

2.5.9 Diagnosis of the Existing Sewerage System Infrastructure

(1) Objectives

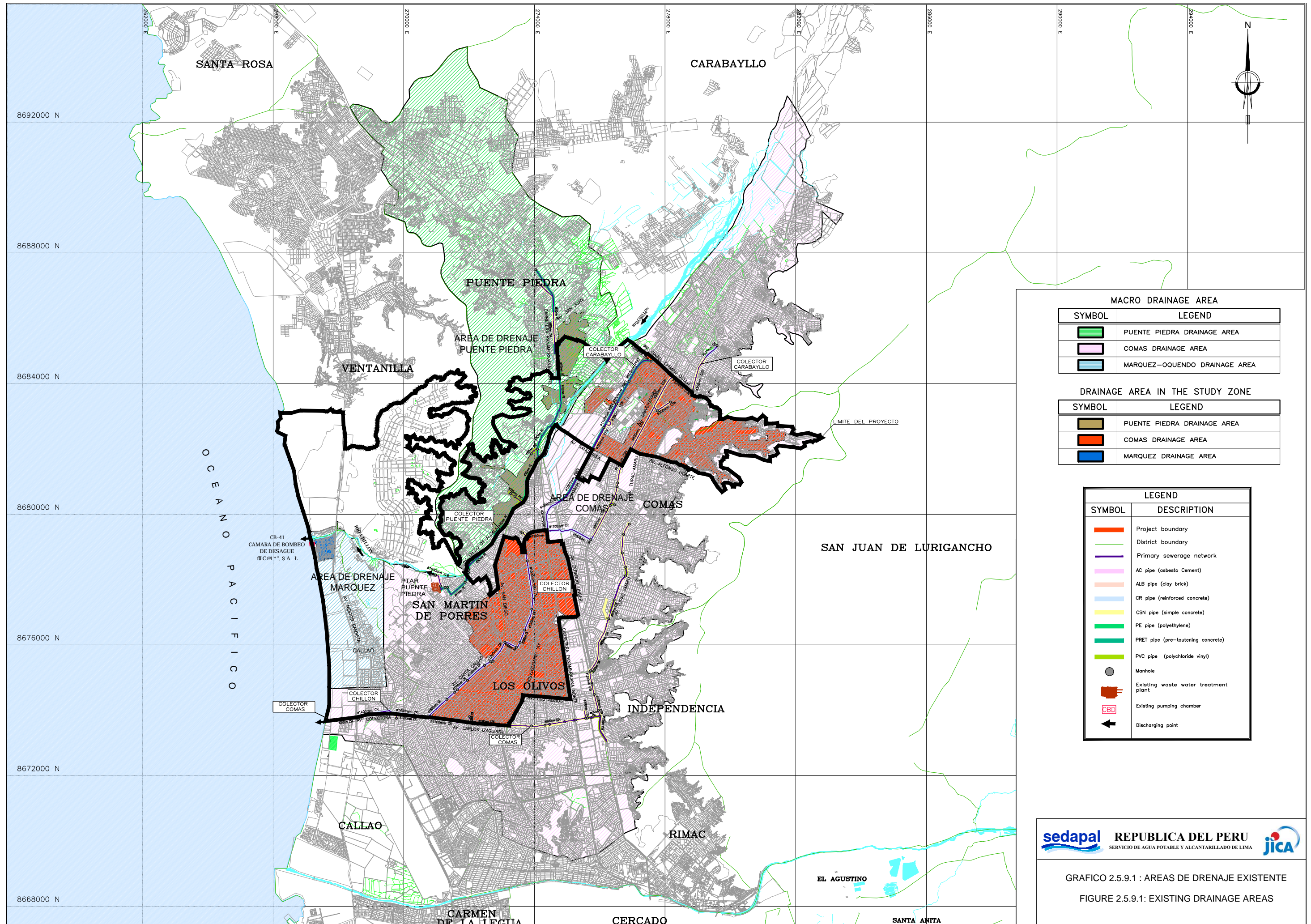
The objective of the present Study is to optimize the existing secondary sewers in the Study Area by rehabilitation or replacement; the Study Area is defined in Section 2.5.1. This Section analyzes the current condition of the secondary sewers in order to diagnose the problems and requirements.

The rehabilitation of primary sewers will take place through a study called “Rehabilitation for Primary Sewers Related with the Water and Sewerage Network Rehabilitation Projects – Lima Norte I and Lima Norte II.” It is known that SEDAPAL has finished carrying out the Terms of Reference for the study of this project at Pre F/S level (Perfil). This Perfil shall be included in the 2011 annual budget, under the consideration that the Perfil should conclude in 2012¹.

(2) Background

The Study Area is part of two large drainage areas called Puente Piedra and Comas, and a small drainage area called Márquez-Oquendo, which can be seen in Figure 2.5.9-1. Some remaining parts of the Study Area have no sewerage system, thus it is not part of any drainage area. In this figure, there are sewerage systems in the area below Marquez drainage area, but not under SEDAPAL administration yet, thus it is beyond the scope of this Study.

¹ Memorandum N° -368-2010-GDI directed to Polo Agüero, Leader of North Management Team; Project for Rehabilitation for Primary Sewers Related with the Water and Sewerage Network Rehabilitation Projects – Lima Norte I and Lima Norte II



MACRO DRAINAGE AREA

SYMBOL	LEGEND
[Green hatched box]	PUENTE PIEDRA DRAINAGE AREA
[Pink hatched box]	COMAS DRAINAGE AREA
[Blue hatched box]	MARQUEZ-OQUENDO DRAINAGE AREA

DRAINAGE AREA IN THE STUDY ZONE

SYMBOL	LEGEND
[Brown hatched box]	PUENTE PIEDRA DRAINAGE AREA
[Orange hatched box]	COMAS DRAINAGE AREA
[Blue hatched box]	MARQUEZ DRAINAGE AREA

LEGEND

SYMBOL	DESCRIPTION
[Red line]	Project boundary
[Green line]	District boundary
[Purple line]	Primary sewerage network
[Pink line]	AC pipe (asbesto Cement)
[Orange line]	ALB pipe (clay brick)
[Light blue line]	CR pipe (reinforced concrete)
[Yellow line]	CSN pipe (simple concrete)
[Green line]	PE pipe (polyethylene)
[Dark green line]	PRET pipe (pre-tautening concrete)
[Light green line]	PVC pipe (polychloride vinyl)
[Grey circle]	Manhole
[Red square]	Existing waste water treatment plant
[Red square with CBD]	Existing pumping chamber
[Black arrow]	Discharging point

GRAFICO 2.5.9.1 : AREAS DE DRENAJE EXISTENTE
 FIGURE 2.5.9.1: EXISTING DRAINAGE AREAS

The extension of the drainage areas and their portions in the Study Area is shown in Table 2.5.9-1.

Table 2.5.9-1: Drainage Area and Wastewater Treatment

Drainage Area (AD)	Area		Wastewater Treatment	
	Area included in the Study Area (ha)	Total Area (ha)	Present	Future
Comas	2,206.40	11,908.4	-	Taboada WWTP*
Puente Piedra	297.80	5,271.8	Puente Piedra WWTP	Puente Piedra WWTP
Márquez	36.80	36.80	-	Taboada WWTP*
Grand Total	2,541.00	1,721.7	-	-

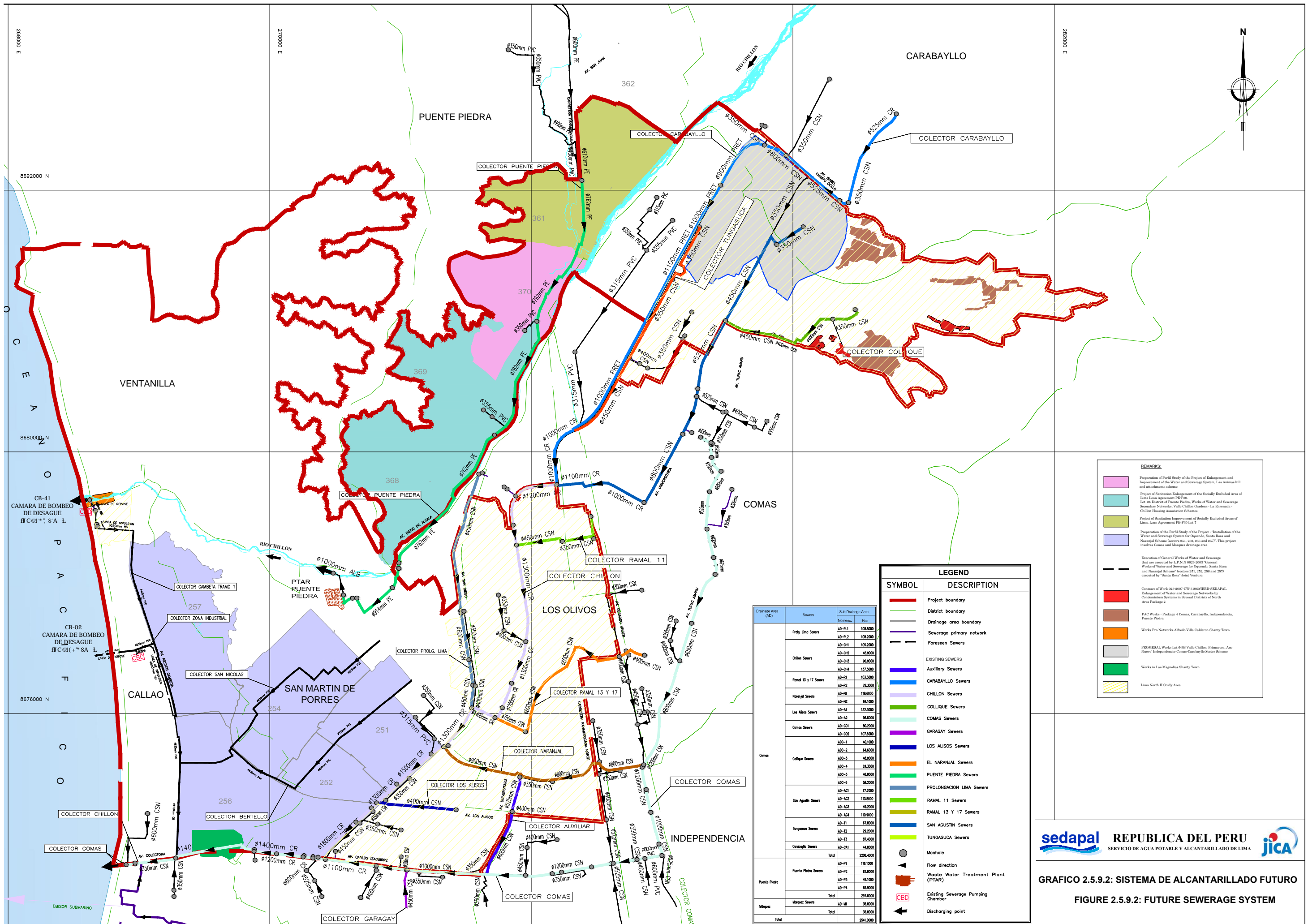
*: scheduled to begin operation in 2013

Source: SEDAPAL Cadastre and JICA Study Team

As shown in the table above, wastewater generated in Puente Piedra AD is treated in the Puente Piedra Wastewater Treatment Plant (WWTP) by primary treatment. On the other hand, however, Comas AD and Márquez AD do not have treatment plant and the wastewater generated in those AD are currently discharged to the sea without treatment.

SEDAPAL has agreed with a Spanish private company on a 25-year BOT contract on construction and operation of a new wastewater treatment plant with a capacity of 14m³/s, named Taboada WWTP. The treatment method is primary treatment process with sedimentation tanks, which is designed based on the National Sanitation Standard, and the treated water will be diffused to the sea at a point distanced 3.8 km from the seashore through a discharge pipe. The WWTP is currently under the design stage and is scheduled to begin operation in 2013. All wastewater generated in Comas AD and Márquez AD is planned to be treated by the Taboada WWTP after completion of the project (2015).

Figure 2.5.9-2 shows the future discharge point; the areas not shown in yellow are not going to be included in the Study area because the sewer pipes in the areas have been rehabilitated by other projects as mentioned in detail in section 2.5.9 (3).



- REMARKS:**
- Preparation of Perfil Study of the Project of Enlargement and Improvement of the Water and Sewerage System, Las Antenas hill and attachments scheme.
 - Project of Sanitation Enlargement of the Socially Excluded Area of Lima, Loan Agreement PE-F10, Lot 10 (District of Puente Piedra, Works of Water and Sewerage Secondary Networks, Valle Chillon Gardens - La Rosanada - Chillon Housing Association Schemes).
 - Project of Sanitation Improvement of Socially Excluded Areas of Lima, Loan Agreement PE-F10 Lot 7.
 - Preparation of the Perfil Study of the Project: "Installation of the Water and Sewerage System for Oquendo, Santa Rosa and Nacional Scheme" sections 251, 252, 256 and 257. This project involves Comas and Marquet drainage areas.
 - Execution of General Works of Water and Sewerage that are executed by I.P.S.A. (1997-2003) "General Works of Water and Sewerage for Oquendo, Santa Rosa and Nacional Scheme" sections 251, 252, 256 and 257, executed by "Santa Rosa" Joint Venture.
 - Contract of Work 021-2007-CW-310001HEB-SEDAPAL, Enlargement of Water and Sewerage Networks by Condominium Systems in Several Districts of North Area Package 2.
 - PAC Works - Package 4 Comas, Carabayllo, Independencia, Puente Piedra.
 - Works Pro-Networks Alfredo Villa Calderon Shanty Town.
 - FROMESAL Works Lot 6-III Valle Chillon, Primavera, San Nuevo Independencia-Comas-Carabayllo-Sector Scheme.
 - Works in Las Magnolias Shanty Town.
 - Lima North II Study Area.

LEGEND	
SYMBOL	DESCRIPTION
	Project boundary
	District boundary
	Drainage area boundary
	Sewerage primary network
	Foreseen network
	EXISTING SEWERS
	Auxiliary Sewers
	CARABAYLLO Sewers
	CHILLON Sewers
	COLLIQUE Sewers
	COMAS Sewers
	GARAGAY Sewers
	LOS ALISOS Sewers
	EL NARANJAL Sewers
	PUENTE PIEDRA Sewers
	PROLONGACION LIMA Sewers
	RAMAL 11 Sewers
	RAMAL 13 Y 17 Sewers
	SAN AGUSTIN Sewers
	TUNGASUICA Sewers
	Manhole
	Flow direction
	Waste Water Treatment Plant (PTAR)
	Existing Sewerage Pumping Chamber
	Discharging point

Drainage Area (AD)	Sewers		Sub Drainage Area (ADM)
	Nomencl.	Has	
Comas	Proj. Line Sewers		
	AD-P11	108,8000	
	AD-P12	108,2000	
	AD-C01	105,2000	
	AD-C02	45,9000	
	AD-C03	96,9000	
	AD-C04	137,5000	
	AD-R1	103,3000	
	AD-R2	78,3000	
	AD-R3	118,6000	
	AD-R4	84,1000	
	AD-R5	132,3000	
	AD-R6	96,8000	
AD-C05	80,2000		
AD-C06	107,6000		
Callao	AD-C07	40,1000	
	AD-C08	64,8000	
	AD-C09	48,9000	
	AD-C10	24,3000	
	AD-C11	48,9000	
San Agustín	AD-A01	17,7000	
	AD-A02	113,8000	
	AD-A03	49,2000	
	AD-A04	110,9000	
Tungasuica	AD-T01	67,8000	
	AD-T02	29,2000	
	AD-T03	87,4000	
Carabayllo	AD-CB1	44,0000	
Total		2206,0000	
Puente Piedra	AD-P13	116,1000	
	AD-P14	62,8000	
	AD-P15	49,1000	
	AD-P16	69,9000	
Total		297,9000	
Marquet	AD-M01	36,8000	
	AD-M02	36,8000	
Total		2541,0000	

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GRAFICO 2.5.9.2: SISTEMA DE ALCANTARILLADO FUTURO
FIGURE 2.5.9.2: FUTURE SEWERAGE SYSTEM

Table 2.5.9-2 shows the three drainage areas that are functioning in the Study area. The table also gives the areas of drainage sub areas as defined in the Perfil Study based on flow direction, and level of manholes.

Table 2.5.9-2: Drainage Sub-areas

Drainage Areas (AD)	Sewers	Drainage Sub-Areas	
		Name	Hectares
Comas	Prolg. Lima Sewer	AD-PL1	108.8
		AD-PL2	108.2
	Chillón Sewer	AD-CH1	105.2
		AD-CH2	45.9
		AD-CH3	96.9
		AD-CH4	137.5
	Ramal 13 and 17 Sewer	AD-R1	103.3
		AD-R2	78.3
	Naranjal Sewer	AD-N1	118.6
		AD-N2	84.1
	Los Alisos Sewer	AD-A1	132.3
		AD-A2	96.6
	Comas Sewer	AD-CO1	80.2
		AD-CO2	107.6
	Collique Sewer	ADC-1	40.1
		ADC-2	64.6
		ADC-3	48.9
		ADC-4	24.3
		ADC-5	46.9
		ADC-6	58.2
San Agustín Sewer	AD-AG1	17.7	
	AD-AG2	113.8	
	AD-AG3	49.2	
	AD-AG4	110.9	
Tungasuca Sewer	AD-T1	67.8	
	AD-T2	29.2	
	AD-T3	87.4	
Carabayllo Sewer	AD-CA1	44.0	
	Total		2206.4
Puente Piedra	Puente Piedra Sewer	AD-P1	116.1
		AD-P2	62.6
		AD-P3	49.1
		AD-P4	69.9
	Total		297.8
Márquez	Márquez Sewer	AD-M1	36.8
	Total		36.8
Grand Total			2541.0

Source: JICA Study Team

It must be pointed out that the Master Plan contemplates the future construction of 2 wastewater treatment plants in the study area, the San Felipe WWTP and the Sinchi Roca WWTP.

According to the SEDAPAL's Investigation and Development Management's Research, Standardization, and Physical Planning Team, the San Felipe WWTP cannot be built as the planned location for its construction has no available land area. Instead, a possibility to extend the Puente Piedra WWTP is being analyzed.

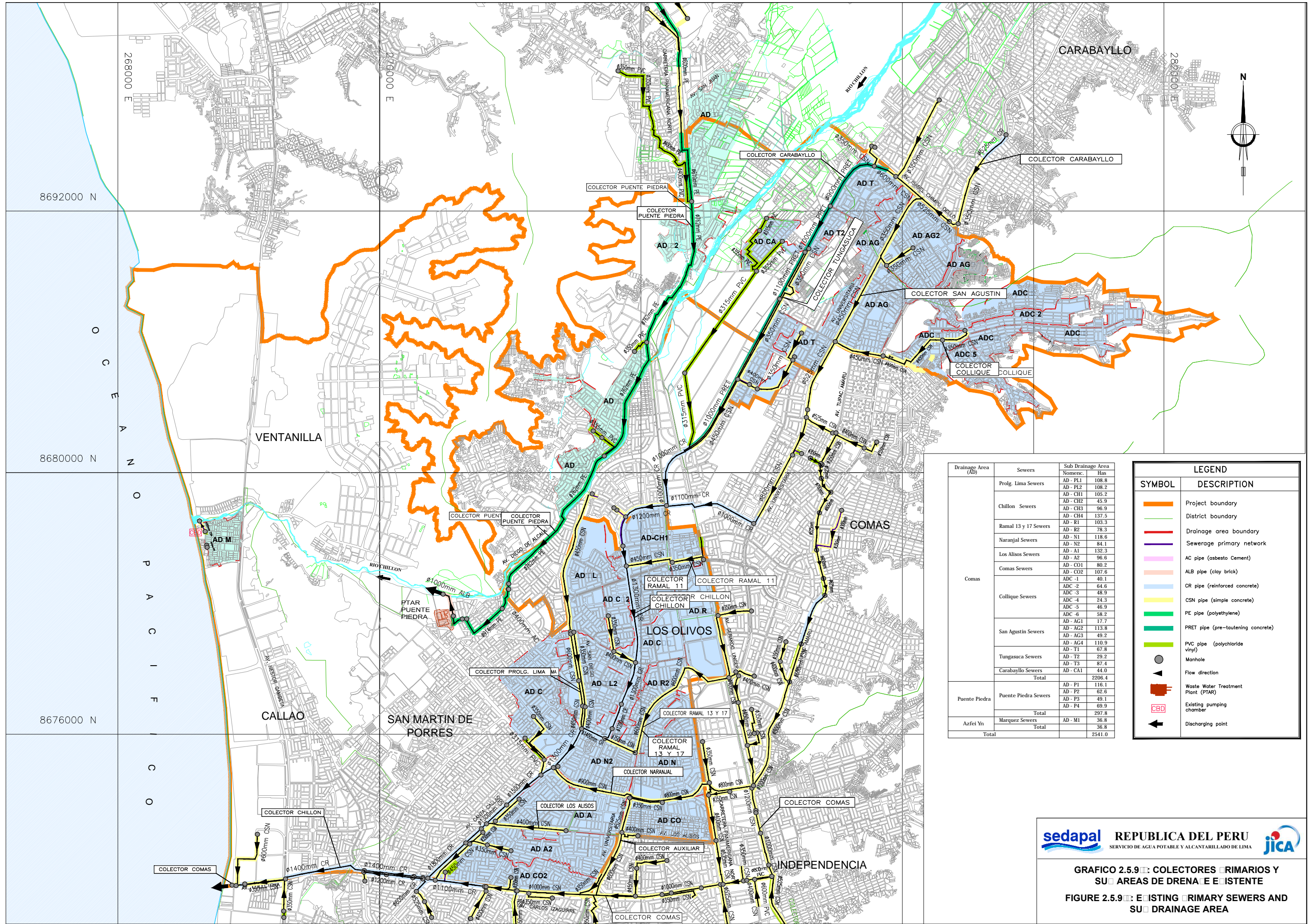
As the Sinchi Roca WWTP is located on the Sinchi Roca Park Zone, no decisions have been made to build a plant yet.

(3) Sewerage System

SEDAPAL differentiates the primary sewers and the secondary sewers in the following way:

- The primary sewers are pipes with a diameter between 350 mm (14") and 1,800 mm (72").
- The secondary sewers are pipes with a diameter between 160 mm (6") and 350 mm (14").

Figure 2.5.9-3 shows the existing drainage sub-areas, as well as the primary sewers that go through this drainage area.



Drainage Area (AD)	Sewers	Sub Drainage Area		
		Nomencl.	Has	
Carabayllo	Prolg. Lima Sewers	AD - PL1	108.8	
		AD - PL2	108.2	
		AD - CH1	105.2	
		AD - CH2	45.9	
		AD - CH3	96.9	
		AD - CH4	137.5	
		AD - R1	103.3	
		AD - R2	78.3	
		AD - N1	118.6	
		AD - N2	84.1	
Comas	Los Alisos Sewers	AD - A1	132.3	
		AD - A2	96.6	
		AD - CO1	80.2	
		AD - CO2	107.6	
		ADC - 1	40.1	
		ADC - 2	64.6	
		ADC - 3	48.9	
		ADC - 4	24.3	
		ADC - 5	46.9	
		ADC - 6	58.2	
San Agustín	San Agustín Sewers	AD - AG1	17.7	
		AD - AG2	113.8	
		AD - AG3	49.2	
		AD - AG4	110.9	
		AD - T1	67.8	
		AD - T2	29.2	
		AD - T3	87.4	
		AD - CA1	44.0	
		Total		2206.4
		Puente Piedra	Puente Piedra Sewers	AD - P1
AD - P2	62.6			
AD - P3	49.1			
AD - P4	69.9			
Total	297.8			
Azfei Yn	Marquez Sewers	AD - M1	36.8	
		Total	36.8	
Total		2541.0		

LEGEND	
SYMBOL	DESCRIPTION
	Project boundary
	District boundary
	Drainage area boundary
	Sewerage primary network
	AC pipe (asbestos Cement)
	ALB pipe (clay brick)
	CR pipe (reinforced concrete)
	CSN pipe (simple concrete)
	PE pipe (polyethylene)
	PRET pipe (pre-tautering concrete)
	Manhole
	Flow direction
	Waste Water Treatment Plant (PTAR)
	Existing pumping chamber
	CBD
	Discharging point

GRAFICO 2.5.9: COLECTORES PRIMARIOS Y SU AREAS DE DRENANEA EXISTENTE
FIGURE 2.5.9: EXISTING PRIMARY SEWERS AND SU DRAINAGE AREA

1) Primary Sewerage System

The drainage areas in the Study area and their respective sewerage systems are detailed in the following items.

(a) Comas Drainage Area

This drainage area involves the districts of Comas, Independencia, Los Olivos, and a part of the districts of Carabayllo, San Martín de Porres and Callao; it has a total drainage area of 11,908.4 hectares.

The Study Area included in this Comas drainage area includes parts of the Comas, Los Olivos and San Martín de Porres districts, with a total drainage area of 2,206.4 hectares.

The Comas-Chillón main collector is the main sewer in this drainage area, and the sewage from the area flows to the main collector by gravity. This sewer collects wastewater from the districts of Carabayllo, Comas, and Los Olivos, as well as partially from Independencia; San Martín de Porres and Callao, and discharges to the sea without treatment.

The technical information about this main collector is given here:

- Diameter of pipe: 1,350 mm (54")
- Drainage Area: 11,908.4 hectares

Main contributors: Comas, Chillón, Garagay, Palao, Ingeniería, Carabayllo.

This main collector discharges directly to the sea at Oquendo Beach – Callao. Opposite Av. El Emisor, but part of its waters are used raw for agricultural purposes.

The total length of the main collector is 82.537km.

Primary Sewers:

In the Study Area, the Comas drainage area contains the following primary sewers:

- | | |
|---------------------|---------------------|
| - Comas Sewer | - Naranjal Sewer |
| - Túpac Amaru Sewer | - Ingeniería Sewer |
| - Infantas Sewer | - Carabayllo Sewer |
| - San Agustín Sewer | - San Diego Sewer |
| - Trapiche Sewer | - 13 and 17 Sewers |
| - Chillón Sewer | - Naranjal Spillway |

In terms of pipe material, pipes are predominantly made of Simple Standard Concrete (64.8%). See Table 2.5.9-3.

Table 2.5.9-3: Length of Primary Sewers by Material

Drainage Area	Diameter Mm	Type of Material / Length (m)					Sub Total (m)	%
		AC	RC	SC	PSC	PVC		
Comas	350			12,225.5		2.10	12,227.6	24.96
	355					1,574.50	1,574.5	3.21
	400	291.4		4,491.9			4,783.3	9.76
	450			6,249.2			6,249.2	12.76
	525			1,290.1			1,290.1	2.63
	600		14.5	3,992.6			4,007.0	8.18
	750			514.5			514.5	1.05
	800			1,244.9			1,244.9	2.54
	900			1,479.0	1,221.7		2,700.7	5.51
	1000		26.0	232.6	1,558.9		1,817.6	3.71
	1100			672.7		814.1	1,486.8	3.04
	1200			2,014.3			2,014.3	4.11
	1300			4,307.3			4,307.3	8.79
	1400			2,813.1			2,813.1	5.74
	1500			842.8			842.8	1.72
	1800			1,113.1			1,113.1	2.27
	Total	291.4	11,803.8	31,720.3	3,594.7	1,576.6	48,986.9	100.00
	%	0.6	24.1	64.8	7.3	3.2		

Note: AC = Asbestos Cement, RC = Reinforced Concrete, SC = Simple Concrete, PSC = Pre Stressed Concrete, PVC = Poly Vinyl Chloride

Source: ECRF

The pipes with an age of between 10 and 25 years represent 25.5 % of the total. See Table 2.5.9-4.

Within this drainage area, the drainage sub-areas have also been defined:

Sinchi Roca: Located in the Comas district; according to SEDAPAL's Master Plan, the Sinchi Roca WWTP is proposed to treat the wastewater generated in the Collique zone. However, as mentioned above, SEDAPAL has not decided the construction of this WWTP yet.

Oquendo: Located in the San Martín and Comas districts, it is proposed that wastewater will be treated in the Taboada WWTP.

Table 2.5.9-4: Length of Primary Sewers by Age

Drainage Area	Diameter	Age / Length (m)					Sub Total (m)	%
	Mm	No Data	< 10	> 35	10 to 25	25 to 35		
Comas	350	5,054.2	1,827.2	486.2	4,060.9	799.1	12,227.6	25.0
	355	24.6	1,549.9				1,574.5	3.2
	400	1,961.4	828.2	145.4	1,848.3		4,783.3	9.8
	450	2,862.3	558.2		2,461.9	366.8	6,249.2	12.80
	525	707.0			399.6	183.5	1,290.1	2.60
	600	2,782.7			948.8	275.5	4,007.0	8.20
	750				514.5		514.5	1.10
	800	150.1		1,094.7			1,244.9	2.50
	900	1,237.3		282.9	614.9	565.7	2,700.7	5.50
	1000	1,610.8			206.8		1,817.6	3.70
	1100	1,486.8					1,486.8	3.00
	1200	938.7			400.2	675.4	2,014.3	4.10
	1300	2,937.7	135.1		898.8	335.8	4,307.3	8.80
	1400	2,266.9	396.0		150.2		2,813.1	5.70
	1500	842.8					842.8	1.70
	1800	1,113.1					1,113.1	2.30
	Total	25,976.2	5,294.7	2,009.2	12,505.1	3,201.7	48,986.9	100.00
	%	53.0	10.8	4.1	25.5	6.5		

Source: ECRF

(b) Puente Piedra Drainage Area

This drainage area involves the Puente Piedra district and part of the Carabayllo district and it has a Drainage Area of 5,271.8 hectares.

The Study area included in this Puente Piedra drainage area includes part of the Puente Piedra district and has a Drainage area of 297.8 hectares.

The Puente Piedra main collector is the main sewer, and the sewage from the Study Area flows to the main collector by gravity. The main collector discharges in the Puente Piedra Wastewater Treatment Plant (WWTP). This treatment plant uses an activated sludge process with a capacity of 450 l/s.

Main Collector: The Puente Piedra main collector is the main sewer, and various interceptors called primary sewers join it by gravity. It partially covers the districts of Los Olivos, San Martín de Porres and Puente Piedra.

The most relevant information about this main collector is as follows:

- Discharge diameter : 914 mm
- Drainage Area: : 5,271.8 hectares

This main collector delivers sewage to the Puente Piedra WWTP, which is then discharged into the Chillón River.

Primary Sewers: The primary sewers of this drainage system included in the Study area are comprised of approximately 9.8 km of pipes, whose diameters range from 350mm to 1219mm.

The piping material is predominantly made up of PE, which accounts for 77.2% of the total. See Table 2.5.9-5.

Table 2.5.9-5: Length of Primary Sewers by Type of Material

Drainage Area	Diameter	Material / Length (m)			Sub Total (m)	%
	Mm	AC	PE	PVC		
Puente Piedra	350			968.7	968.7	9.80
	355			251.8	251.8	2.60
	400	748.1		274.3	1,022.4	10.40
	610		792.2		792.2	8.10
	762		5,529.3		5,529.3	56.20
	914		1,022.9		1,022.9	10.40
	1219		252.8		252.8	2.60
	Total	748.1	7,597.2	1,494.8	9,840.1	100.00
%		7.6	77.2	15.2		

Source: ECRF

The pipes with less than 10 years of age represent 24.9% of the total. See Table 2.5.9-6.

Table 2.5.9-6: Length of Primary Sewers by Age

Drainage Area	Diameter	Age / Length (m)			Sub Total (m)	%
	Mm	No Data	< 10	10 to 25		
Puente Piedra	350	147.9	589.5	231.3	968.7	9.80
	355	251.8			251.8	2.60
	400	800.3	222.1		1,022.4	10.40
	610	792.2			792.2	8.10
	762	3,992.3	1,537.0		5,529.3	56.20
	914	1,022.9			1,022.9	10.40
	1219	153.5	99.3		252.8	2.60
	Total	7,161.1	2,447.8	231.3	9,840.1	100.00
%		72.8	24.9	2.4		

Source: ECRF

(c) Márquez-Oquendo Drainage Area

This area is limited by the coastline of the sea and the Comas drainage area. It has a drainage area of 36.8 hectares, and it includes part of the Callao district. Area south of this drainage area has a sewerage system which is not administrated by SEDAPAL yet.

The Study Area included in this drainage area includes part of the Callao district. The entire drainage area is included in the Study area.

Because of the drainage area's topography, it requires a pumping system, which discharges wastewater to the Chillón River without any treatment.

Main Collector: The technical information regarding the main collector is as follows:

- The discharge diameter is 350 mm
- Area of Drainage: 839.7 hectares
- This main collector discharges to the Chillón River without any treatment.

Primary Sewers: The primary sewer in the Study Area is made up of approximately 0.2 km of piping with a diameter of 350 mm.

The single material used in the sewer is Simple Standard Concrete. See Table 2.5.9-7.

Table 2.5.9-7: Length of Primary Sewers by Type of Material

Drainage Area	Diameter	Material / Length (m)	Sub Total (m)	%
	Mm	CSN		
Márquez	350	165.70	165.70	100.00
	Total	165.70	165.70	100.00
%		100.00		

Source: ECRF

Pipes with between 10 and 25 years of age represent 100% of the total. See Table 2.5.9-8.

Table 2.5.9-8: Length of Primary Sewers by Type of Material

Drainage Area	Diameter	Age / Length (m)	Sub Total (m)	%
	Mm	10 to 25		
Márquez	350	165.70	165.70	100.00
	Total	165.70	165.70	
%		100.00		

Source: ECRF

2) Secondary Sewers

The secondary networks in the Study Area are made up of approximately 652 km of pipes, whose diameters range from 100 mm to 315 mm.

The piping materials are mostly CSN and PVC. Table 2.5.9-9 shows the distribution of piping according to type of material.

Table 2.5.9-9: Piping in the Study Area

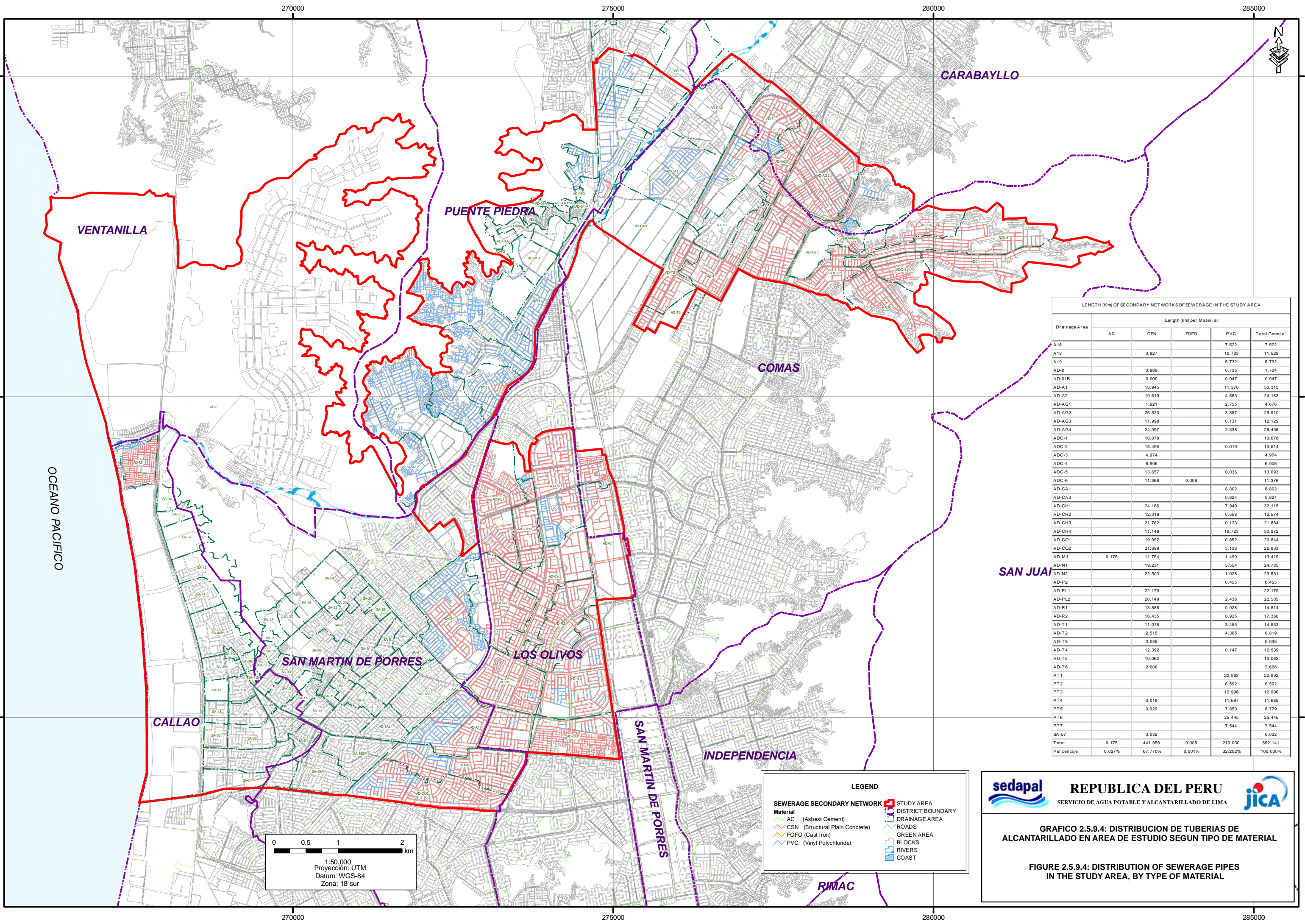
Material	Quantity (Km)	Percentage
Asbestos Cement	0.175	0.027%
PVC	210.000	32.202%
Simple Standard Concrete	441.960	67.700%
Cast Iron	0.008	0.001%

Source: ECRF

Figure 2.5.9-4 is a map showing the distribution of pipes in the Study area, considering the different types of material.

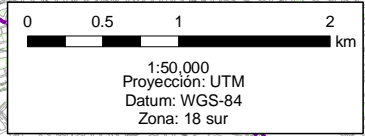
It is to be noted that there are some other studies and projects which are either ongoing or completed related to water supply and/or secondary sewerage upgrading. The names are given below and their respective influence areas are shown in Figure 2.5.9-5. Thus, these areas will not be investigated further in this Study.

1. Elaboration of the study of the proposed expansion and improvement of drinking water system and sewerage scheme in Cerro Las Animas and adjacent areas.
2. Health Improvement Project of the marginal areas of Lima. Loan Agreement Pe - 930. Lot 10 Puente Piedra district, water networks and secondary sewage. Schemes Chillón Valley Gardens, La Ensenada, Chillón Housing Association.
3. Health Improvement Project for Marginal Areas in Lima, Loan Agreement - PE-P30, Lot 7.
4. Perfil of the "Installation of the Water Supply and Sewerage Scheme for the Oquendo Santa Rosa and El Naranjal (Sectors 251, 252, 256, and 257) Scheme" Project. This Project involves the Comas Drainage areas and the Valle Chillón, Primavera, Año Nuevo, Independencia, Comas, and Carabayllo sectors. General Water Supply Works have been executed for this scheme, by means of LP 0029-2003 Contract.
5. Promesal works, Lot 6B, Valle Chillón Chillón, Primavera, Año Nuevo, Independencia, Comas, and Carabayllo Sector Scheme. Improvement Works in the Water Supply General Works. No improvement Works have been carried out for the sewerage network.
6. Works contract L.P. 021-2007-CW -31960 IBRD- SEDAPAL Water supply and sewerage network extensions through condominium systems in various districts. These condominium systems have carried out works on sewerage networks with diameters of less than 200 mm, and have not been included in this Study.
7. PAC 4 Comas Carabayllo Independencia, and Puente Piedra works. Reservoir rehabilitation Works.



LENGTH (Km) OF SECONDARY NETWORKS OF SEWERAGE IN THE STUDY AREA

Drainage Area	Length (km) per Material				Total General
	AC	CSN	FOFO	PVC	
A16		7.522		7.522	7.522
A18		0.827		10.703	11.529
A19				5.732	5.732
AD-0		0.969		0.735	1.704
AD-01B		0.000		0.947	0.947
AD-A1		18.945		11.370	30.315
AD-A2		19.610		4.553	24.163
AD-AG1		1.921		2.755	4.676
AD-AG2		26.523		3.387	29.910
AD-AG3		11.998		0.131	12.129
AD-AG4		24.097		2.338	26.435
ADC-1		10.078			10.078
ADC-2		13.495		0.019	13.514
ADC-3		4.974			4.974
ADC-4		6.906			6.906
ADC-5		13.657		0.036	13.693
ADC-6		11.368	0.008		11.376
AD-CA1				8.802	8.802
AD-CA3				0.824	0.824
AD-CH1		24.166		7.949	32.115
AD-CH2		12.016		0.558	12.574
AD-CH3		21.762		0.123	21.884
AD-CH4		11.149		19.723	30.872
AD-CO1		19.992		0.852	20.844
AD-CO2		21.699		5.133	26.833
AD-M1	0.175	11.754		1.490	13.419
AD-N1		19.231		5.554	24.785
AD-N2		22.503		1.028	23.531
AD-P2				0.455	0.455
AD-PL1		22.179			22.179
AD-PL2		20.149		2.436	22.585
AD-R1		13.886		0.928	14.814
AD-R2		16.435		0.925	17.360
AD-T1		11.078		3.455	14.533
AD-T2		2.515		4.305	6.819
AD-T3		0.035			0.035
AD-T4		12.392		0.147	12.539
AD-T5		10.062			10.062
AD-T6		2.606			2.606
PT1				22.992	22.992
PT2				6.592	6.592
PT3				12.996	12.996
PT4		0.018		11.667	11.685
PT5		0.929		7.850	8.779
PT6				25.445	25.445
PT7				7.544	7.544
SA-57		0.032			0.032
Total	0.175	441.958	0.008	210.000	652.141
Porcentaje	0.027%	67.770%	0.001%	32.202%	100.000%



LEGEND

SEWERAGE SECONDARY NETWORK

Material

- AC (Asbest Cement)
- CSN (Structural Plain Concrete)
- FOFO (Cast Iron)
- PVC (Vinyl Polychloride)

STUDY AREA

- DISTRICT BOUNDARY
- DRAINAGE AREA
- ROADS
- GREEN AREA
- BLOCKS
- RIVERS
- COAST

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 SERVICIO DE AGUA POTABLE Y ALCANTARILLADO DE LIMA

GRAFICO 2.5.9.4: DISTRIBUCION DE TUBERIAS DE ALCANTARILLADO EN AREA DE ESTUDIO SEGUN TIPO DE MATERIAL

FIGURE 2.5.9.4: DISTRIBUTION OF SEWERAGE PIPES IN THE STUDY AREA, BY TYPE OF MATERIAL

Table 2.5.9-10 shows the distribution of pipes by material according to the drainage areas.

Table 2.5.9-10: Drainage Area Distribution of Pipes by Type of Material in the Study Area

Drainage Area	Length by Material (Km)				Demand of Pipe Km
	AC	CSN	FOFO	PVC	
A16				7.52	7.52
A18		0.83		10.70	11.53
A19				5.73	5.73
AD-0		0.97		0.73	1.70
AD-01B		0.00		0.95	0.95
AD-A1		18.94		11.37	30.31
AD-A2		19.61		4.55	24.16
AD-AG1		1.92		2.76	4.68
AD-AG2		26.52		3.39	29.91
AD-AG3		12.00		0.13	12.13
AD-AG4		24.10		2.34	26.44
ADC-1		10.08			10.08
ADC-2		13.50		0.02	13.52
ADC-3		4.97			4.97
ADC-4		6.91			6.91
ADC-5		13.66		0.04	13.70
ADC-6		11.37	0.01		11.38
AD-CA1				8.80	8.80
AD-CA3				0.82	0.82
AD-CH1		24.17		7.86	32.03
AD-CH2		12.02		0.56	12.58
AD-CH3		21.76		0.12	21.88
AD-CH4		11.15		19.72	30.87
AD-CO1		19.99		0.85	20.84
AD-CO2		21.70		5.13	26.83
AD-M1	0.08	11.75		1.49	13.32
AD-N1		19.04		5.53	24.57
AD-N2		22.50		1.03	23.53
AD-P2				0.46	0.46
AD-PL1		22.18			22.18
AD-PL2		20.15		2.44	22.59
AD-R1		13.88		0.93	14.81
AD-R2		16.43		0.93	17.36
AD-T1		11.08		3.46	14.54
AD-T2		2.33		4.28	6.61
AD-T3		0.04			0.04
AD-T4		12.39		0.15	12.54
AD-T5		10.06			10.06
AD-T6		2.61			2.61
PT1				22.99	22.99
PT2				6.59	6.59
PT3				13.00	13.00
PT4		0.02		11.68	11.70
PT5		0.93		7.85	8.78
PT6				25.44	25.44
PT7				7.54	7.54
SA-57		0.03			0.03
Total	0.08	441.59	0.01	209.88	651.56
Percentage	0.01%	67.77%	0.00%	32.21%	100.00%

Source: JICA Study Team

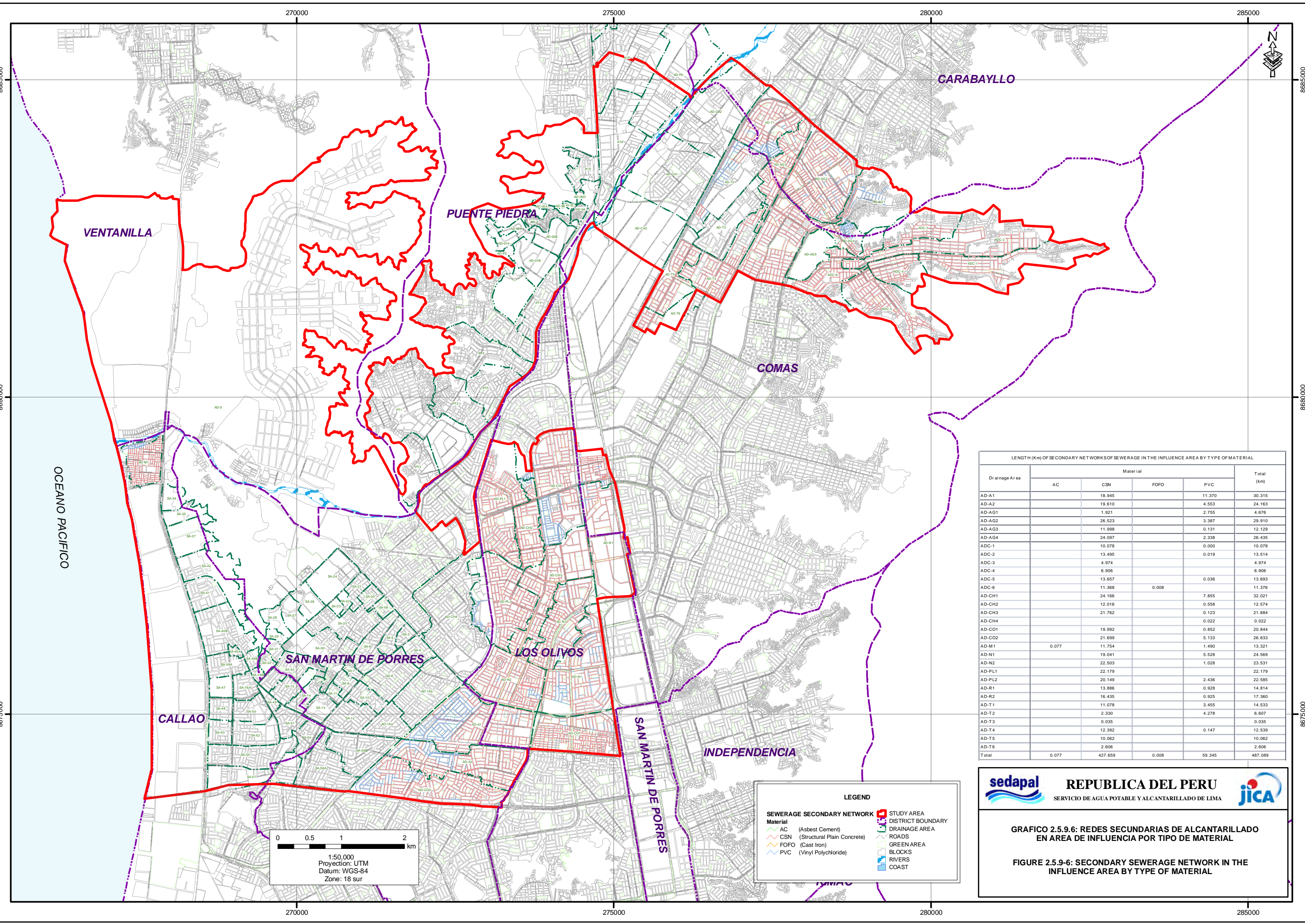
Figure 2.5.9.6 shows a map with the distribution of the pipes in the Study Area, according to pipe material.

Table N° 2.5.9.11 shows pipe distribution, according to pipe material, in the Study area.

Table 2.5.9-11: Drainage Area Distribution of Pipes by Type of Material in the Influence Area

Length of pipes (Km) in Secondary Sewerage Networks by Type of Material					
Drainage Area	Length by Material (Km)				Total
	AC	CSN	FOFO	PVC	
AD-A1		18.94		11.37	30.31
AD-A2		19.61		4.55	24.16
AD-AG1		1.92		2.76	4.68
AD-AG2		26.52		3.39	29.91
AD-AG3		12.00		0.13	12.13
AD-AG4		24.10		2.34	26.44
ADC-1		10.08			10.08
ADC-2		13.50		0.02	13.52
ADC-3		4.97			4.97
ADC-4		6.91			6.91
ADC-5		13.66		0.04	13.70
ADC-6		11.37	0.01		11.38
AD-CH1		24.17		7.86	32.03
AD-CH2		12.02		0.56	12.58
AD-CH3		21.76		0.12	21.88
AD-CO1		19.99		0.85	20.84
AD-CO2		21.70		5.13	26.83
AD-M1	0.08	11.75		1.49	13.32
AD-N1		19.04		5.53	24.57
AD-N2		22.50		1.03	23.53
AD-PL1		22.18			22.18
AD-PL2		20.15		2.44	22.59
AD-R1		13.88		0.93	14.81
AD-R2		16.43		0.93	17.36
AD-T1		11.08		3.46	14.54
AD-T2		2.33		4.28	6.61
AD-T3		0.04			0.04
AD-T4		12.39		0.15	12.54
AD-T5		10.06			10.06
AD-T6		2.61			2.61
Total	0.08	427.66	0.01	59.36	487.11

Source: JICA Study Team



LENGTH (Km) OF SE SECONDARY NETWORKS OF SEWERAGE IN THE INFLUENCE AREA BY TYPE OF MATERIAL

Drainage Area	Material				Total (km)
	AC	CSN	FOFO	PVC	
AD-A1		18.945		11.370	30.315
AD-A2		19.610		4.553	24.163
AD-AG1		1.921		2.755	4.676
AD-AG2		26.523		3.387	29.910
AD-AG3		11.998		0.131	12.129
AD-AG4		24.097		2.338	26.435
ADC-1		10.078		0.000	10.078
ADC-2		13.495		0.019	13.514
ADC-3		4.974			4.974
ADC-4		6.906			6.906
ADC-5		13.657		0.036	13.693
ADC-6		11.368	0.008		11.376
AD-CH1		24.166		7.855	32.021
AD-CH2		12.016		0.558	12.574
AD-CH3		21.762		0.123	21.884
AD-CH4				0.022	0.022
AD-CO1		19.992		0.852	20.844
AD-CO2		21.699		5.133	26.833
AD-M1	0.077	11.754		1.490	13.321
AD-N1		19.041		5.528	24.569
AD-N2		22.503		1.028	23.531
AD-PL1		22.179			22.179
AD-PL2		20.149		2.436	22.585
AD-R1		13.886		0.928	14.814
AD-R2		16.435		0.925	17.360
AD-T1		11.078		3.455	14.533
AD-T2		2.330		4.278	6.607
AD-T3		0.035			0.035
AD-T4		12.392		0.147	12.539
AD-T5		10.062			10.062
AD-T6		2.606			2.606
Total	0.077	427.659	0.008	59.345	487.089

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GRAFICO 2.5.9.6: REDES SECUNDARIAS DE ALCANTARILLADO EN AREA DE INFLUENCIA POR TIPO DE MATERIAL

FIGURE 2.5.9-6: SECONDARY SEWERAGE NETWORK IN THE INFLUENCE AREA BY TYPE OF MATERIAL

LEGEND

SEWERAGE SECONDARY NETWORK

Material

- AC (Asbest Cement)
- CSN (Structural Plain Concrete)
- FOFO (Cast Iron)
- PVC (Vinyl Polychloride)

STUDY AREA

DISTRICT BOUNDARY

DRAINAGE AREA

ROADS

GREEN AREA

BLOCKS

RIVERS

COAST

0 0.5 1 2 km

1:50,000
 Projection: UTM
 Datum: WGS-84
 Zone: 18 sur