no reservoir exists, the sectors will be controlled by a downstream pressure stabilizer.

Figure 35 : Materialization of the sectors' limits

1. Tokoin reservoir area
2. Boka reservoir area
3. Administrative area
4. Downtown area
5. Bassadji area
6. Bé reservoir area
7. Gbényédji area
8. Bé Port reservoir area

This area is a priority in terms of network renewal, given the materials found there: steel, grey cast iron, asbestos, galva.

5.5 Creation of the structuring network of the upper-zone

The upper zone to be served is not or only slightly channeled, except for Agoé-Nyivé, Adétikopé and the developments around the PURISE projects of Vakpossito, Klémé and Lankouvi.

The eastern backbone network links the Dalavé storage site to the Stade site. From the Kovié storage site, the backbone network joins Lomé, on the one hand to Sanguéra, via Noépé and Aképé, and on the other hand to Legbassito, via Kovié and Mission-Tové.

Several structural links are to be created between these two axes, the most important of which is the one to be planned along the circumventing road (Expressway).

Will be supplied by gravity on the road, by tapping on these structuring axes:

- Adétikopé and North Djagblé. The south of Djagblé is planned to be served from the conveyance bringing the resource of the East wellfield to Lomé, a connection will nevertheless be planned from the Dalavé/Adétikopé structuring axis, in case of stop of the above-mentioned conveyance;
- Kovié and Mission-Tové, on the one hand, and Noépé, Aképé, on the other hand.

The structuring coverage network will be progressively reinforced from the two loading points of Dalavé and Kovié, by densifying the networks.

5.6 Evolution of the structuring network

The short-term priority is to take into account future new resources planned to improve coverage of existing networks by densifying them. With the additional resources and the extension of the tertiary networks to areas with little or no canalization, the restructuring of the backbone network will continue in order to extend the water supply to the entire territory of Lower Lomé, under good flow and pressure conditions.

The plans associated with the Report situate the projected installations by horizon, and the nomenclature of the installations shown corresponds to the lines of the investment plans presented in ***Chapter 7*** and in ***Appendix 3***.

Plan 9: Projected Backbone Coverage Network [2023-2030]
Plan 10: Projected Backbone Coverage Network [2030-2040]
Plan 11: Projected Backbone Coverage Network [2040-2050]

Figure 36 : Backbone Coverage Network by 2025

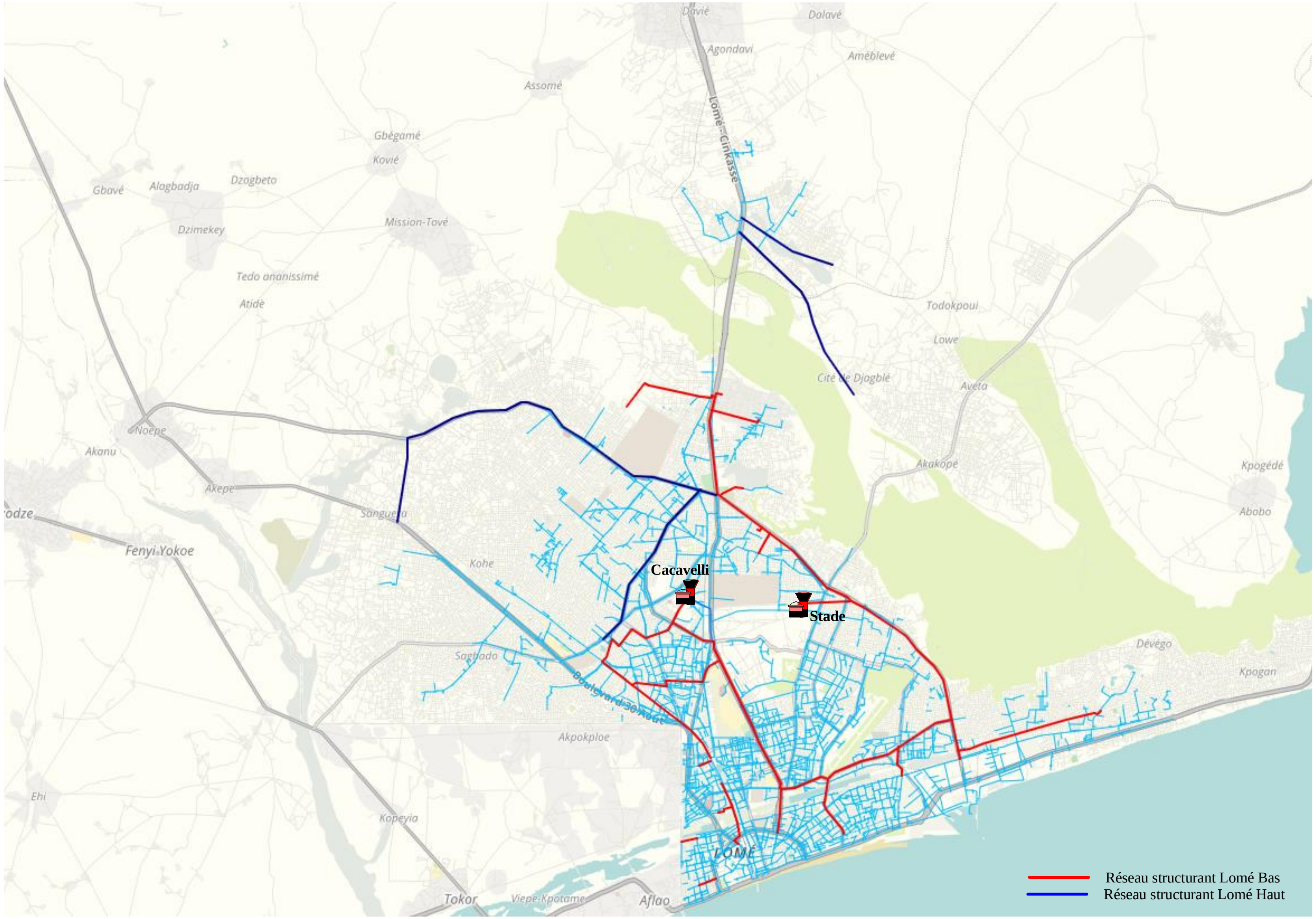


Figure 37 : Backbone Coverage Network by 2030

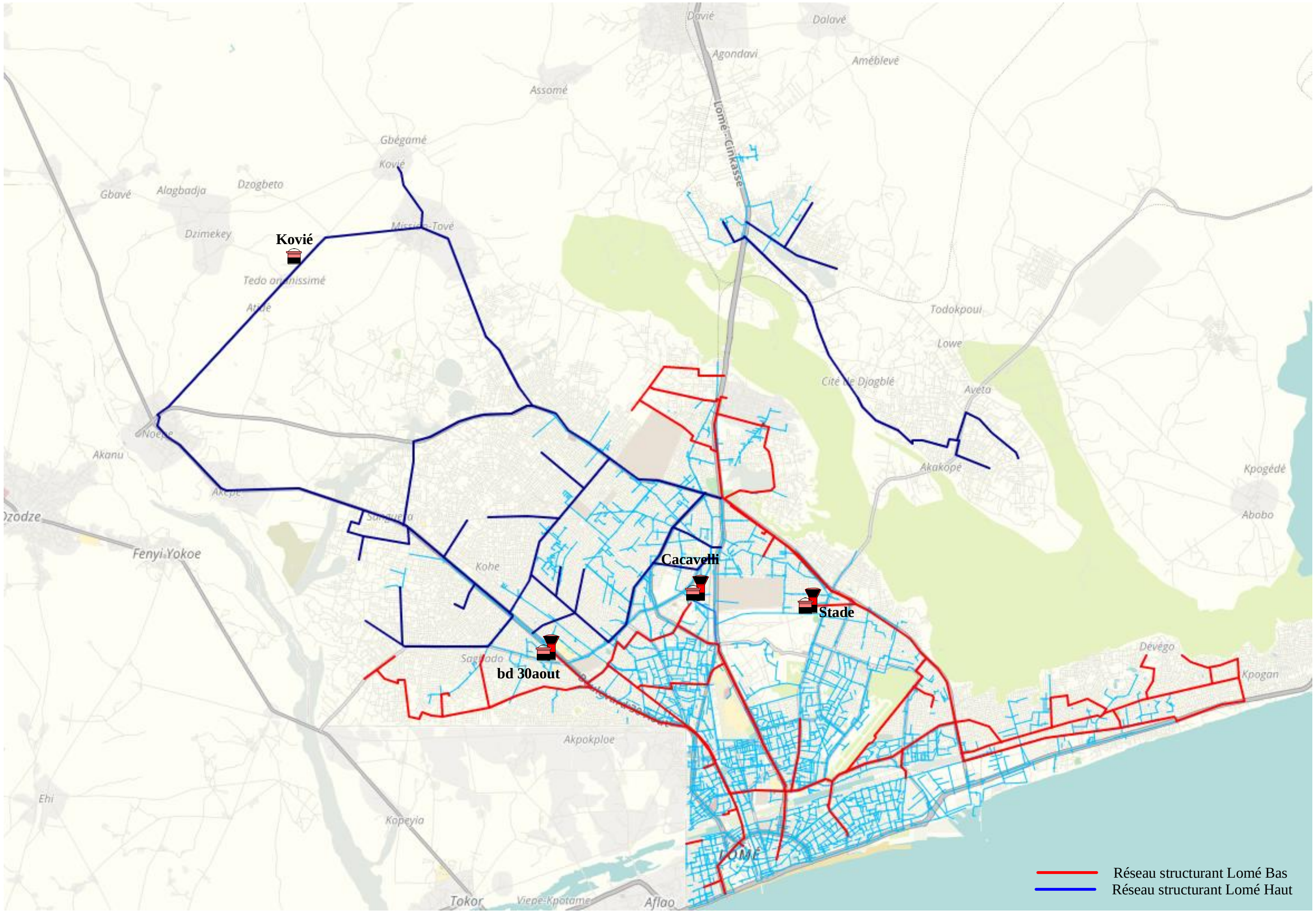


Figure 38 : Backbone Coverage Network by 2040

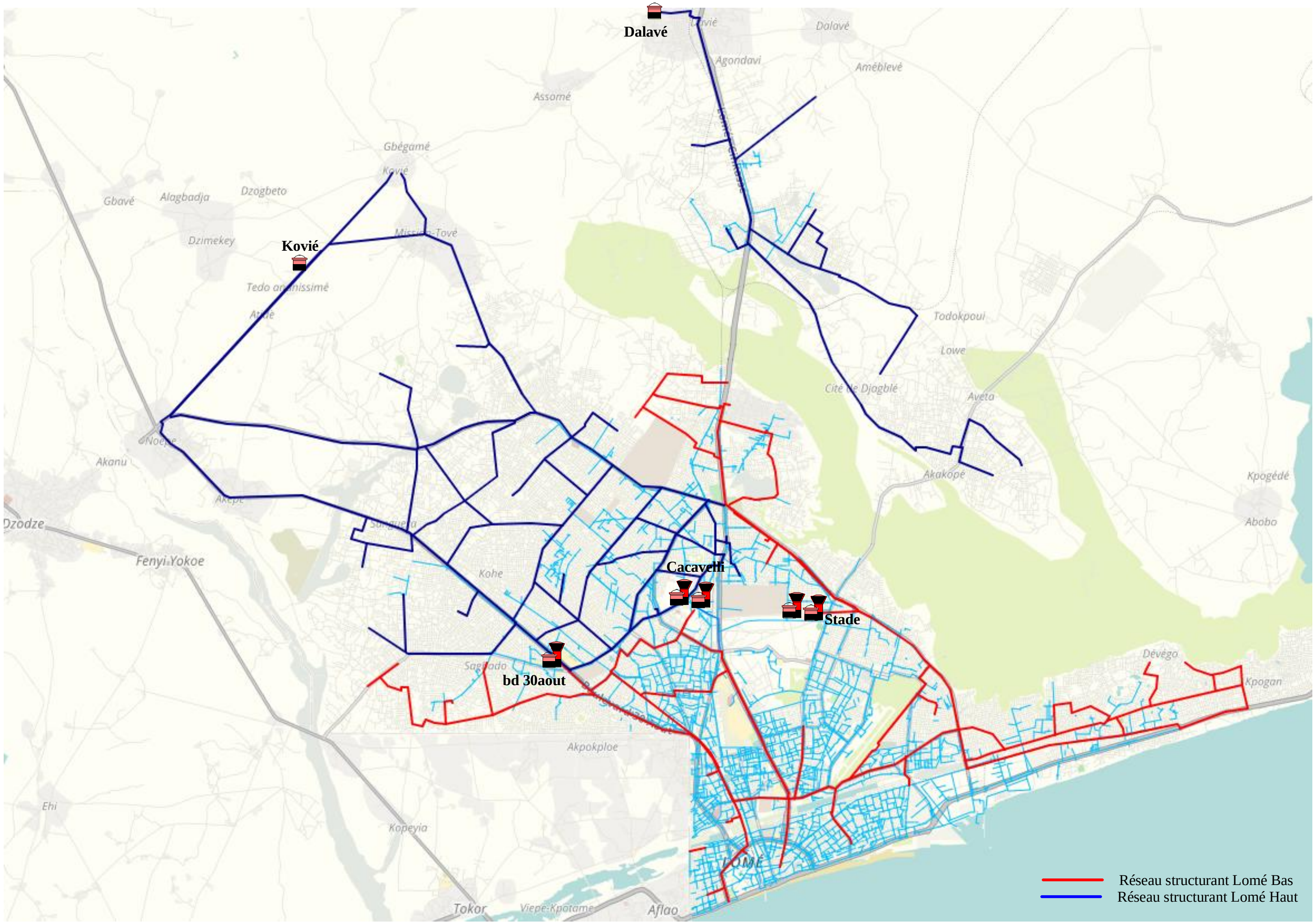
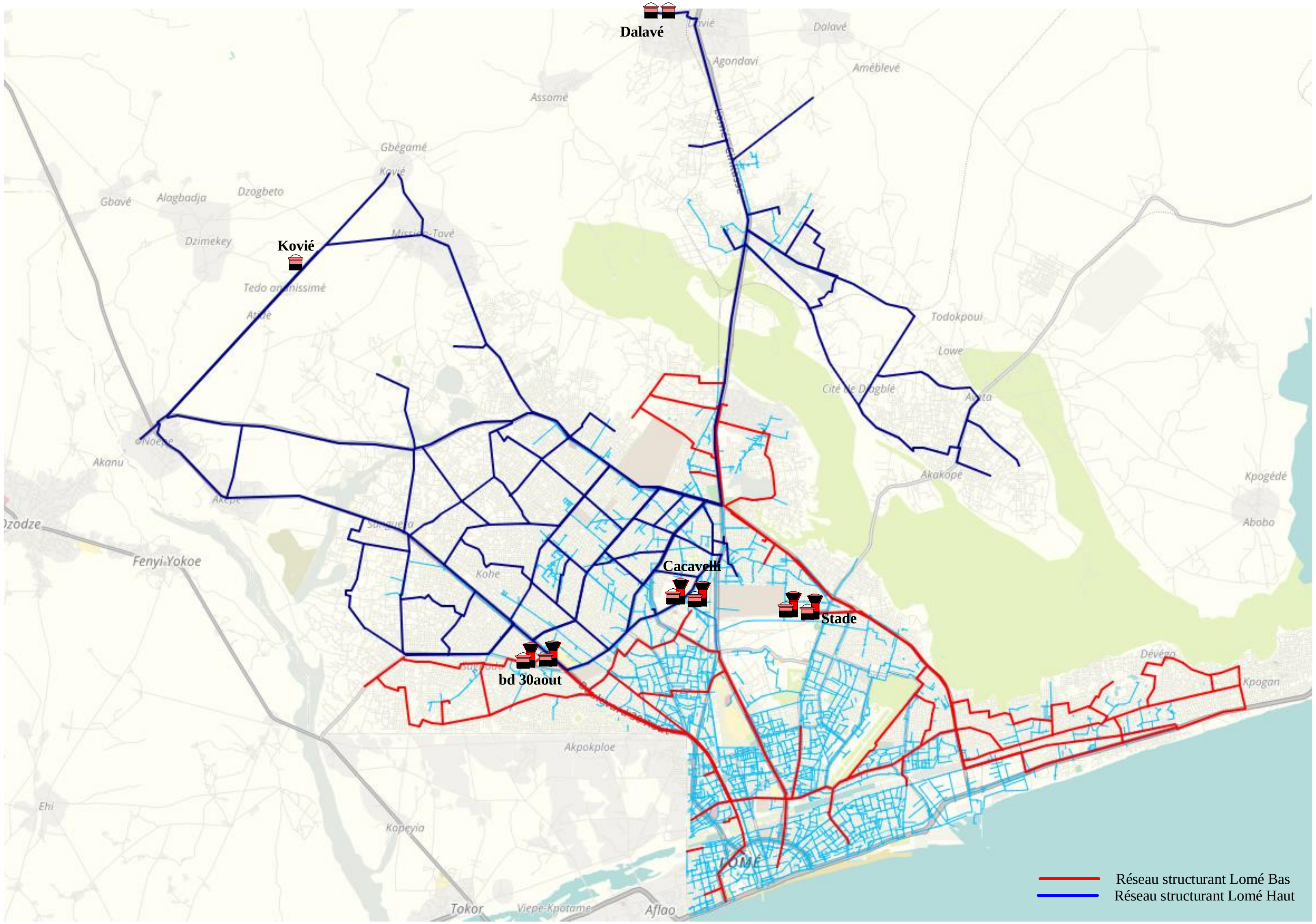


Figure 39 : Backbone Coverage Network by 2050



6

Unit costs of the installations

The purpose of this chapter is to present price ratios applicable to the various drinking water supply infrastructures and installations in order to evaluate the investment program to be carried out. The prices do not include investments for project management, studies and works control (about 12% of the works amount).

- The infrastructures and installations concerned by these ratios are essentially :
- Pipes ;
- drinking water storage tanks
- drinking water pumping stations
- treatment ;
- boreholes.

6.1 The pipes

The following pipe ratios are constructed from the latest collected Contracts for cast iron pipes up to DN 1500 mm in neighboring countries for larger diameters, between 2018 and 2020. Considering the current price increases, the item "Provision for miscellaneous and unforeseen" is priced at 20%.

These prices include:

- site installation;
- earthworks, supply of bedding and backfill materials, support and marking out;
- supply and laying of the pipes;
- supply and installation of special parts and fittings;
- concrete and structural work;
- the share of linear under pavement, including demolition and repair.

For the investment plan, the pipes are in ductile cast iron for the diameters higher or equal to 400mm. The 300mm diameter sections are made of PVC or HDPE 16 bars, the smaller diameters are made of PVC or HDPE 10 bars.

The earthwork and pipe laying takes into account:

- 3/4 soft ground and 1/4 rocky ground;
- a trench width increased by 0.6 m in relation to the diameter for pipes up to 600 mm and by 0.8 m for larger diameters;
- a trench depth related to the diameter of the pipe;
- demolition and repair of the roadway according to the route

Table 8 : Average depth of laying per diameter

$$H_{couverture} = 1 + \frac{DN}{1000}$$

$$H_{lit\_de\_pose} = 0.1 + \frac{\frac{DN}{10}}{1000}$$

$$H_{totale} = H_{couverture} + H_{lit\_de\_pose} + \frac{DN}{1000}$$

diamètre (mm)	largeur (m)	profondeur (m)
DN300	0,7	1,73
DN400	0,8	1,94
DN500	0,9	2,15
DN600	1,2	2,36
DN800	1,4	2,78
DN1000	1,6	3,2
DN1200	1,8	3,62
DN1400	2	4,04
DN1500	2,1	4,25

Table 9 : Average overall cost of pipes per linear metre for diameters over 300 mm

Diamètre (mm)	Longueur (ml)	*dont voie non revêtue*	*dont sous chaussée ou accot revêtu*	Fourniture et pose (Fcfa HT HD/ml) (*)			
				Fourniture Tuyau	*Pose voie non revêtue*	*Pose chaussée revêtue*	*Total Fourniture et pose*
DN 1500	1 m	0,5 m	0,5 m	630 000 Fcfa	212 393 Fcfa	237 593 Fcfa	1 079 986 Fcfa
DN 1400	1 m	0,5 m	0,5 m	562 000 Fcfa	193 720 Fcfa	217 720 Fcfa	973 439 Fcfa
DN 1200	1 m	0,5 m	0,5 m	420 000 Fcfa	158 845 Fcfa	180 445 Fcfa	759 291 Fcfa
DN 1000	1 m	0,5 m	0,5 m	295 000 Fcfa	127 267 Fcfa	146 467 Fcfa	568 734 Fcfa
DN 800	1 m	0,5 m	0,5 m	190 000 Fcfa	93 774 Fcfa	110 574 Fcfa	394 349 Fcfa
DN 600	1 m	0,5 m	0,5 m	115 000 Fcfa	62 313 Fcfa	76 713 Fcfa	254 026 Fcfa
DN 500	1 m	0,5 m	0,5 m	95 000 Fcfa	42 513 Fcfa	53 313 Fcfa	190 826 Fcfa
DN 400	1 m	0,5 m	0,5 m	70 000 Fcfa	34 735 Fcfa	44 335 Fcfa	149 069 Fcfa

(*) yc terrassements, hors pièces spéciales, gros oeuvre, installation de chantier

Diamètre (mm)	*Total Fourniture et pose des tuyaux (75%)*	*Installation de chantier (10%)*	*Pièces spéciales (10%)*	*Gros œuvre, Béton (5%)*	Total (Fcfa HT HD/ml) (100%)	+ Provision divers/ imprévus (120%)
DN 1500	1 079 986 Fcfa	143 998 Fcfa	143 998 Fcfa	71 999 Fcfa	**1 439 981 Fcfa**	**1 727 977 Fcfa**
DN 1400	973 439 Fcfa	129 792 Fcfa	129 792 Fcfa	64 896 Fcfa	**1 297 919 Fcfa**	**1 557 503 Fcfa**
DN 1200	759 291 Fcfa	101 239 Fcfa	101 239 Fcfa	50 619 Fcfa	**1 012 388 Fcfa**	**1 214 865 Fcfa**
DN 1000	568 734 Fcfa	75 831 Fcfa	75 831 Fcfa	37 916 Fcfa	**758 311 Fcfa**	**909 974 Fcfa**
DN 800	394 349 Fcfa	52 580 Fcfa	52 580 Fcfa	26 290 Fcfa	**525 798 Fcfa**	**630 958 Fcfa**
DN 600	254 026 Fcfa	33 870 Fcfa	33 870 Fcfa	16 935 Fcfa	**338 702 Fcfa**	**406 442 Fcfa**
DN 500	190 826 Fcfa	25 443 Fcfa	25 443 Fcfa	12 722 Fcfa	**254 435 Fcfa**	**305 322 Fcfa**
DN 400	149 069 Fcfa	19 876 Fcfa	19 876 Fcfa	9 938 Fcfa	**198 759 Fcfa**	**238 511 Fcfa**

Diamètre (mm)	*Fourniture tuyaux et pièces spéciales*	*Installation, terrassement, gros œuvre, pose, essais*	Total (Fcfa HT HD/ml)	+ Provision divers/ imprévus (120%)
DN 1500	773 998 Fcfa	665 983 Fcfa	**1 439 981 Fcfa**	**1 727 977 Fcfa**
DN 1400	691 792 Fcfa	606 127 Fcfa	**1 297 919 Fcfa**	**1 557 503 Fcfa**
DN 1200	521 239 Fcfa	491 149 Fcfa	**1 012 388 Fcfa**	**1 214 865 Fcfa**
DN 1000	370 831 Fcfa	387 480 Fcfa	**758 311 Fcfa**	**909 974 Fcfa**
DN 800	242 580 Fcfa	283 218 Fcfa	**525 798 Fcfa**	**630 958 Fcfa**
DN 600	148 870 Fcfa	189 832 Fcfa	**338 702 Fcfa**	**406 442 Fcfa**
DN 500	120 443 Fcfa	133 991 Fcfa	**254 435 Fcfa**	**305 322 Fcfa**
DN 400	89 876 Fcfa	108 883 Fcfa	**198 759 Fcfa**	**238 511 Fcfa**

Table 9 : Average overall cost of pipes per linear metre for diameters below 300 mm

Diamètre (mm)	Longueur (ml)	*dont voie non revêtue*	*dont sous chaussée ou accot revêtu*	Fourniture et pose (Fcfa HT HD/ml) (*) *Fourniture Tuyau*	*Pose voie non revêtue*	*Pose chaussée revêtue*	*Total Fourniture et pose*
DN 315 -16b	1 m	0,5 m	0,5 m	65 000 Fcfa	11 493 Fcfa	19 868 Fcfa	96 362 Fcfa
DN 225 -16b	1 m	0,5 m	0,5 m	30 000 Fcfa	9 406 Fcfa	17 781 Fcfa	57 186 Fcfa
DN 160 -10b	1 m	0,5 m	0,5 m	18 000 Fcfa	6 948 Fcfa	15 323 Fcfa	40 271 Fcfa
DN 110 -10b	1 m	0,5 m	0,5 m	11 000 Fcfa	5 852 Fcfa	14 227 Fcfa	31 079 Fcfa
DN 63 -10b	1 m	0,5 m	0,5 m	5 000 Fcfa	5 043 Fcfa	13 418 Fcfa	23 460 Fcfa

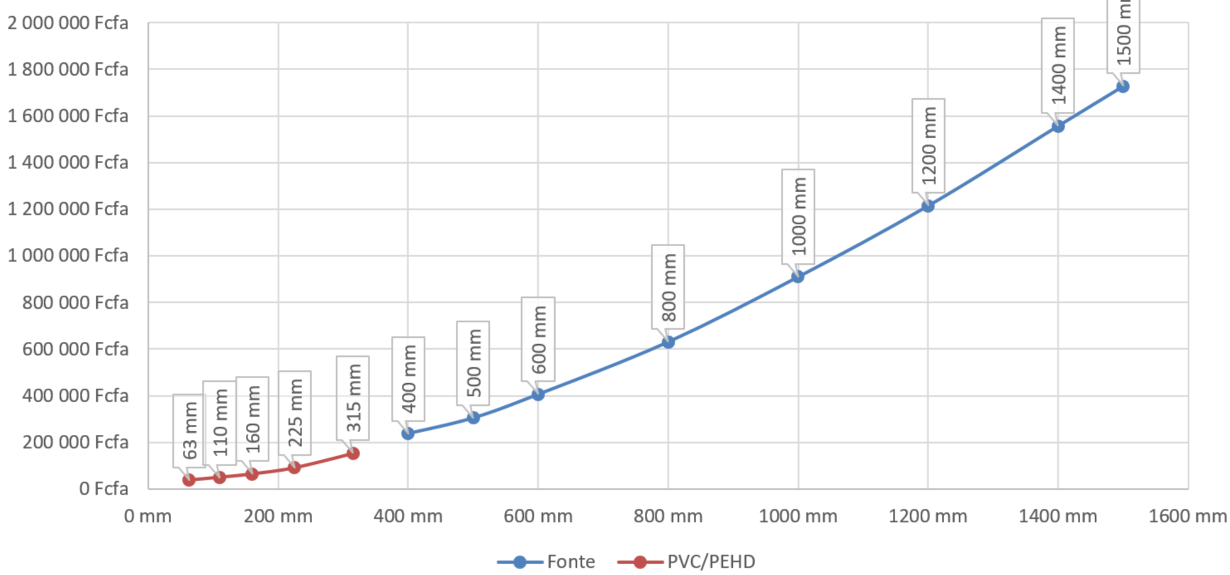
(*) yc terrassements, hors pièces spéciales, gros oeuvre, installation de chantier

Diamètre (mm)	*Total Fourniture et pose des tuyaux (75%)*	*Installation de chantier (10%)*	*Pièces spéciales (10%)*	*Gros œuvre, Béton (5%)*	Total (Fcfa HT HD/ml) (100%)	+ Provision divers/ imprévus (120%)
DN 315 -16b	96 362 Fcfa	12 848 Fcfa	12 848 Fcfa	6 424 Fcfa	**128 482 Fcfa**	**154 178 Fcfa**
DN 225 -16b	57 186 Fcfa	7 625 Fcfa	7 625 Fcfa	3 812 Fcfa	**76 248 Fcfa**	**91 498 Fcfa**
DN 160 -10b	40 271 Fcfa	5 370 Fcfa	5 370 Fcfa	2 685 Fcfa	**53 695 Fcfa**	**64 434 Fcfa**
DN 110 -10b	31 079 Fcfa	4 144 Fcfa	4 144 Fcfa	2 072 Fcfa	**41 439 Fcfa**	**49 727 Fcfa**
DN 63 -10b	23 460 Fcfa	3 128 Fcfa	3 128 Fcfa	1 564 Fcfa	**31 280 Fcfa**	**37 537 Fcfa**

Diamètre (mm)	*Fourniture tuyaux et pièces spéciales*	*Installation, terrassement, gros œuvre, pose, essais*	Total (Fcfa HT HD/ml)	+ Provision divers/ imprévus (120%)
DN 315 -16b	77 848 Fcfa	50 634 Fcfa	**128 482 Fcfa**	**154 178 Fcfa**
DN 225 -16b	37 625 Fcfa	38 623 Fcfa	**76 248 Fcfa**	**91 498 Fcfa**
DN 160 -10b	23 370 Fcfa	30 326 Fcfa	**53 695 Fcfa**	**64 434 Fcfa**
DN 110 -10b	15 144 Fcfa	26 295 Fcfa	**41 439 Fcfa**	**49 727 Fcfa**
DN 63 -10b	8 128 Fcfa	23 152 Fcfa	**31 280 Fcfa**	**37 537 Fcfa**

These cost elements for the pipes will make it possible to reconstitute the estimations by section of network, by modulating the unit price according to the environment of installation (body of road, not paved way…).

Figure 40 : Average overall cost of pipes per linear metre (mid-pavement, mid-track)



6.2 Storages

The price of water towers and ground tanks comes from our updated database based on the latest markets collected in the sub-region.

6.2.1 Ground tanks

The prices of ground tanks depend essentially on the storage capacity. They are calculated on the basis of semi-underground cylindrical reinforced concrete tanks for volumes below 5,000 m3 and on the basis of semi-underground rectangular reinforced concrete tanks for volumes above 5,000 m3.

6.2.2 Elevated tanks

In the case of water towers, the cost depends on two parameters: the storage volume and the storage height. The unit costs per m3 are presented in the following tables.

Table 10 : Total price of tanks in MM cfa francs excl. tax

Volume/Hauteur	0 m	10 m	20 m	30 m	40 m
100 m3	32	56	80	110	132
250 m3	80	141	198	272	327
500 m3	158	277	391	537	645
1 000 m3	307	541	761	1 047	1 256
1 500 m3	448	790	1 111	1 528	1 833
2 000 m3	581	1 023	1 441	1 981	2 378
2 500 m3	706	1 243	1 750	2 407	2 888
3 000 m3	822	1 448	2 039	2 804	3 365
4 000 m3	1 030	1 816	2 555	3 514	4 217
5 000 m3	1 206	2 124	2 991	4 113	-
10 000 m3	2 154	-	-	-	-
20 000 m3	3 948	-	-	-	-
40 000 m3	7 178	-	-	-	-

Tableau 11 : Unit price of tanks in MM cfa francs excl. tax/m3 of storage

Volume/Hauteur	0 m	10 m	20 m	30 m	40 m
100 m3	0,32	0,56	0,80	1,10	1,32
250 m3	0,32	0,56	0,79	1,09	1,31
500 m3	0,32	0,55	0,78	1,07	1,29
1 000 m3	0,31	0,54	0,76	1,05	1,26
1 500 m3	0,30	0,53	0,74	1,02	1,22
2 000 m3	0,29	0,51	0,72	0,99	1,19
2 500 m3	0,28	0,50	0,70	0,96	1,16
3 000 m3	0,27	0,48	0,68	0,93	1,12
4 000 m3	0,26	0,45	0,64	0,88	1,05
5 000 m3	0,24	0,42	0,60	0,82	-
10 000 m3	0,22	-	-	-	-
20 000 m3	0,20	-	-	-	-
40 000 m3	0,18	-	-	-	-

6.3 Pumping stations

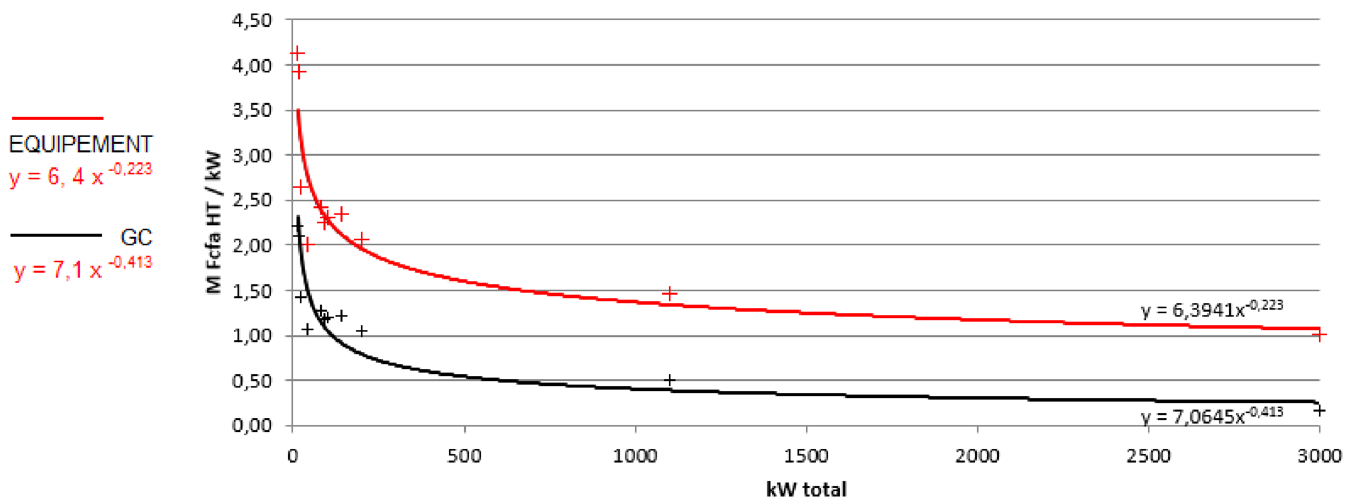
The proposed method is based on estimated formulas used in the evaluation of drinking water pumping station projects.

The curves below show the cost of the stations according to the total installed power by differentiating the civil engineering from the equipment.

$$P = \frac{9.81 \times Q \times HMT}{\eta}$$

Where Q is the flow in m3/s, HMT is the total head in m, η is the pump efficiency.

Figure 41 : Average overall cost of pumping stations



The table below summarizes the cost of the stations according to the power of the pumps installed. The costs include civil engineering, hydraulic, electrical and automatic equipment as well as the development of the surroundings.

Table 12 : Unit price of the stations in MM cfa francs excl. tax/kW installed

puissance installée kW	Equipements M Fcfa HT	%	Génie Civil M Fcfa HT	%	Total M Fcfa HT
15	61,8	0,65	33,3	0,35	95,1
20	78,5	0,65	42,2	0,35	120,7
25	66,2	0,65	35,5	0,35	101,7
40	80,4	0,65	42,9	0,35	123,3
80	193,7	0,65	102,2	0,35	295,9
90	203,3	0,66	107,0	0,34	310,3
100	230,2	0,66	120,7	0,34	351,0
140	329,0	0,66	170,4	0,34	499,4
200	413,2	0,66	210,0	0,34	623,2
1400	2059,3	0,75	695,9	0,25	2755,2
3000	3010,0	0,86	490,0	0,14	3500,0

Volume 2 of the report ("Energy requirements") takes into account the fact that certain strategic equipment must be backed up by electricity (***Volume 2_Chapter 8.1***).

The following table summarizes the sites that have been backed up with the corresponding generator sets: the amounts of these investments are added to the cost of the equipment concerned in the Investment Plan.

Tableau 13 : Unit price of the Generator Sets on the rescued sites

Secours	ST Zio	ST Mono		ST CCE	Bd 30 Aout		Cacavelli		Stade	
	2028	2030	2040	2025	2030	2045	2025	2035	2025	2040
Puissance nécessaire (kVA)	465	1 057	1 057	106	513	513	465	465	1 104	513
Puissance GE (kVA)	550	1 350	1 350	165	550	550	550	550	1 350	550
Consommation à 3/4 % (l/h)	80	150	150	25	80	80	80	80	150	80
Autonomie (h)	24	24	24	24	24	24	24	24	24	24
Capacité nécessaire (l)	1 920	3 600	3 600	600	1 920	1 920	1 920	1 920	3 600	1 920
Volume de la citerne gasoil (m3)	2	4	4	1	2	2	2	2	4	2
Estimation GE + Citerne (M Fcfa HTHD)	80	180	180	19	80	80	80	80	180	80

6.4 The Zio dam

The amount of the investments related to the construction of the ZIO dam, whose dike is projected, at approximately 1 km, upstream of the bridge of the Assahoun-Aholoukopé road includes:

- The complementary surveys and studies;
- The costs of the construction of the installation and its equipment;
- The cost of submergence.

The work includes:

- excavations (stripping);
- backfill (compacted earth dike, downstream drainage mat, protective riprap, grassed topsoil, geotextile);
- Civil engineering (staff housing, formwork and concrete for installations associated with the dike, service footbridge, roads);
- equipment related to the bottom drain, the water intake and the spillway;

The estimate for the construction of the installation and its equipment is 46 billion CFA francs excluding tax

The cost of submergence includes clean-up, demolition of existing buildings before commissioning, the cost of expropriation and various indemnities. These costs will have to be established during the studies prior to the works.

6.5 Traetments

Based on the processes and assumptions described above, the following estimates are made:

Table 14 : Traetment units' cost

	Treatment plant	Civil engineering	Equipments	Total
East wellfield	40,000 m3/d unit	4.2 bn CFAF excl. tax.	3.2 bn CFAF excl. tax.	**7.4 bn CFAF** excl. tax.
Desalination 100,000 m3/d	Raw water conveyance Outlet and pumping of brine discharge Outlet and loading desalination plant 150,000 m3/d unit	27.0 bn CFAF excl. tax.	48.4 bn CFAF excl. tax.	**75.4 bn CFAF** excl. tax.
Desalination 150,000 m3/d	Raw water conveyance Outlet and pumping of brine discharge Outlet and loading desalination plant 150,000 m3/d unit	34.3 bn CFAF excl. tax.	64.3 bn CFAF excl. tax.	**98.6 bn CFAF** excl. tax.
Zio	88,000 m3/d unit	12.2 bn CFAF excl. tax.	9.5 bn CFAF excl. tax.	**21.7 bn CFAF** excl. tax.
Mono	200,000 m3/d unit	19.9 bn CFAF excl. tax.	19.2 bn CFAF excl. tax.	**39.1 bn CFAF** excl. tax.

6.6 East wellfield

Based on the production capacity of the wellfield from the Continental Terminal groundwater, and the assumptions described above, the following estimates are made. The raw water pipes considered here are the individual borehole pipes, the location of which is not fixed. The raw water collector to Hahotoé is calculated separately.

Table 15 : Detail of the cost of the wellfield

	works		quantity	Unit price (CFAF)	Total (bn CFAF)	including equipments	including civil engineering
1.1	Drilling of boreholes ~basis 100 m3/d	u	22	60,000,000	**1,320**	1,320	
1.2	Hydraulic equipment of the drillings ~basis 100 m3/d	u	22	45,000,000	**990**	990	
1.3	Enclosure of wells	m	2,640	140,000	**370**		370
1.4	Individual raw water pipeline ~basis 22 km	m	22,000	92,000	**2,024**		2,024
	Electricity and automation						
2.1	civil engineering and equipment of the transmitter stations	u	11	40,000,000	**440**	440	
2.2	Electrical connection of the wells	u	22	15,000,000	**330**	330	
2.3	Drillings automation	u	22	15,000,000	**330**	330	
	Tracks, platforms and various networks						
3.1	6m wide access track and site development	m	10,000	110,000	**1,100**		1,100
					6,904	3,410	3,494

6.7 Remote management

The proposed remote management principle is described and costed by stage in Volume 2.

7

Capital Expenditures

7.1 Structuring installations

Capital expenditure (CAPEX) refers to the costs of the infrastructure and network development described above by horizon.

As a synthesis of the previous paragraphs, the tables reported in ***Appendix 2*** and ***Appendix 3*** present the investment plans related respectively to the installations related to resources and conveyance system, and to the structuring infrastructures related to coverage (≥ 300 mm).

The total investment up to the study horizon (2050) amounts respectively to ~1066 billion CFA francs excluding taxes for installations related to resources and conveyance, and ~178 billion CFA francs excluding tax for structuring infrastructures related to coverage (≥ 300 mm):

These investments do not include:

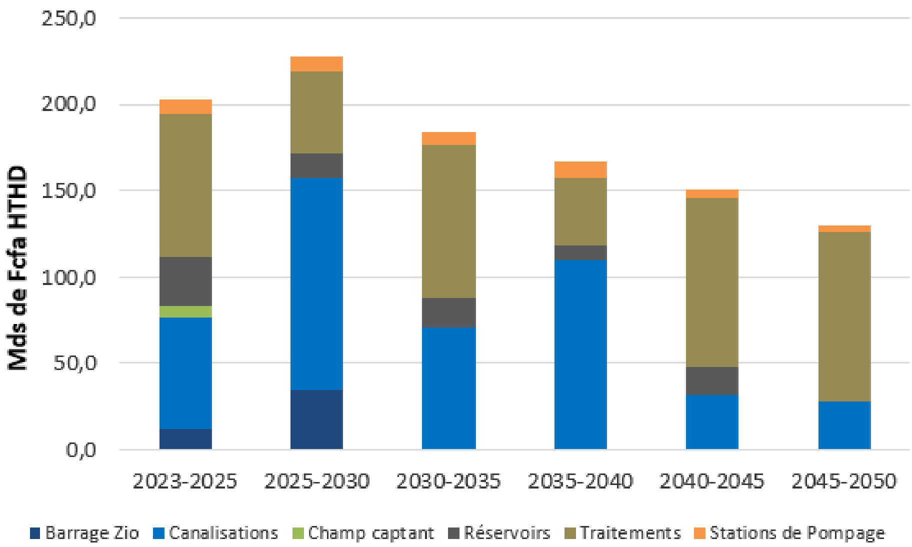
- The Coverage networks for extension and densification zones, connections allowing a significant increase in the coverage rate;
- The costs of project management, various studies, including preliminary surveys related to water resources, and work control;
- The Investment costs related to the supply of energy to the treatment and pumping sites.

In terms of resources, the projects consider an additional mobilizable resource capacity of about 1 million m3/d by 2050.

For the storage facilities at the head of the distribution network and the conveyance pipelines, there is a total capacity of 250,000 m3 and a length of conveyance network of 325 km to be created by 2050 (diameters between 800 mm and 1400 mm). The corresponding Investment Plan in **Appendix 2**, details about 160 project lines classified by nature, by area and by year over the period.

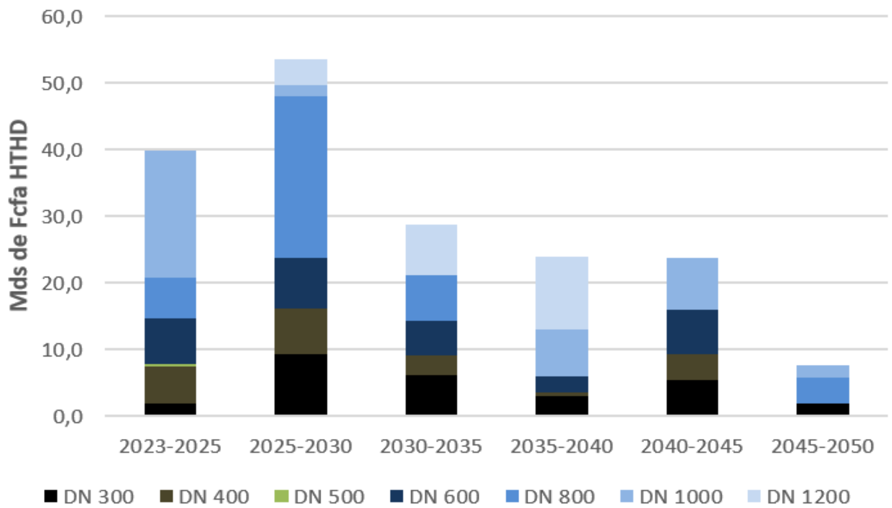
For the structuring coverage infrastructures, the reinforcement and extension work concern a linear distance of approximately 460 km of pipes (diameters between 300 and 1200 mm). The corresponding Investment Plan in ***Appendix 3***, details approximately 200 project lines classified by municipality and by year over the period.

Figure 42 : Summary of investments - Resources and supply



Périodes	2023-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050	Total (Mds Fcfa HTHD)
Barrage Zio	11,5	34,5	0,0	0,0	0,0	0,0	46,0
Canalisations	64,9	123,0	71,1	109,5	32,3	27,6	428,4
Champ captant	6,9	0,0	0,0	0,0	0,0	0,0	6,9
Réservoirs	28,6	14,2	16,8	9,3	15,3	0,0	84,1
Traitements	82,9	47,8	88,4	39,1	98,6	98,6	455,4
Stations de Pompage	8,4	8,5	7,7	9,6	5,0	3,3	42,5
Télégestion	1,5	0,6	0,1	0,2	0,1	0,1	2,6
investissements par période	**204,7**	**228,5**	**184,1**	**167,7**	**151,3**	**129,6**	**1065,9**
investissements cumulés	**204,7**	**433,2**	**617,2**	**784,9**	**936,3**	**1065,9**	

Figure 43 : Summary of investments – structuring infrastructures



Périodes	2023-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050	Total (Mds Fcfa HTHD)
DN 300	2,0	9,3	6,2	3,0	5,5	1,9	27,9
DN 400	5,5	6,9	2,8	0,6	3,8	0,0	19,7
DN 500	0,3	0,0	0,0	0,0	0,0	0,0	0,3
DN 600	6,8	7,6	5,2	2,4	6,7	0,0	28,8
DN 800	6,3	24,2	6,8	0,0	0,0	4,0	41,3
DN 1000	19,0	1,7	0,0	7,0	7,7	1,8	37,3
DN 1200	0,0	3,9	7,7	10,9	0,0	0,0	22,5
investissements par période	**39,9**	**53,6**	**28,8**	**23,9**	**23,8**	**7,7**	**177,7**
investissements cumulés	**39,9**	**93,6**	**122,4**	**146,3**	**170,1**	**177,7**	

Structuring coverage infrastructure can be broken down by municipality. This breakdown is provided for information purposes, as the pipes that cross a municipality are not necessarily intended solely for the needs of that municipality.

Table 16 : Summary of investments - Structuring infrastructure by municipality

Total (Mds Fcfa) Commune/Arrondissement	Lomé bas	Lomé haut	Total général
ADETIKOPE		14,9	14,9
AFLAO_GAKLI	4,6	3,2	7,8
AFLAO_SAGBADO	12,7	8,0	20,7
AGOE_NYIVE	3,7	19,4	23,1
AKEPE		14,5	14,5
ALMOUTIVE	5,8		5,8
BAGUIDA	11,0		11,0
BE_CENTRE	9,0		9,0
BE_EST	17,2		17,2
BE_OUEST	7,1		7,1
DJAGBLE		3,7	3,7
LEGBASSITO		8,3	8,3
MISSION-TOVE_KOVIE		10,6	10,6
TOGBLE	4,1	5,2	9,3
VAKPOSSITO		1,3	1,3
ZANGUERA		6,8	6,8
HorsZone		6,8	6,8
Total général	**75,1**	**102,6**	**177,7**

Longueur (ml)

Diamètre (mm) Commune/Arrondissement	Lomé bas 300 mm	Lomé bas 400 mm	Lomé bas 500 mm	Lomé bas 600 mm	Lomé bas 800 mm	Lomé bas 1000 mm	Total Lomé bas
ADETIKOPE							
AFLAO_GAKLI		8 900 ml	300 ml		990 ml	1 900 ml	**12 090 ml**
AFLAO_SAGBADO	10 425 ml	2 995 ml		6 225 ml	6 850 ml	3 840 ml	**30 335 ml**
AGOE_NYIVE	2 000 ml			7 080 ml		570 ml	**9 650 ml**
AKEPE							
ALMOUTIVE	6 740 ml	3 920 ml		900 ml	5 520 ml		**17 080 ml**
BAGUIDA	19 020 ml	4 800 ml		16 990 ml			**40 810 ml**
BE_CENTRE	3 285 ml			1 790 ml	1 650 ml	7 360 ml	**14 085 ml**
BE_EST	10 670 ml	1 300 ml		6 500 ml	4 600 ml	10 630 ml	**33 700 ml**
BE_OUEST			700 ml	2 900 ml	1 290 ml	5 370 ml	**10 260 ml**
DJAGBLE							
LEGBASSITO							
MISSION-TOVE_KOVIE							
TOGBLE	16 255 ml	6 720 ml					**22 975 ml**
VAKPOSSITO							
ZANGUERA							
HorsZone							
Total général	68 395 ml	28 635 ml	1 000 ml	42 385 ml	20 900 ml	29 670 ml	**190 985 ml**

Diamètre (mm) Commune/Arrondissement	Lomé haut 300 mm	Lomé haut 400 mm	Lomé haut 600 mm	Lomé haut 800 mm	Lomé haut 1000 mm	Lomé haut 1200 mm	Total Lomé haut	Total général
ADETIKOPE	9 040 ml	15 730 ml				8 010 ml	**32 780 ml**	**32 780 ml**
AFLAO_GAKLI	7 250 ml	3 550 ml	3 130 ml				**13 930 ml**	**26 020 ml**
AFLAO_SAGBADO	13 383 ml	10 170 ml		5 625 ml			**29 178 ml**	**59 513 ml**
AGOE_NYIVE	15 150 ml	9 860 ml	14 210 ml	630 ml	8 400 ml	750 ml	**49 000 ml**	**58 650 ml**
AKEPE	3 940 ml			22 020 ml			**25 960 ml**	**25 960 ml**
ALMOUTIVE								**17 080 ml**
BAGUIDA								**40 810 ml**
BE_CENTRE								**14 085 ml**
BE_EST								**33 700 ml**
BE_OUEST								**10 260 ml**
DJAGBLE	19 380 ml	2 900 ml					**22 280 ml**	**22 280 ml**
LEGBASSITO	12 790 ml	4 710 ml	1 900 ml	2 900 ml	2 900 ml		**25 200 ml**	**25 200 ml**
MISSION-TOVE_KOVIE	8 990 ml		9 225 ml	8 600 ml			**26 815 ml**	**26 815 ml**
TOGBLE						4 250 ml	**4 250 ml**	**27 225 ml**
VAKPOSSITO	4 390 ml	2 490 ml					**6 880 ml**	**6 880 ml**
ZANGUERA	17 530 ml	4 640 ml		4 720 ml			**26 890 ml**	**26 890 ml**
HorsZone	610 ml					5 500 ml	**6 110 ml**	**6 110 ml**
Total général	112 453 ml	54 050 ml	28 465 ml	44 495 ml	11 300 ml	18 510 ml	**269 273 ml**	**460 258 ml**

The high level of investment in the very short term reflects the delay in the development of Lomé's infrastructures in relation to the strategy for access to drinking water in Togo, which aims to achieve 100% coverage by 2030 for Lomé.

The projects, identified in the Investment Plans in ***Appendix 2 and 3***, are individually located on the network plans, associated with the file, and are provided in GIS format.

The presentation of the Investment Plans includes for each project line (about 360) an identifier in the nomenclature, helping to locate the project on one of the Network Plans or on the functional synoptic for Resources and Conveyances. Each project is located in the municipality where it is located (the word "out of area" is indicated when it is located outside the Greater Lomé area), it is briefly characterized technically and related to unit prices, as detailed in ***Chapter 6***. Finally, a start and end date for the works are proposed according to the urgency of the work and the general evolution of the network as presented in the report.

7.2 Distribution infrastructures

7.2.1 Distribution network

The extensions of the distribution network (diameter ≤ 225 mm) concern the areas to be urbanized in the future but also the partially served unsaturated areas. Pipes are not modeled, they are not considered as part of the hydraulic structure of the network, but as an access way to the delivery point from the backbone network.

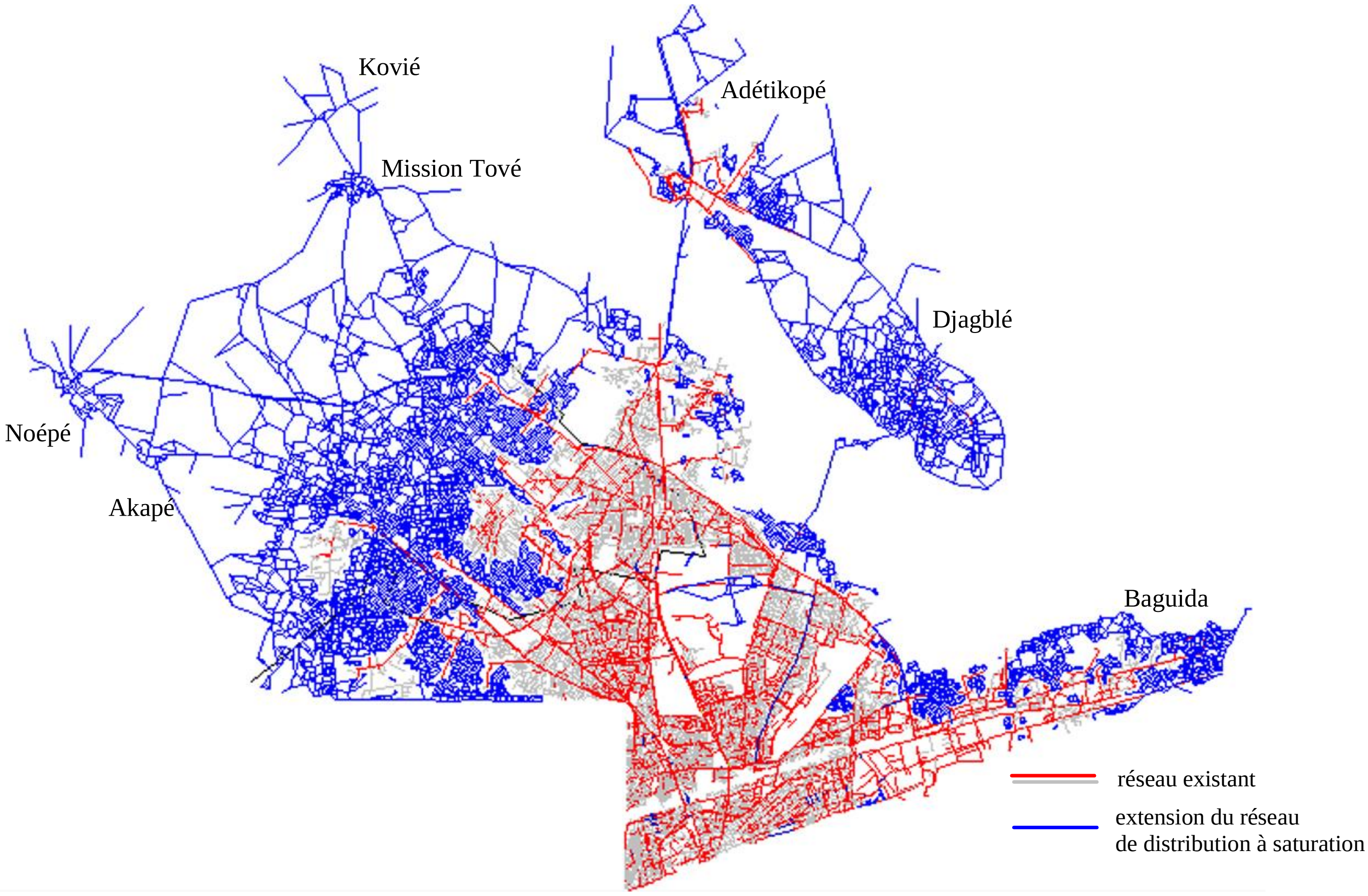
The methodology used is as follows:

1. Assessment of the current network length by municipality;
2. Evaluation of the linear of non-canalized roads/tracks by municipality, based on satellite photos;
3. Evaluation of the coverage network needs based on average ratios per km2: ~10% of pipes DN 160/225mm, 20% of pipes DN 110mm, 70% of pipes between [DN 63mm and DN 75 mm];
4. Assigning a network extension rate per municipality on the un-piped roads, based on the coverage rate progression retained in **the Demand Study** (Deliverable)

In total, the TdE GIS shows a total length of distribution network of about 1,700 km, the length of the roads not equipped with pipes and to be equipped by 2050 is estimated at 2,000 km (census of existing roads based on the current mapping).

In the following figure, the blue lines correspond to the pipes to be laid in extension to the existing network.

Figure 44 : Distribution pipes to be laid as an extension of the current network



The following tables present the results obtained successively.

Table 17 : Existing lines and extensions to be planned by municipality

Longueur (ml) diamètre Commune/Arrondissement	réseau existant Ø ≤ 63mm	63 < Ø ≤ 125mm	125 < Ø ≤ 175mm	175 < Ø ≤ 250mm	linéaire extension à poser	linéaire total à saturation
ADETIKOPE	2 987	10 706	9 344	3 003	126 011	152 051
AFLAO_GAKLI	91 348	96 366	27 195	10 128	80 774	305 811
AFLAO_SAGBADO	32 974	35 185	26 185	8 574	389 886	492 804
AGOE_NYIVE	126 389	128 249	28 519	22 576	44 469	350 202
NOEPE-AKEPE	-	-	-	-	115 315	115 315
ALMOUTIVE	85 830	102 920	17 311	18 514	-	224 575
BAGUIDA	17 948	31 010	16 710	15 055	189 390	270 113
BE_CENTRE	98 351	85 759	39 440	7 144	49	230 743
BE_EST	76 021	103 813	22 650	27 411	113 467	343 362
BE_OUEST	32 747	49 868	10 394	13 965	13 068	120 042
DJAGBLE	-	-	-	-	244 902	244 902
LEGBASSITO	3 478	8 484	2 872	835	248 369	264 038
MISSION-TOVE_KOVIE	-	-	-	-	125 686	125 686
VAKPOSSITO	5 374	26 141	1 703	510	14 808	48 536
ZANGUERA	200	4 501	990	101	252 659	258 451
TOGBLE	37 456	40 143	10 642	7 556	101 984	197 781
TOTAL (ml)	611 103	723 145	213 955	135 372	2 060 837	3 744 412

Table 18 : Extension lines to be planned per period and per municipality

Longueur (ml)	linéaire réseau	linéaire extension	desserte (%)		linéaire à poser par période (ml)			
Commune/Arrondissement	existant	à poser	2 025		2023 - 2025	2025 - 2030	2030 - 2040	2040 - 2050
ADETIKOPE	26 040	126 011	53 %		30 093	42 130	35 859	17 929
AFLAO_GAKLI	225 037	80 774	74 %		13 673	19 142	31 973	15 986
AFLAO_SAGBADO	102 918	389 886	77 %		111 071	155 500	82 210	41 105
AGOE_NYIVE	305 733	44 469	88 %		7 819	10 947	17 136	8 568
NOEPE-AKEPE	-	115 315	*40 %*	(*)	-	56 504	39 207	19 604
AMOUTIVE	224 575	-	100 %		-	-	-	-
BAGUIDA	80 723	189 390	47 %		39 270	54 978	63 428	31 714
BE_CENTRE	230 694	49	100 %		16	23	7	3
BE_EST	229 895	113 467	78 %		25 232	35 325	35 273	17 636
BE_OUEST	106 974	13 068	97 %		3 756	5 258	2 703	1 351
DJAGBLE	-	244 902	45 %		59 185	82 859	68 573	34 286
LEGBASSITO	15 669	248 369	50 %		60 787	85 101	68 321	34 160
MISSION-TOVE_KOVIE	-	125 686	*40 %*	(*)	-	61 586	42 733	21 367
VAKPOSSITO	33 728	14 808	75 %		2 914	4 079	5 210	2 605
ZANGUERA	5 792	252 659	47 %		61 390	85 946	70 216	35 108
TOGBLE	95 797	101 984	66 %		22 787	31 902	31 530	15 765
TOTAL (ml)	1 683 575	2 060 837			437 992	731 280	594 377	297 188

(*) voir nota

Table 19 : Estimates of the costs of the extensions to be planned by period and by municipality

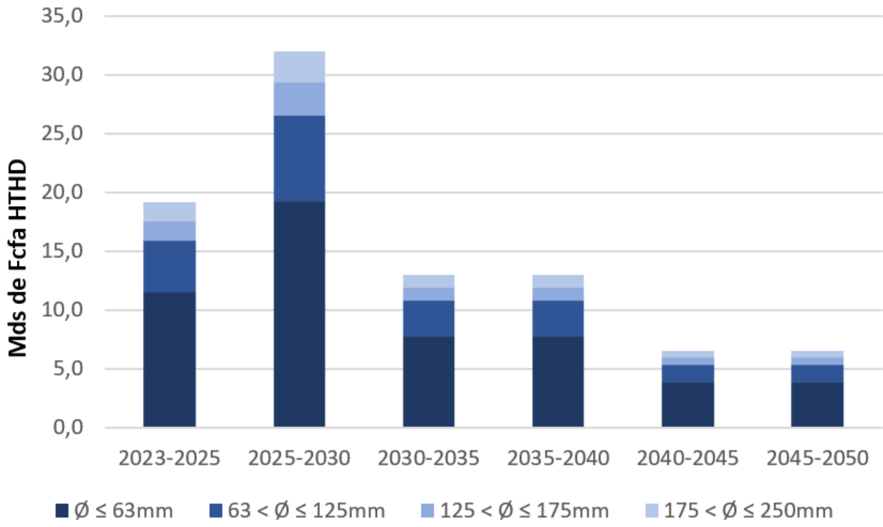
Longueur (ml)	linéaire à poser sur la période 2023-2025 (ml)				montant
Commune/Arrondissement	Ø ≤ 63mm	63 < Ø ≤ 125mm	125 < Ø ≤ 175mm	175 < Ø ≤ 250mm	Mds Fcfa HTHD
ADETIKOPE	21 065	6 019	1 806	1 204	1,32
AFLAO_GAKLI	9 571	2 735	820	547	0,60
AFLAO_SAGBADO	77 750	22 214	6 664	4 443	4,86
AGOE_NYIVE	5 473	1 564	469	313	0,34
NOEPE-AKEPE	-	-	-	-	-
AMOUTIVE	-	-	-	-	-
BAGUIDA	27 489	7 854	2 356	1 571	1,72
BE_CENTRE	11	3	1	1	0,001
BE_EST	17 663	5 046	1 514	1 009	1,10
BE_OUEST	2 629	751	225	150	0,16
DJAGBLE	41 429	11 837	3 551	2 367	2,59
LEGBASSITO	42 551	12 157	3 647	2 431	2,66
MISSION-TOVE_KOVIE	-	-	-	-	-
VAKPOSSITO	2 040	583	175	117	0,13
ZANGUERA	42 973	12 278	3 683	2 456	2,69
TOGBLE	15 951	4 557	1 367	911	1,00
TOTAL (ml)	306 595 ml	87 598 ml	26 280 ml	17 520 ml	19,2 Mds Fcfa

Longueur (ml)	linéaire à poser sur la période 2025-2030 (ml)				montant
Commune/Arrondissement	Ø ≤ 63mm	63 < Ø ≤ 125mm	125 < Ø ≤ 175mm	175 < Ø ≤ 250mm	Mds Fcfa HTHD
ADETIKOPE	29 491	8 426	2 528	1 685	1,84
AFLAO_GAKLI	13 399	3 828	1 149	766	0,84
AFLAO_SAGBADO	108 850	31 100	9 330	6 220	6,80
AGOE_NYIVE	7 663	2 189	657	438	0,48
NOEPE-AKEPE	39 553	11 301	3 390	2 260	2,47
AMOUTIVE	-	-	-	-	-
BAGUIDA	38 485	10 996	3 299	2 199	2,41
BE_CENTRE	16	5	1	1	0,001
BE_EST	24 728	7 065	2 120	1 413	1,55
BE_OUEST	3 681	1 052	315	210	0,23
DJAGBLE	58 001	16 572	4 972	3 314	3,62
LEGBASSITO	59 571	17 020	5 106	3 404	3,72
MISSION-TOVE_KOVIE	43 110	12 317	3 695	2 463	2,69
VAKPOSSITO	2 855	816	245	163	0,18
ZANGUERA	60 162	17 189	5 157	3 438	3,76
TOGBLE	22 331	6 380	1 914	1 276	1,40
TOTAL (ml)	511 896 ml	146 256 ml	43 877 ml	29 251 ml	32,0 Mds Fcfa

Longueur (ml)	linéaire à poser sur la période 2030-2040 (ml)				montant
Commune/Arrondissement	Ø ≤ 63mm	63 < Ø ≤ 125mm	125 < Ø ≤ 175mm	175 < Ø ≤ 250mm	Mds Fcfa HTHD
ADETIKOPE	25 101	7 172	2 152	1 434	1,57
AFLAO_GAKLI	22 381	6 395	1 918	1 279	1,40
AFLAO_SAGBADO	57 547	16 442	4 933	3 288	3,60
AGOE_NYIVE	11 995	3 427	1 028	685	0,75
NOEPE-AKEPE	27 445	7 841	2 352	1 568	1,72
AMOUTIVE	-	-	-	-	-
BAGUIDA	44 400	12 686	3 806	2 537	2,77
BE_CENTRE	5	1	-	-	0,0002
BE_EST	24 691	7 055	2 116	1 411	1,54
BE_OUEST	1 892	541	162	108	0,12
DJAGBLE	48 001	13 715	4 114	2 743	3,00
LEGBASSITO	47 825	13 664	4 099	2 733	2,99
MISSION-TOVE_KOVIE	29 913	8 547	2 564	1 709	1,87
VAKPOSSITO	3 647	1 042	313	208	0,23
ZANGUERA	49 151	14 043	4 213	2 809	3,07
TOGBLE	22 071	6 306	1 892	1 261	1,38
TOTAL (ml)	416 064 ml	118 875 ml	35 662 ml	23 775 ml	26,0 Mds Fcfa

Longueur (ml)	linéaire à poser sur la période 2040-2050 (ml)				montant
Commune/Arrondissement	Ø ≤ 63mm	63 < Ø ≤ 125mm	125 < Ø ≤ 175mm	175 < Ø ≤ 250mm	Mds Fcfa HTHD
ADETIKOPE	12 550	3 586	1 076	717	0,78
AFLAO_GAKLI	11 190	3 197	959	639	0,70
AFLAO_SAGBADO	28 774	8 221	2 466	1 644	1,80
AGOE_NYIVE	5 997	1 714	514	343	0,37
NOEPE-AKEPE	13 722	3 921	1 176	784	0,86
AMOUTIVE	-	-	-	-	-
BAGUIDA	22 200	6 343	1 903	1 269	1,39
BE_CENTRE	2	-	-	-	0,0001
BE_EST	12 345	3 527	1 058	705	0,77
BE_OUEST	946	270	81	54	0,06
DJAGBLE	24 000	6 857	2 057	1 371	1,50
LEGBASSITO	23 912	6 832	2 050	1 366	1,49
MISSION-TOVE_KOVIE	14 957	4 273	1 282	855	0,93
VAKPOSSITO	1 824	521	156	104	0,11
ZANGUERA	24 575	7 022	2 106	1 404	1,54
TOGBLE	11 036	3 153	946	631	0,69
TOTAL (ml)	208 032 ml	59 437 ml	17 831 ml	11 887 ml	13,0 Mds Fcfa

Figure 45 : Summary of investments - Distribution network



Périodes	2023-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050	Total (Mds Fcfa HTHD)
Ø ≤ 63mm	11,5	19,2	7,8	7,8	3,9	3,9	54,2
63 < Ø ≤ 125mm	4,4	7,3	3,0	3,0	1,5	1,5	20,5
125 < Ø ≤ 175mm	1,7	2,8	1,1	1,1	0,6	0,6	8,0
175 < Ø ≤ 250mm	1,6	2,7	1,1	1,1	0,5	0,5	7,5
investissements par période	**19,2**	**32,0**	**13,0**	**13,0**	**6,5**	**6,5**	**90,2**
investissements cumulés	**19,2**	**51,2**	**64,2**	**77,2**	**83,7**	**90,2**	

Note: the structuring network planned for the North-East of Greater Lomé will only allow the development of the distribution network in the Kovié, Mission Tové, Noépé and Aképé zones from the 2025-2030 period. As an extension of the PURISE project, the distribution network can be extended to the municipalities of Zanguera and Aflao Sagbado, from the Dangbessito, Segbé, Logoté, Apédokoé and Yokoé boreholes, while waiting for the installation of the backbone network.

7.2.2 Connections

Given the objectives of improving the coverage rate and the evolution of the population retained - Demand Study (deliverable 5), the campaigns for the connections implementation must be ambitious, on the one hand on the distribution networks to be created in extension, and on the other hand on the existing distribution networks, in densification.

The table below estimates the number of new connections to be installed per year and per municipality over the period, for a connection estimated at 150,000 CFA francs (excluding tax). The assumption is that there will be about **7 people per connection by the time of the study, compared to about 14 people at present -** Demand Study **(*Deliverable 5*)**.

Table 20 : Annual connection program

branchements - unités	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
ADETIKOPE	2 135	2 555	3 032	3 661	4 377	5 188	6 106	7 143	7 779	8 468	9 214	10 022	10 897	11 845
AFLAO_GAKLI	16 621	18 147	19 792	21 688	23 735	25 947	28 337	30 918	32 654	34 496	36 451	38 527	40 733	43 077
AFLAO_SAGBADO	11 416	12 516	13 713	14 874	16 130	17 486	18 953	20 538	21 788	23 121	24 542	26 059	27 677	29 406
AGOE_NYIVE	24 010	26 406	28 988	31 297	33 772	36 424	39 266	42 312	44 552	46 922	49 432	52 090	54 909	57 897
NOEPE-AKEPE	-	-	-	-	1 935	2 341	2 801	3 599	4 160	4 746	5 361	5 731	5 858	6 020
AMOUTIVE	15 710	17 383	19 161	20 327	21 554	22 847	24 208	25 643	26 682	27 771	28 912	30 110	31 367	32 687
BAGUIDA	7 890	9 402	11 087	13 601	16 410	19 544	23 035	26 919	28 802	30 822	32 989	35 315	37 814	40 499
BE_CENTRE	14 003	15 113	16 291	17 074	17 895	18 755	19 657	20 603	21 493	22 424	23 398	24 417	25 484	26 602
BE_EST	23 340	25 919	28 683	32 295	36 180	40 359	44 851	49 679	51 803	54 032	56 371	58 829	61 414	64 129
BE_OUEST	5 606	6 097	6 626	7 025	7 450	7 902	8 383	8 894	9 395	9 928	10 493	11 093	11 731	12 409
DJAGBLE	2 071	2 550	3 094	3 859	4 729	5 718	6 840	8 110	8 801	9 553	10 373	11 267	12 244	13 307
LEGBASSITO	2 138	2 519	2 943	3 552	4 232	4 989	5 831	6 766	7 238	7 743	8 285	8 868	9 493	10 164
MISSION-TOVE_KOVIE	-	-	-	-	3 533	4 273	5 114	6 571	7 594	8 665	9 788	10 462	10 695	10 991
TOGBLE	4 587	5 197	5 868	6 634	7 478	8 408	9 432	10 559	11 301	12 097	12 952	13 869	14 855	15 915
VAKPOSSITO	2 393	2 632	2 888	3 135	3 399	3 683	3 988	4 315	4 537	4 772	5 020	5 283	5 561	5 856
ZANGUERA	2 578	3 073	3 623	4 453	5 380	6 415	7 567	8 850	9 466	10 127	10 836	11 597	12 413	13 291
unités cumulées	**134 500**	**149 508**	**165 789**	**183 475**	**208 190**	**230 278**	**254 367**	**281 417**	**298 045**	**315 685**	**334 416**	**353 538**	**373 144**	**394 095**

branchements - unités	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
ADETIKOPE	12 874	13 991	15 202	16 516	17 943	19 492	21 175	23 004	24 992	27 156	29 513	32 080	34 881	37 939
AFLAO_GAKLI	45 570	48 222	51 045	54 054	57 263	60 689	64 349	68 265	72 459	76 956	81 784	86 975	92 566	98 595
AFLAO_SAGBADO	31 253	33 228	35 342	37 606	40 032	42 636	45 433	48 439	51 675	55 162	58 925	62 991	67 392	72 161
AGOE_NYIVE	61 068	64 434	68 010	71 814	75 862	80 175	84 775	89 687	94 937	100 557	106 580	113 045	119 996	127 480
NOEPE-AKEPE	6 221	6 464	7 029	7 644	8 313	9 043	9 838	10 706	11 654	12 689	13 821	15 061	16 419	17 909
AMOUTIVE	34 073	35 531	37 065	38 681	40 384	42 181	44 081	46 090	48 218	50 476	52 874	55 425	58 144	61 047
BAGUIDA	43 386	46 492	49 836	53 439	57 324	61 515	66 042	70 936	76 232	81 969	88 192	94 950	102 299	110 304
BE_CENTRE	27 774	29 005	30 297	31 655	33 084	34 589	36 175	37 850	39 619	41 492	43 477	45 583	47 822	50 207
BE_EST	66 983	69 986	73 148	76 481	79 997	83 710	87 635	91 789	96 191	100 862	105 825	111 108	116 740	122 755
BE_OUEST	13 130	13 897	14 714	15 585	16 514	17 506	18 566	19 701	20 916	22 219	23 618	25 123	26 744	28 492
DJAGBLE	14 463	15 722	17 094	18 590	20 220	22 000	23 943	26 067	28 389	30 932	33 718	36 774	40 130	43 821
LEGBASSITO	10 886	11 662	12 498	13 398	14 368	15 415	16 545	17 767	19 089	20 520	22 072	23 758	25 590	27 586
MISSION-TOVE_KOVIE	11 358	11 801	12 832	13 954	15 177	16 509	17 961	19 546	21 275	23 165	25 232	27 495	29 975	32 696
TOGBLE	17 054	18 281	19 602	21 025	22 560	24 217	26 007	27 943	30 038	32 309	34 772	37 448	40 358	43 530
VAKPOSSITO	6 169	6 500	6 852	7 225	7 623	8 045	8 496	8 976	9 490	10 038	10 626	11 256	11 933	12 662
ZANGUERA	14 234	15 248	16 340	17 516	18 784	20 151	21 627	23 223	24 949	26 819	28 846	31 047	33 441	36 047
unités cumulées	**416 496**	**440 464**	**466 906**	**495 183**	**525 448**	**557 874**	**592 650**	**629 988**	**670 124**	**713 321**	**759 875**	**810 119**	**864 429**	**923 231**

moyenne à poser par an: 2023–2025: **15 041 u/an**; 2025–2030: **23 126 u/an**; 2030–2050: **25 007 u/an**

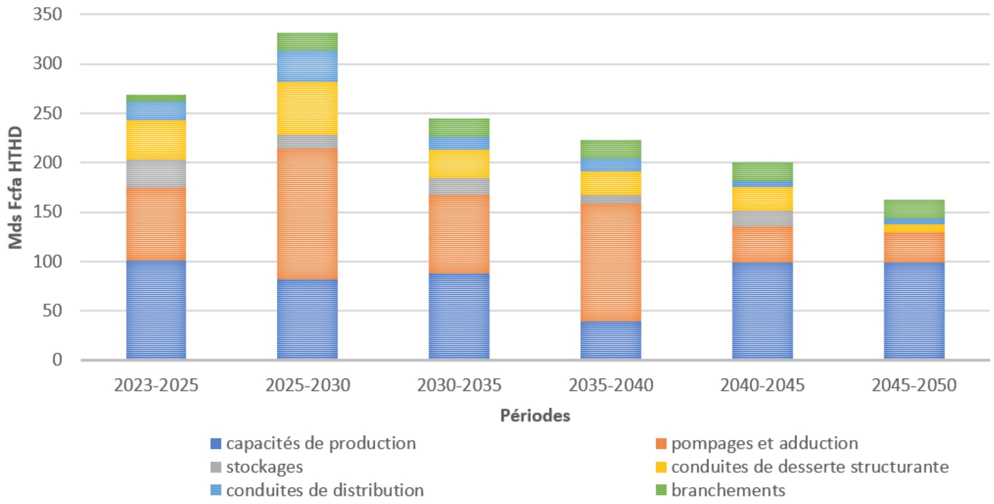
Cout annuel (Mds Fcfa HT/an): **2,3 Mds Fcfa/an**; **3,5 Mds Fcfa/an**; **3,8 Mds Fcfa/an**

Note: as previously indicated for the distribution network, the structuring network planned for the North-East of Greater Lomé will only allow the development of connections in the areas of Kovié, Mission Tové, Noépé and Aképé from the period 2025-2030. As an extension of the PURISE project, connections can be developed in the municipalities of Zanguera and Aflao Sagbado, from the distribution networks created from the Dangbessito, Segbé, Logoté, Apédokoé and Yokoé boreholes, pending the installation of the structuring network.

7.3 Summary of investments

The proposed investments are summarized in the figures below, to remain within the scope of the Strategy for Access to Safe Water in Togo with 100% coverage by 2030 for Lomé.

Figure 46 : Summary of global investments



Périodes	2023-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050	Total (Mds Fcfa HTHD)	
capacités de production	101,3	82,3	88,4	39,1	98,6	98,6	**508,3**	74%
pompages et adductions	73,3	131,5	78,8	119,1	37,3	30,9	**470,9**	
stockages	28,6	14,2	16,8	9,3	15,3	-	**84,2**	
télégestion	1,5	0,6	0,1	0,2	0,1	0,1	**2,6**	
conduites de desserte structurantse	39,9	53,6	28,8	23,9	23,8	7,7	**177,7**	12%
conduites de distribution	19,2	32,0	13,0	13,0	6,5	6,5	**90,2**	6%
branchements	6,8	17,3	18,8	18,8	18,8	18,8	**99,1**	7%
investissements par période	**270,6**	**331,5**	**244,6**	**223,4**	**200,4**	**162,6**	**1433,0**	100%
investissements cumulés	**270,6**	**602,1**	**846,7**	**1070,1**	**1270,5**	**1433,0**		

Approximately 74% of the investments are for resources and conveyance branches that allow for distribution loading and nearly 45% of the investments are to be made in the current decade until 2030.

7.4 Summary – project sheets by horizon

2025

Resources-Supply

East wellfield branch	bn CFA F excl. tax			
Drilling		6.9	16%	30 boreholes
treatment		7.4	17%	40,000 m3/d
pumping station		0.5	1%	1 loading station
reservoirs		1.5	3%	1500 m3
network		26.7	62%	42.2 km
land		0.0	0%	1.3ha
	Sub-total 1	**43.0**		
Desalination (phase 1)	bn CFA F excl. tax			
treatment		75.4	74%	100,000 m3/d
pumping station		2.5	2%	1 backflow station
network		23.9	23%	27.9 km
land		PM		7 ha
	Sub-total 2	**101.8**		
Stade site (phase 1)	bn CFA F excl. tax			
pumping station		1.8	12%	1 pumping station
reservoirs		8.1	53%	20,000 m3 + WT 5,000m3
land		5.4	35%	4.5 ha
	Sub-total 3a	**15.3**		
Adeticopé link	bn CFA F excl. tax			
pumping station		1.9	5%	1 pumping station
reservoirs		4.0	11%	20,000 m3
land		0.05	0%	5 ha
canalizations		30.4	84%	25 km
	Sub-total 3b	**36.4**		
Caccaveli site	bn CFA F excl. tax			
pumping station		1.6	16%	1 pumping station
reservoir		8.1	84%	20,000 m3 + WT 5,000m3
	Sub-total 4	**9.7**		
remote management	bn CFA F excl. tax			
	remote management 1	**1.5**		general control station
structuring coverage	bn CFA F excl. tax			
	Structuring 1	**39.9**		74.9 km
coverage extension	bn CFA F excl. tax			
	tertiary 1	**19.2**		438 km
connections	bn CFA F excl. tax			
	connections 1	**6.7**		45,200

2028

Resources-Supply				
Zio branch	bn CFA F excl. tax			
Dam		46.0	38%	50M m3
treatment		21.7	18%	88,000 m3/d
pumping station		2.3	2%	2 stations
reservoirs		5.5	5%	2,000 m3 + WT 1500 m3
network		44.7	37%	38.2 km
land		0.04	0%	3.7 ha
Sub-total 5		**120.3**		
remote management	bn CFA F excl. tax			
remote management 2		**0.3**		addition
structuring coverage	bn CFA F excl. tax			
Structuring 2		**33.3**		115.4 km
coverage extension	bn CFA F excl. tax			
tertiary 2		**19.2**		438.0 km
connections	bn CFA F excl. tax			
connections 2		**9.7**		64,500

2030

Resources-Supply				
Mono branch (phase 1)	bn CFA F excl. tax			
treatment		39.1	25%	200,000 m3/d
pumping station		7.9	5%	1 backflow station
reservoirs		5.2	3%	2,000 m3 + 5,000 m3
network		102.8	66%	66 km
land		0.07	0%	7.2 ha
Sub-total 6		**155.1**		
Bd 30 Août site (phase 1)	bn CFA F excl. tax			
pumping station		1.7	11%	1 pumping station
reservoirs		8.1	53%	2,000 m3 + WT 5,000 m3
land		5.4	36%	4.5 ha
Sub-total 7		**15.2**		
remote management	bn CFA F excl. tax			
remote management 3		**0.3**		addition
structuring coverage	bn CFA F excl. tax			
Structuring 3		**6.8**		21.2 km
coverage extension	bn CFA F excl. tax			
tertiary 3		**12.8**		292.5 km
connections	bn CFA F excl. tax			
connections 3		**7.5**		51,200

2035

Resources-Supply				
Desalination (phase 2)	bn CFA F excl. tax			
treatment		75.4	74%	100,000 m3/d
pumping station		2.5	2%	1 backflow station
network		23.9	23%	27.9 km
Sub-total 8		**101.8**		
Caccavelli site (phase 2)	bn CFA F excl. tax			
pumping station		1.6	16%	1 pumping station
reservoirs		8.1	84%	2,000 m3 + WT 5,000 m3
Sub-total 9		**9.7**		
remote management	bn CFA F excl. tax			
remote management 4		**0.1**		addition
structuring coverage	bn CFA F excl. tax			
Structuring 4		**42.4**		100.9 km
coverage extension	bn CFA F excl. tax			
tertiary 4		**13.0**		297.2 km
connections	bn CFA F excl. tax			
connections 4		**18.8**		125,000

2040

Resources-Supply				
Mono branch (phase 2)	bn CFA F excl. tax			
treatment		39.1	23%	200,000 m3/d
pumping station		7.9	5%	1 backflow station
reservoir		8.4	5%	2 * 20,000 m3 + 5,000 m3
network		116.2	68%	66 km + 11 km by-pass
Sub-total 10		**171.6**		
Stade site (phase 2)	bn CFA F excl. tax			
pumping station		1.7	17%	1 pumping station
reservoirs		8.1	83%	2,000 m3 + WT 5,000 m3
Sub-total 11		**9.8**		
remote management	bn CFA F excl. tax			
remote management 4		**0.2**		addition
structuring coverage	bn CFA F excl. tax			
Structuring 5		**23.9**		62.4 km
coverage extension	bn CFA F excl. tax			
tertiary 5		**13.0**		297.2 km
connections	bn CFA F excl. tax			
connections 5		**18.8**		125,000

2045

Resources-Supply				
Desalination (phase 3)	bn CFA F excl. tax			
treatment		98.6	73%	150,000 m3/d
pumping station		3.3	2%	1 backflow station
network		32.3	24%	27.9 km
Sub-total 12		**134.2**		
Bd 30 Août site (phase 2)	bn CFA F excl. tax			
pumping station		1.7	17%	1 pumping station
reservoirs		8.1	83%	2,000 m3 + WT 5,000 m3
Sub-total 13		**9.8**		
remote management	bn CFA F excl. tax			
remote management 6		**0.1**		addition
structuring coverage	bn CFA F excl. tax			
Structuring 6		**23.8**		62.4 km
coverage extension	bn CFA F excl. tax			
tertiary 6		**6.5**		148.6 km
connections	bn CFA F excl. tax			
connections 6		**18.8**		125,000

2050

Resources-Supply				
Desalination (phase 4)	bn CFA F excl. tax			
treatment		98.6	76%	150,000 m3/d
pumping station		3.3	3%	1 backflow station
network		27.6	21%	22.7 km
Sub-total 14		**129.5**		
remote management	bn CFA F excl. tax			
remote management 7		**0.1**		addition
structuring coverage	bn CFA F excl. tax			
Structuring 7		**7.6**		22.8 km
coverage extension	bn CFA F excl. tax			
tertiary 7		**6.5**		148.6 km
connections	bn CFA F excl. tax			
connections 7		**18.8**		125,000

8

Operating costs

Operating expenses (OPEX) refer to the current costs of operating the network. Here we evaluate the additional operating costs generated by the new installations and infrastructure.

The projected investments call for various types of works hypothesis. The operating cost is broken down into:

1. annual operating costs ;
2. annual maintenance costs.

8.1 Operating costs

Annual operating costs have been estimated. These are primarily:

- Electrical energy costs, based on the power and operating times of the new pumping and treatment stations;
- Reagent costs related to treatment.

The energy needs are the subject of Volume 2 of the report, **with a price per kWh considered equal to** 85 CFA francs **and a fee of** 2500 CFA francs/kVA/month.

8.2 Maintenance costs

The annual maintenance and servicing costs have been considered for each category of installation, their estimation is based on 10% of the annual renewal value, with:

- a 100-year lifespan for the civil engineering of tanks and stations;
- a 100-year lifespan for the primary pipelines
- a 50-year lifespan for distribution pipes
- a 10-year lifespan for equipment.

Summary
The following tables summarize the annual operating costs, by branch (intake, treatment, pumping, transfer):

Table 21 : Operating cost per branch

East wellfield (40,000 m3/d) — **Annual amount (MM CFAF)**

Electrical energy	1,400 kVA 25,500 Kwh/d	charges : 2,500 CFAF/Kva/month Kwh cost : 85 CFAF	fixed part: 42.0 MM CFAF variable part: 791.1 MM CFAF
Raegents	Reagents lime, calcium hypochlorite		39.7 MM CFAF
Labor (*)	Direction, Station & control Production & exploitation Maintenance & service		64.5 MM CFAF
Maintenance fees 3 CFAF/m3 produced	Materials, equipment, ressources, auxiliaries and subcontractors		43.8 MM CFAF
General fees 2.5 CFAF/m3 produced	Insurance, analysis material, safety and work equipment etc.		36.5 MM CFAF
Renewal fees 2.8 CFAF/m3 produced	material, common equipment, filters...		40.9 MM CFAF
Total			**1,058.6 MM CFAF**

Desalination (100,000 m3/d) — **Annual amount (MM CFAF)**

Electrical energy	26,000 kVA 495,000 Kwh/d	charges : 2,500 CFAF/Kva/month Kwh cost : 85 CFAF	fixed part: 780.0 MM CFAF variable part: 15,357.4 MM CFAF
Raegents	coagulant, polymer, sulfuric acid, soda, anti-scaling lime, CO2, calcium hypochlorite		1061.8 MM CFAF
Labor (*)	Direction, Station & control Production & exploitation Maintenance & service		191.8 MM CFAF
Maintenance fees 10 CFAF/m3 produced	Materials, equipment, ressources, auxiliaries and subcontractors required for maintenance and conservation of facilities		365.0 MM CFAF
General fees 4.0 CFAF/m3 produced	Insurance, analysis material, safety and work equipment etc.		146.0 MM CFAF
Renewal fees 5.6 CFAF/m3 produced	material, common equipment, filters...		203.7 MM CFAF
Total			**18,105.6 MM CFAF**

Desalination (150,000 m3/d)

Electrical energy	38,000 kVA 735,000 Kwh/d	charges : 2,500 CFAF/Kva/month Kwh cost : 85 CFAF	fixed part: 1,140.0 MM CFAF variable part: 22,803.4 MM CFAF
Raegents	coagulant, polymer, sulfuric acid, soda, anti-scaling lime, CO2, calcium hypochlorite		1,592.7 MM CFAF
Labor (*)	Direction, Station & control Production & exploitation Maintenance & service		254.8 MM CFAF
Maintenance fees 10 CFAF/m3 produced	Materials, equipment, ressources, auxiliaries and subcontractors required for maintenance and conservation of facilities		547.5 MM CFAF
General fees 4.0 CFAF/m3 produced	Insurance, analysis material, safety and work equipment etc.		219.0 MM CFAF
Renewal fees 5.6 CFAF/m3 produced	material, common equipment, filters...		305.5 MM CFAF
Total			**26,862.8 MM CFAF**

Zio (88,000 m3/d)			**Annual amount (MM CFAF)**
Electrical energy	1,730 kVA 31,000 Kwh/d	charges : 2,500 CFAF/Kva/month Kwh cost : 85 CFAF	fixed part: 51.9 MM CFAF variable part: 961.8 MM CFAF
Raegents	coagulant, polymer, sulfuric acid, soda, anti-scaling lime, CO2, calcium hypochlorite		488.1 MM CFAF
Labor (*)	Direction, Station & control Production & exploitation Maintenance & service		113.8 MM CFAF
Maintenance fees 5 CFAF/m3 produced	Materials, equipment, ressources, auxiliaries and subcontractors required for maintenance and conservation of facilities		164.3 MM CFAF
General fees 3.0 CFAF/m3 produced	Insurance, analysis material, safety and work equipment etc.		98.6 MM CFAF
Renewal fees 4.0 CFAF/m3 produced	material, common equipment, filters...		131.4 MM CFAF
Dam	maintenance of the reservoir, installation and flooded area		50.0 MM CFAF
Total			**2,059.8 MM CFAF**

Table 22 : Operating cost per branch – continuation

Mono (200,000 m3/d)			**Annual amount (MM CFAF)**
Electrical energy	7,700 kVA 160,000 Kwh/d	charges : 2,500 CFAF/Kva/month Kwh cost : 85 CFAF	fixed part: 231.0 MM CFAF variable part: 4,964.0 MM CFAF
Raegents	coagulant, polymer, sulfuric acid, soda, anti-scaling lime, CO2, calcium hypochlorite		878.0 MM CFAF
Labor (*)	Direction, Station & control Production & exploitation Maintenance & service		199.1 MM CFAF
Maintenance fees 5 CFAF/m3 produced	Materials, equipment, ressources, auxiliaries and subcontractors required for maintenance and conservation of facilities		365.0 MM CFAF
General fees 3.0 CFAF/m3 produced	Insurance, analysis material, safety and work equipment etc.		219.0 MM CFAF
Renewal fees 4.0 CFAF/m3 produced	material, common equipment, filters...		292.0 MM CFAF
Total			**7,148.1 MM CFAF**

Caccavelli, Stadium, Bd 30 Août sites, with tanks/pumping stations/water tower			**Annual amount (MM CFAF)**
Electrical energy	800 kVA 15,000 Kwh/d	charges : 2,500 CFAF/Kva/month Kwh cost : 85 CFAF	fixed part: 24.0 MM CFAF variable part: 465.4 MM CFAF
Various charges	overhead, labor, maintenance		878.0 MM CFAF
Total			**7,148.1 MM CFAF**

(*) Labour estimated on a pro rata basis for a plant with the same process and capacity range

Table 23 : Summary of indicative annual operating costs by period

	Périodes					
Site	**2025-2028**	**2028-2030**	**2030-2035**	**2035-2040**	**2040-2045**	**2045-2050**
Branche Champ Captant Est	1,1	1,1	1,1	1,1	1,1	1,1
Branches dessalement	18,1	18,1	18,1	36,2	63,1	89,9
Branche Zio	-	2,1	2,1	2,1	2,1	2,1
Branches Mono	-	-	7,1	7,1	14,3	14,3
Site Cacavelli	0,5	0,5	0,5	1,0	1,0	1,0
Site Stade	1,0	1,0	1,0	1,0	1,0	1,0
Site bd 30-août	-	-	0,5	0,5	0,5	1,0
conduites d'adduction	0,1	0,2	0,2	0,4	0,4	0,4
conduites structurante	0,0	0,1	0,1	0,1	0,1	0,1
conduites desserte	0,0	0,1	0,1	0,2	0,2	0,2
Total	**21 Mds Fcfa/an**	**23 Mds Fcfa/an**	**30 Mds Fcfa/an**	**49 Mds Fcfa/an**	**83 Mds Fcfa/an**	**111 Mds Fcfa/an**

9

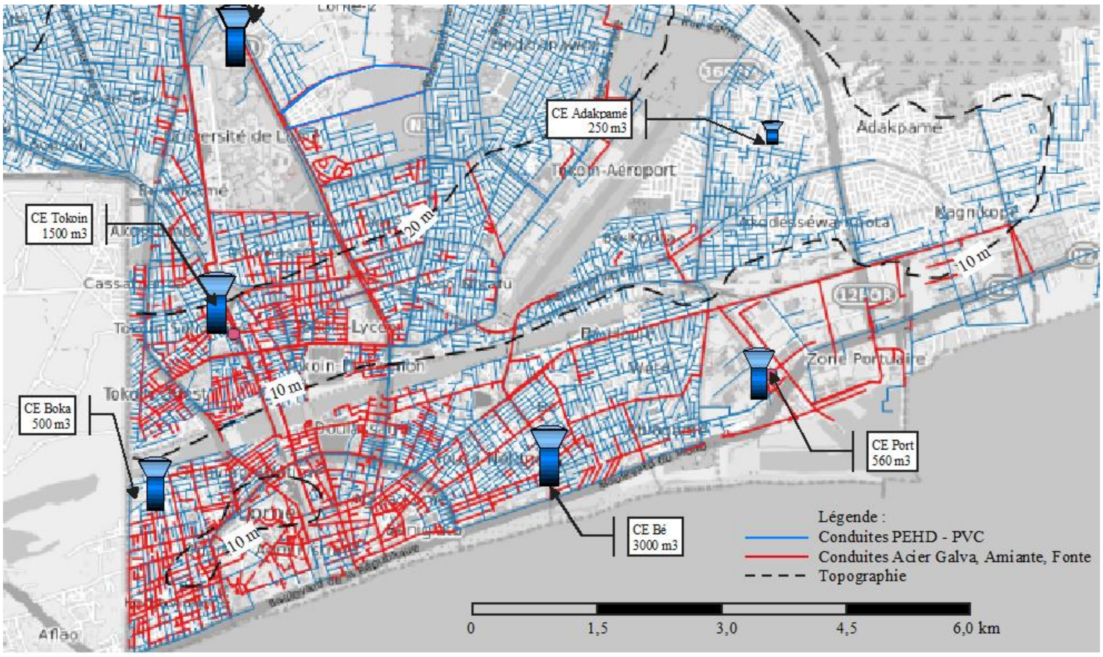
Renewal

9.1 Canalizations

Pipes that are laid in good condition and operate under pressure can have a service life of over 50 years. In the case of the existing network in Lomé, the network is not under load all day long and in some places contains materials laid before the 1980s, such as steel, asbestos, grey cast iron and zinc.

These materials are located in the oldest part of the city, with average reference pressures in 2020 varying between 3 and 5m. The recent commissioning of new boreholes in the lower part of the city (Oct. 2021) and the loading of the network from the Boka and Bè reservoirs has been made very difficult due to the state of the distribution network.

Figure 47 : Location of old pipe materials



We propose to consider this area as a priority for renewal - ***Paragraph 5.4.2*** also proposes a sectorization of this area into sub-areas.

Table 24 : Linear of pipe to be renewed as a priority

matériaux	Ø ≤ 63mm	63 < Ø ≤ 125mm	125 < Ø ≤ 175mm	175 < Ø ≤ 250mm	total
ACIER	357 ml	8 972 ml	397 ml	-	9 726 ml
AMIANTE	-	17 517 ml	4 353 ml	-	21 870 ml
FONTE	2 768 ml	46 822 ml	8 148 ml	28 027 ml	85 765 ml
GALVA	63 481 ml	14 564 ml	5 280 ml	4 331 ml	87 656 ml
total	66 606 ml	87 875 ml	18 178 ml	32 358 ml	205 017 ml
Montant Mds Fcfa HTHD	**2,5**	**4,4**	**1,2**	**3,0**	**11,0 Mds Fcfa HTHD**

The renewal of this area, which is known to be very leaky, should be carried out before the additional resources are put back into the network, therefore before 2026.

The condition of the rest of the network, mostly in PVC (80% of the linear), is not well known. It does not remain under uniform load throughout the day. We propose to retain a minimum average annual rate of 1.5%/year, which would allow the renewal of about one third of the current network by 2050.

In proportion to the average diameters of the network, the annual amount corresponding to approximately 22 km of linear to be renewed is 1.2 billion CFA francs excluding tax per year.

9.2 Connections

The technical lifespan of a service line is approximately 30 years.

As part of the renewal work on the 205 km of the priority network, the connections concerned will be renewed, i.e. approximately 10,000 connections and 1.5 billion CFA francs of excluding taxes, before 2026.

For the rest of the network, the proposed number of connection renewals per year is about 1,000 units - it corresponds to the length of the network to be renewed per year and allows the renewal by 2050 of all the connections that are more than 5 years old today, i.e. 0.15 billion CFA francs excluding taxes per year.

9.3 Water meters

La durée de vie technique d'un branchement est d'environ 15 ans.

We consider a renewal of 5,000 meters per year until 2030, 10,000 meters per year until 2040 and 20,000 meters per year until 2050.

9.4 Tanks and pumping stations

The structural condition of the reservoirs and water towers is good, except for the Tokoin water tower. A provision of a budget corresponding to the asset value of this water tower is planned for 1 billion CFA francs (excluding tax) until 2050.

A provision of a budget corresponding to the asset value of the equipments of the Caccavelli pumping station is planned for 0.8 billion CFA francs excluding tax until 2050.

9.5 Wellfield and treatment

A provision of a budget corresponding to the patrimonial value of the drilling equipments and 50% of the civil engineering is foreseen for 6 billion CFA francs (excluding taxes) until 2050.

A provision of a budget corresponding to the patrimonial value of the treatment equipments existing on the Caccavelli site and of 50% of its civil engineering is foreseen for 5 billion Fcfa (excluding tax) until 2050.

9.6 Conclusion

The asset renewal policy proposed in the Master Plan for the year 2050, aims to act as a priority on installations at risk of failure over the period, in order to ensure the proper operating conditions of the system.

The financial resources to be deployed for the works during the period on the existing installations is about 68 billion CFA francs excluding taxes until 2050.

Table 25 : Summary of renewals by year and period

nature des renouvellements proposés (Mds Fcfa HT)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	Total
réseau de distribution	3,7	3,7	3,7	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	**41,0 Mds Fcfa**
branchements	0,5	0,5	0,5	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	**5,3 Mds Fcfa**
compteurs	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	**8,5 Mds Fcfa**
réservoir Tokoin																													**1,0 Mds Fcfa**
Cacavelli- Station de pompage	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	**0,8 Mds Fcfa**
Champ captant et traitement																													**11,0 Mds Fcfa**
Montants annuels	4,7	4,7	4,7	1,9	1,9	1,9	1,9	1,9	2,1	2,1	2,1	2,1	2,1	2,1	2,1	2,1	2,1	2,1	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	**67,6 Mds Fcfa**

Périodes	2023-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050	Total (Mds Fcfa HTHD)
réseau de distribution	11,0	6,0	6,0	6,0	6,0	6,0	41,0
branchements	1,5	0,8	0,8	0,8	0,8	0,8	5,3
compteurs	0,4	0,6	1,3	1,3	2,5	2,5	8,5
réservoir Tokoin							
Cacavelli- Station de pompage	1,4	2,3	2,3	2,3	2,3	2,3	12,8
Champ captant et traitement							
investissements par période	**14,2**	**9,7**	**10,3**	**10,3**	**11,5**	**11,5**	**67,6**
investissements cumulés	**14,2**	**23,9**	**34,2**	**44,5**	**56,0**	**67,6**	

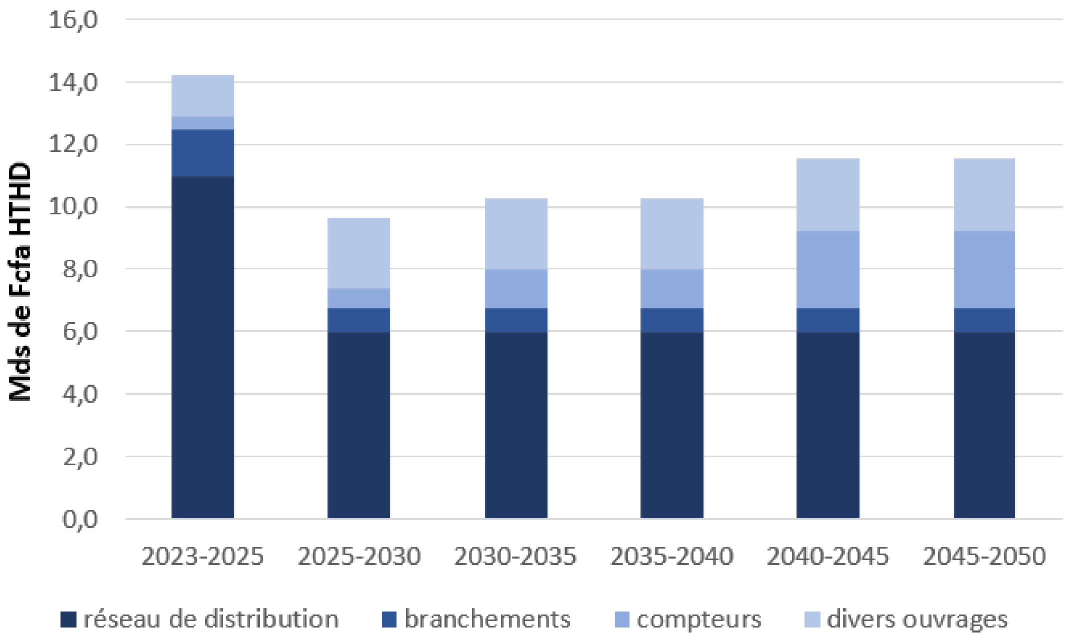

16,0
14,0
12,0
10,0
8,0
6,0
4,0
2,0
0,0
Mds de Fcfa HTHD
2023-2025
2025-2030
2030-2035
2035-2040
2040-2045
2045-2050
réseau de distribution
branchements
compteurs
divers ouvrages

TABLE OF APPENDICES

APPENDIX 1

WATER SUPPLY AND PROTECTION AGAINST TRANSITORIAL EVENTS

The objective of this appendix is to present the calculation of the conveyance and the associated transient phenomena, between the plants at the resources and the loading reservoirs, and to propose a protection sizing if it is necessary.

APPENDIX 2

INVESTMENT PLAN FOR RESOURCES AND WATER SUPPLY

The presentation of the Investment Plans includes for each project line (about 160) an identifier in the nomenclature, in order to locate the project on one of the network plans or on the functional synoptic. Each project is located in the municipality where it is situated (the word "out of area" is indicated when it is located outside Greater Lomé), it is briefly characterized technically and related to unit prices, as detailed in Chapter 6. Finally, a start and end date for the work is proposed according to its emergency nature and the general evolution of the network as presented in the report.

APPENDIX 3

INVESTMENT PLAN FOR STRUCTURING COVERAGE INFRASTRUCTURES

The presentation of the Investment Plans includes for each project line (about 200) an identifier in the nomenclature, in order to locate the project on one of the Network Plans. Each project is located in the municipality where it is situated ("out of area" is indicated when it is outside the Greater Lomé area), it is briefly characterized technically and referred to unit prices, as detailed in Chapter 6. Finally, a start and end date for the work is proposed according to its emergency nature and the general evolution of the network as presented in the report.