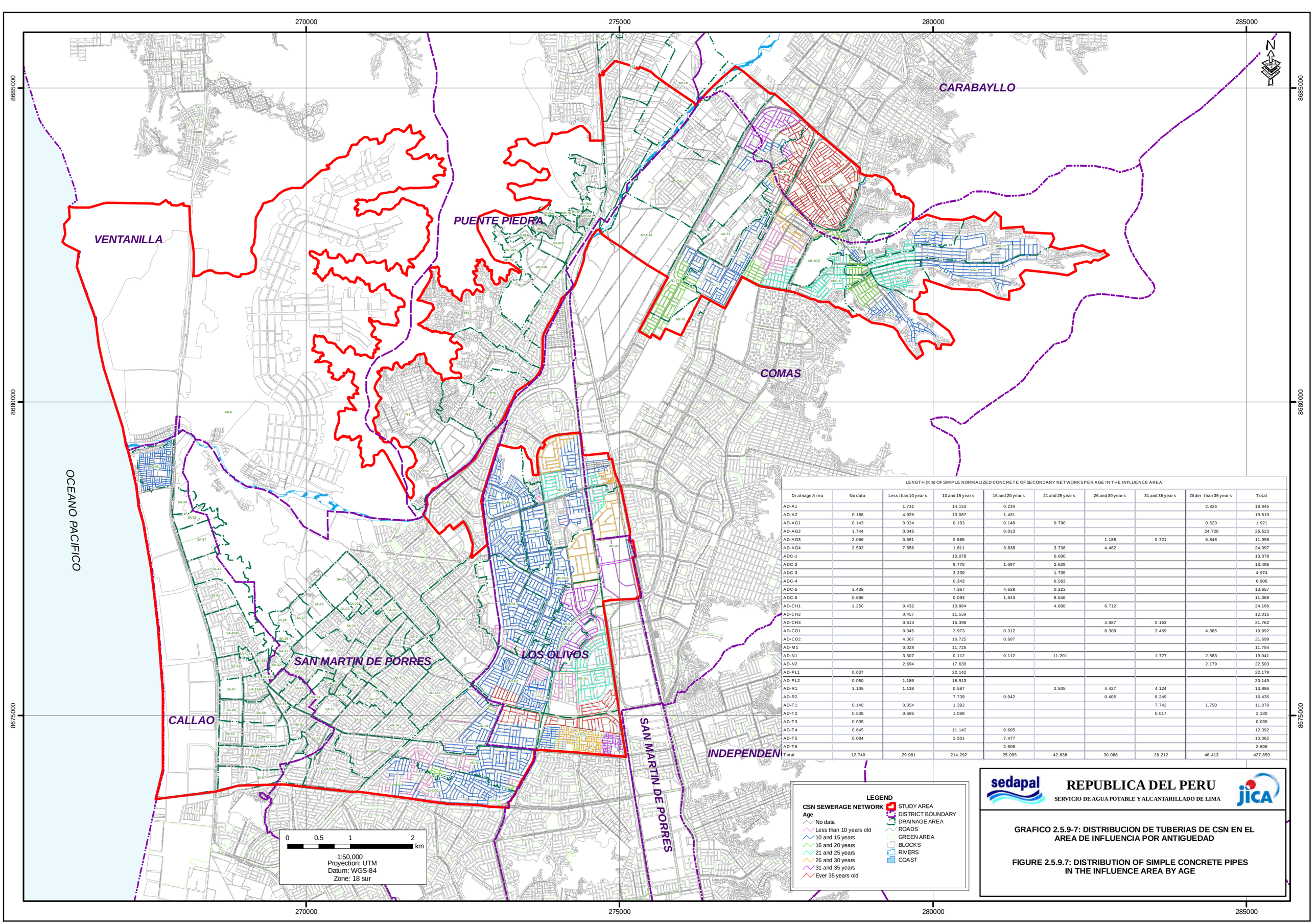
It must be pointed out that installation of PVC pipes has been started from year 2000 (10 years old). Simple concrete pipe average age ranges between 10 and 50 years old. Many of the identified problems are related to the simple concrete pipes. Table 2.5.9.12 shows distribution of simple concrete pipes in the Study Area, according to pipe age. This distribution has been grouped for every 5 years.

Table 2.5.9-12: Drainage Area Distribution of Pipes by Age in the Influence Area

Length of pipes of Normalizad Simple Concrete by age in secondary sewerage network (Km)									
Drainage Area	**No Data**	**Less than 10 years**	**Between 10 and 15 years**	**Between 16 and 20 years**	**Between 21 and 25 years**	**Between 26 and 30 years**	**Between 31 and 35 years**	**More than 35 years**	**Total**
AD-A1		1.730	14.150	0.230				2.830	18.94
AD-A2	0.19	4.930	13.070	1.430					19.61
AD-AG1	0.14	0.020	0.190	0.150	0.790			0.620	1.92
AD-AG2	1.74	0.050		0.010				24.720	26.52
AD-AG3	2.07	0.590	0.580			1.190	0.720	6.850	12.00
AD-AG4	2.59	7.660	1.810	3.840	3.740	4.460			24.10
ADC-1			10.080						10.08
ADC-2			9.770	1.100	2.630				13.50
ADC-3			3.240		1.740				4.97
ADC-4			0.340		6.560				6.91
ADC-5	1.44		7.370	4.630	0.220				13.66
ADC-6	0.69		0.090	1.940	8.650				11.37
AD-CH1	1.25	0.430	10.960		4.810	6.710			24.17
AD-CH2		0.460	11.560						12.02
AD-CH3		0.610	16.400			4.590	0.160		21.76
AD-CO1		0.04	2.97	0.31		8.31	3.47	4.88	19.99
AD-CO2		4.370	16.720	0.610					21.70
AD-M1		0.030	11.730						11.75
AD-N1		3.310	0.110	0.110	11.200		1.730	2.580	19.04
AD-N2		2.690	17.630					2.180	22.50
AD-PL1	0.04		22.140						22.18
AD-PL2	0.05	1.190	18.910						20.15
AD-R1	1.11	1.140	0.590		2.510	4.430	4.120		13.88
AD-R2			7.740	0.040		0.410	8.250		16.43
AD-T1	0.14	0.050	1.390				7.740	1.750	11.08
AD-T2	0.54	0.690	1.090				0.020		2.33
AD-T3	0.03								0.04
AD-T4	0.64		11.140	0.600					12.39
AD-T5	0.08		2.500	7.480					10.06
AD-T6				2.610					2.61
Total	**12.74**	**29.99**	**214.27**	**25.09**	**42.85**	**30.10**	**26.21**	**46.41**	**427.66**

Source: SEDAPAL Cadastre and JICA Study Team

Figure 2.5.9.7 shows a pipe distribution map in the Study Area based on pipe age, focusing on simple concrete pipes.



LENGTH (Km) OF SIMPLE NORMALIZED CONCRETE OF SECONDARY NETWORKS PER AGE IN THE INFLUENCE AREA

Drainage Area	No data	Less than 10 years	10 and 15 years	16 and 20 years	21 and 25 years	26 and 30 years	31 and 35 years	Older than 35 years	Total
AD-A1		1.731	14.153	0.234				2.826	18.945
AD-A2	0.186	4.926	13.067	1.431					19.610
AD-AG1	0.143	0.024	0.193	0.148	0.790			0.623	1.921
AD-AG2	1.744	0.045		0.013				24.720	26.523
AD-AG3	2.066	0.591	0.585			1.188	0.721	6.848	11.998
AD-AG4	2.592	7.656	1.811	3.838	3.738	4.462			24.097
ADC-1			10.078		0.000				10.078
ADC-2			9.770	1.097	2.629				13.495
ADC-3			3.239		1.735				4.974
ADC-4			0.343		6.563				6.906
ADC-5	1.438		7.367	4.628	0.223				13.657
ADC-6	0.686		0.093	1.943	8.646				11.368
AD-CH1	1.250	0.432	10.964		4.808	6.712			24.166
AD-CH2		0.457	11.559						12.016
AD-CH3		0.613	16.398			4.587	0.163		21.762
AD-CO1		0.045	2.973	0.312		8.308	3.469	4.885	19.992
AD-CO2		4.367	16.725	0.607					21.699
AD-M1		0.028	11.725						11.754
AD-N1		3.307	0.112	0.112	11.201		1.727	2.583	19.041
AD-N2		2.694	17.630					2.179	22.503
AD-PL1	0.037		22.142						22.179
AD-PL2	0.050	1.186	18.913						20.149
AD-R1	1.105	1.138	0.587		2.505	4.427	4.124		13.886
AD-R2			7.739	0.042		0.405	8.249		16.435
AD-T1	0.140	0.054	1.392				7.742	1.750	11.078
AD-T2	0.538	0.686	1.088				0.017		2.330
AD-T3	0.035								0.035
AD-T4	0.645		11.142	0.605					12.392
AD-T5	0.084		2.501	7.477					10.062
AD-T6				2.606					2.606
Total	12.740	29.981	214.292	25.095	42.838	30.088	26.212	46.413	427.659

LEGEND

CSN SEWERAGE NETWORK

Age
- No data
- Less than 10 years old
- 10 and 15 years
- 16 and 20 years
- 21 and 25 years
- 26 and 30 years
- 31 and 35 years
- Ever 35 years old

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

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GRAFICO 2.5.9-7: DISTRIBUCION DE TUBERIAS DE CSN EN EL AREA DE INFLUENCIA POR ANTIGUEDAD

FIGURE 2.5.9.7: DISTRIBUTION OF SIMPLE CONCRETE PIPES IN THE INFLUENCE AREA BY AGE

(4) Diagnosis of Condition of Sewerage Networks

The following criteria have been considered in defining the condition of the sewerage pipes in the Lima Norte II Study Area:

1. Quality of pipes.
2. Physical conditions of pipes, which was determined through a study of manholes and pipes.
3. Pipe corrosion.
4. Incidents.
5. Verification of the condition of pipes through a study using exploration pits.
6. Pipe gradient
7. SEDAPAL's preventive maintenance data

(a) Quality of pipes

The service life of the pipes depends on the manufacturing quality of the materials; this characteristic, along with other hydraulic and biological processes that develop in the sewerage systems, can reduce the service life of the pipes.

In order to have a general idea of the condition of pipes, a procedure was used to divide the Study Area into sectors by using the SEDAPAL's construction records (including as-built drawings) including:

- Age of installation
- Probable quality of pipes in similar construction areas
- Probable construction process in similar construction areas

Figure 2.5.9-8 is a map showing the construction records. This map was very useful for defining the representative sample of construction records in order to study the condition of pipes and manholes in the Study Area. This map can help to verify the physical characteristics of pipes, the state of corrosion, and the speed of corrosion, and the remaining service life.

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COMAS

OCEANO PACIFICO

SAN MARTIN DE PORRES

LOS OLIVOS

CALLAO

INDEPENDENCIA

SAN MARTIN DE PORRES

RIMAC

SAN JU

0 0.5 1 2 km

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

LEGEND

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

LEGEND

PROJECTS
07-CH
1003
1003-A
1017
1041
1069
111
1133
1136
1180
1196
1198
1230
1271
1332-A
1333
1358-A
1359
136-A
136-B
136-C
136-D
136-E
1473
1473-A
1474
1475
1476
1477
1481
1482
1500
1501-A
1502
1514
1515
1516-A
1517
1517-A
1520
1521
1523
1536-A
1548
1560-A
1561
1565
1575
1592
1617
1618
1620
1622
1648
1650
1650-A
1655
1681
1700
1707
1731
1732
1733
1741
1743
1768
1816
1816-A
1862
1863
1887
1972
1973
1973-A
1978
1993
2051
2054
2079
2093
2094
2096
2096-A
2148
2199
220
220-A
220-B
2263
2336
2337
2402
25-A
25-B
2528-A
2528-B
2528-C
2598
2710
2713
272-A
272-B
272-D
272-G
272-H
272-I
272-K
2725
2757
2828
2830
2838
2928
2931
2990
3117
3132
3158
3170
3172
3182
3208
3213
3217
3217-A
3217-B
3217-C
3218
3298
3342
3343
3344-A
3363
3520
3528-A
3528-B
3528-C
3576
3635
3659
3691
3699
3722
3786
3798
3805
3808
381-E
381-G
381-J
381-L
381-LL
381-M
381-O
381-Q
381-S
381-T
4162
4198
4234-A
4235
4236
4237
4240
4241
4277
4314
4340
4393
4414
4459
4466
478-A
478-B
478-C
483
487-A
487-B
488-A
488-B
508
7-A
7-B
718
819
825
825-A
882
886
889
890
950
950-A
950-B
950-C
950-D
950-E
986-B

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GRAFICO 2.5.9.8: UBICACION DE EXPEDIENTES POR AREAS DE DRENAJE

FIGURE 2.5.9.8: LOCATION OF PROJECTS BY DRAINAGE AREA

(b) Physical Conditions of Pipes

The evaluation of the pipes was determined by the physical parameters found during the investigation. The physical characteristics considered include the pipe wall thickness, roughness, roundness, etc. This allows projecting the remaining service life of the pipe.

The study of pipes and manholes was carried out in order to determine the physical condition of the pipes. The main problem of the existence of severe corrosion was found in the lower parts of the Study Area, which has direct relation with the deterioration of the pipes in those zones. The visual inspection was carried out by a set of pictures taken from inside of the manhole, which show the corrosion inside the pipes as shown in Picture 2.5.9-1.

In this study the manholes and pipes were scored according to different grades of corrosion, following the criteria established by the Water Resource Center (WRC) in England.

The WRC establishes 5 grades of corrosion in pipes:

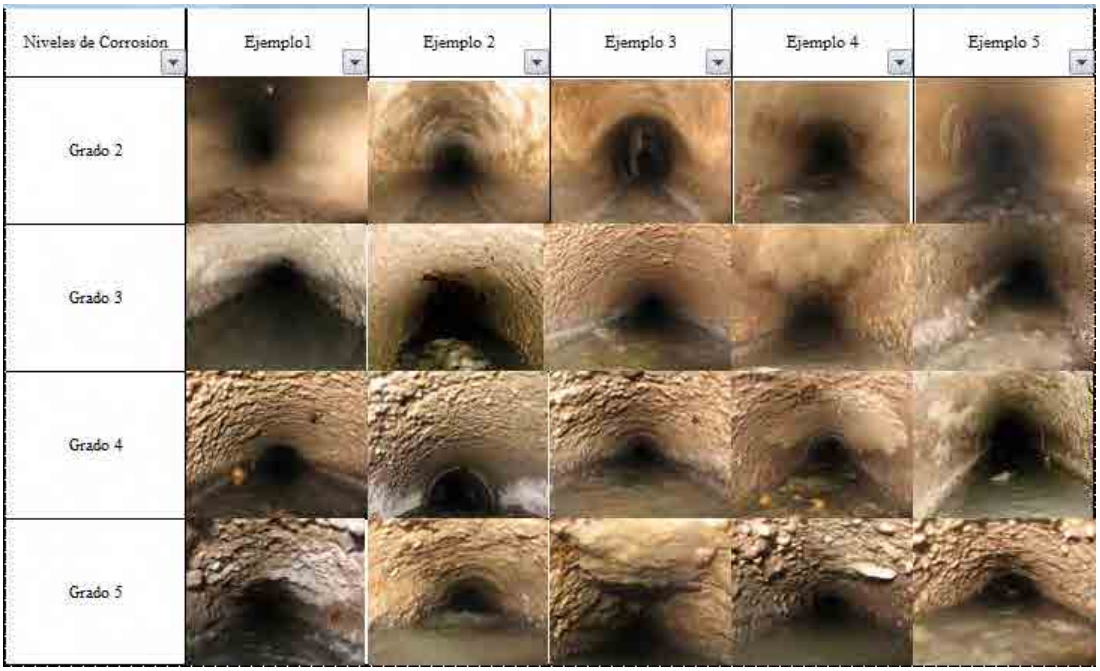
Grade 1 Low Level of Corrosion

Grade 2 Small Level of Corrosion

Grade 3 Medium Level of Corrosion

Grade 4 High Level of Corrosion

Grade 5 Pipe Completely Corroded



Source: JICA Study Team

Picture 2.5.9-1: Condition of Corrosion of Pipes by Grade

Figure 2.5.9-9 shows the location of surveyed manholes and the corrosion grades found in the pipes after conducting the Manholes and Pipes survey.

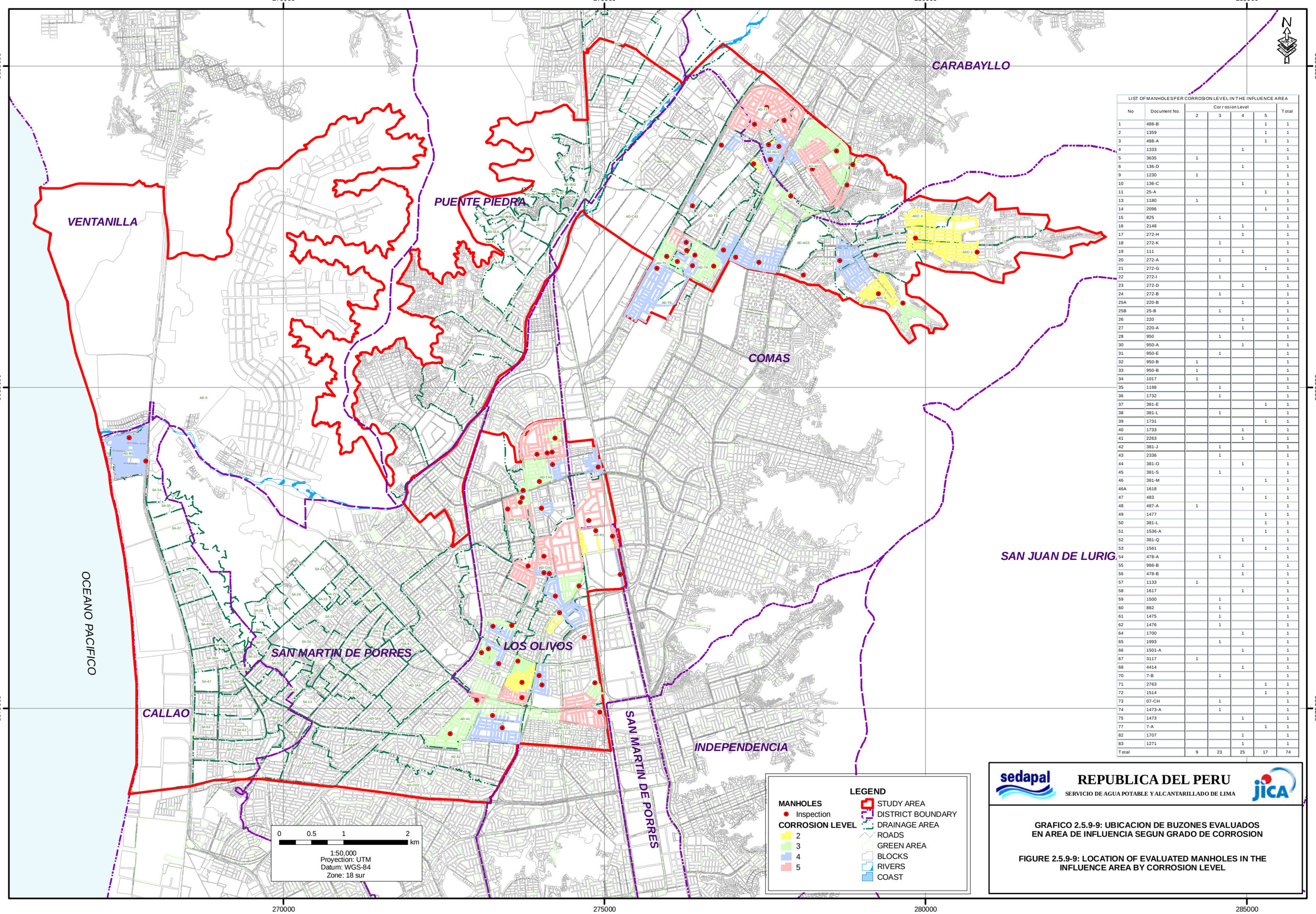
Table 2.5.9-13 shows the distribution of number of pipes found by corrosion level in the influence area.

The pictures grouped by level of corrosion are found in Appendix A.5.2.1; in these pictures, the different grades and the levels of corrosion in each sector can be identified.

Table 2.5.9-13: Corrosion Identified by the Manhole Survey

Grade of corrosion	2	3	4	5	Total
Total	9	23	25	17	74

Source: JICA Study Team



LIST OF MANHOLES PER CORROSION LEVEL IN THE INFLUENCE AREA

No	Document No.	Corrosion Level				Total
		2	3	4	5	
1	488-B				1	1
2	1359				1	1
3	488-A				1	1
4	1333			1		1
5	3635	1				1
6	136-D			1		1
9	1230	1				1
10	136-C			1		1
11	25-A				1	1
13	1180	1				1
14	2096				1	1
15	825		1			1
16	2148			1		1
17	272-H			1		1
18	272-K		1			1
19	111			1		1
20	272-A		1			1
21	272-G				1	1
22	272-I		1			1
23	272-D			1		1
24	272-B		1			1
25A	220-B			1		1
25B	25-B		1			1
26	220			1		1
27	220-A			1		1
28	950		1			1
30	950-A			1		1
31	950-E		1			1
32	950-B	1				1
33	950-B	1				1
34	1017	1				1
35	1198		1			1
36	1732		1			1
37	381-E				1	1
38	381-L		1			1
39	1731				1	1
40	1733			1		1
41	2263			1		1
42	381-J		1			1
43	2336		1			1
44	381-O			1		1
45	381-S		1			1
46	381-M				1	1
46A	1618			1		1
47	483				1	1
48	487-A	1				1
49	1477				1	1
50	381-L				1	1
51	1536-A				1	1
52	381-Q			1		1
53	1561				1	1
54	478-A		1			1
55	986-B			1		1
56	478-B			1		1
57	1133	1				1
58	1617			1		1
59	1500		1			1
60	882		1			1
61	1475		1			1
62	1476		1			1
64	1700			1		1
65	1993		1			1
66	1501-A			1		1
67	3117	1				1
68	4414			1		1
70	7-B		1			1
71	2763				1	1
72	1514				1	1
73	07-CH		1			1
74	1473-A		1			1
75	1473			1		1
77	7-A				1	1
82	1707			1		1
83	1271			1		1
Total		9	23	25	17	74

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GRAFICO 2.5.9-9: UBICACION DE BUZONES EVALUADOS EN AREA DE INFLUENCIA SEGUN GRADO DE CORROSION

FIGURE 2.5.9-9: LOCATION OF EVALUATED MANHOLES IN THE INFLUENCE AREA BY CORROSION LEVEL

(c) Pipe Corrosion

One of the main problems found in the sewerage systems is pipe corrosion. Unfortunately, such problems are only considered when there is an evident problem such as sinking of a road due to a faulty sewerage pipe, which as explained in more detail in Section (4)(d)"Incidents", is known as collapse.

H_2S is one of the main causes of the corrosion in the pipes. The aspects regarding the formation and emission of the H2S gas is shown in Annex A5.2.

The Study expected to find some level of this gas. This gas was measured by a spot test and was found only in some manholes. In Figure 2.5.9-10, the manholes with H_2S more than 3ppm is shown.

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PUENTE PIEDRA

CARABAYLLO

COMAS

SAN JUAN DE LURIGANCHO

LOS OLIVOS

SAN MARTIN DE PORRES

CALLAO

INDEPENDENCIA

SAN MARTIN DE PORRES

OCEANO PACIFICO

MANHOLES WITH H2S LEVEL HIGHER THAN 3PPM	
No.	Document No.
1	488-B
13	1180
27	220-A
46	381-M
49	1477
50	381-L
56	478-B
70	7-B
72	1414
73	1473
83	1271

0 0.5 1 2 km

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

LEGEND

MANHOLES H2S
CORROSION LEVEL
2
3
4
5

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

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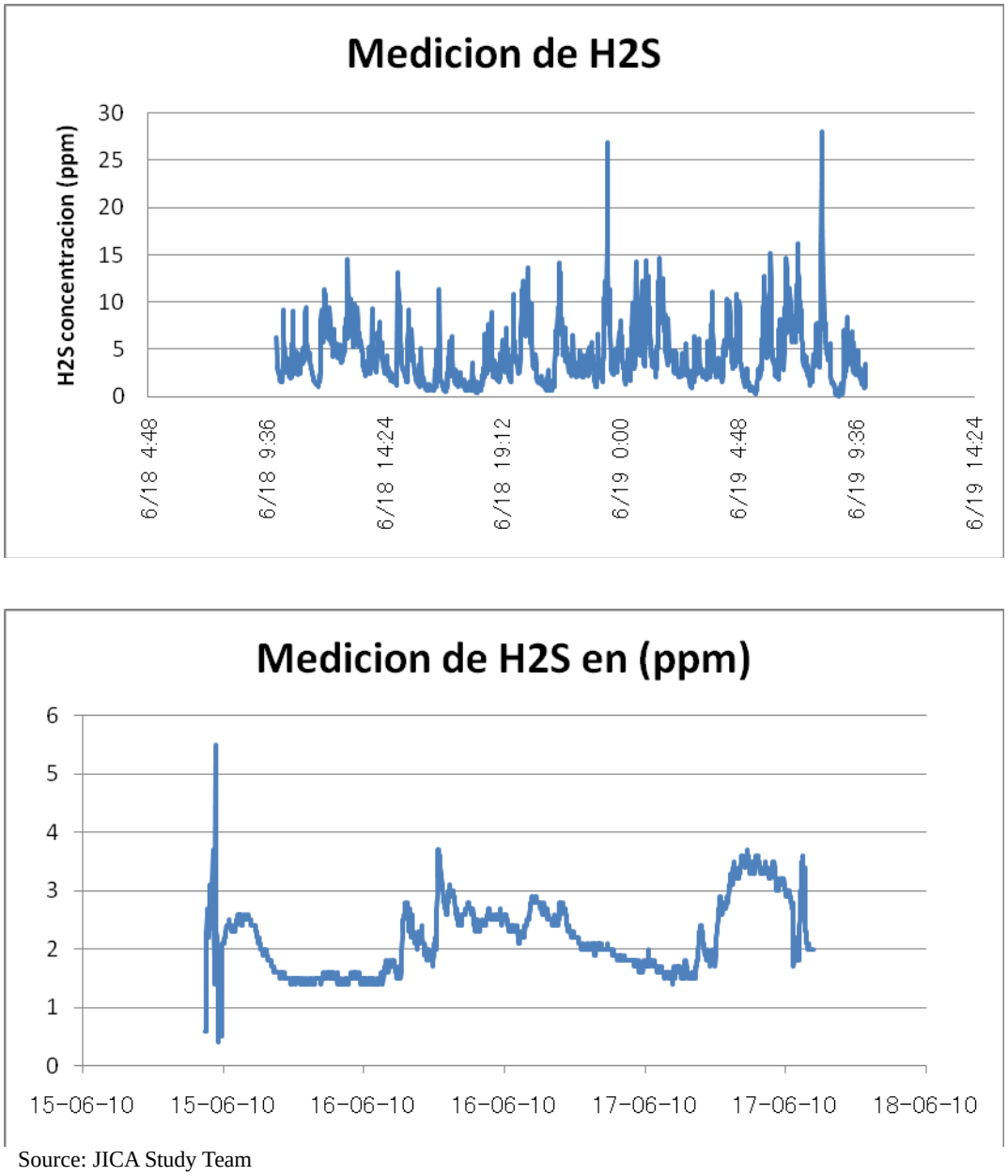
GRAFICO 2.5.9.10: INSPECCION DE BUZONES CON ALTO NIVEL DE H2S EN EL AREA DE PROYECTO

FIGURE 2.5.9.10: INSPECTION OF MANHOLES WITH HIGH H2S LEVEL IN THE PROJECT AREA

However, for verification purposes, the H_2S was measured for a longer duration in two locations; which demonstrated the fluctuation of H_2S and the presence of this gas in the entire sewerage system. The measurement of gas emission of this evaluation are presented in the Figure 2.5.9-11



Source: JICA Study Team

Figure 2.5.9-11: Evaluation of H_2S

The speed of corrosion has been calculated based on the methodology developed by the Environmental Protection Agency of the USA (EPA). (Appendix A.5.2.3.3 presents a detailed explanation). The results of this life span evaluation are shown in the Table 2.5.9-14. During the Detail Design of this Project, it is recommendable to follow this same methodology and use a long term H_2S meter in every manhole survey to have an accurate knowledge of the corrosion speed and pipes' life span.

Cuadro N° 2.5.9-14: Calculation of Corrosion through field study

Manhole	Thickness of pipe	Speed ft/sec	pH	Factor that relates the fracion present as dissolved sulfide H2S and pH	H_2S [DS]	Radius Feet	Height Feet	Width of free wáter surface Ft	perimeter of the pipe exposed to the atmosphere ft	The rate of H2S in the walls of the pipe	Percentage of Corrosion K_{minim} y A_{minimo}	Percentage of Corrosion K_{maximo} y A_{maximo}	Percentage of Corrosion $K_{average}$ y $A_{average}$	Life Span years Pipe Minimus	Life Span Years Pipe l Maximus	Life Span Years Pipe Average
N.-	mm	V'		J	ppm	r'	y'	b	p'	$\square_{sw}$ g/m^2-hr	C_{minimo}	C_{max}	$C_{average}$	L Actual$_{min}$	L Actual$_{max.}$	L Actual $_{prom}$
1	3	2,428	1	1	3,05	0,333248	0,2296	0,633	1,258	0,21	0,165	0,047	0,056	0,716346	2,52828	2,110141
13	11	1,746	6	0,9	5	0,333248	0,164	0,574	1,402	0,20	0,157	0,044	0,053	2,759594	9,739743	8,12894
27	10	3,080	6	0,9	10	0,333248	0,2952	0,662	1,123	0,85	0,678	0,192	0,230	0,580969	2,050477	1,71136
46	1	2,096	5	0,98	3,5	0,333248	0,328	0,666	1,057	0,22	0,173	0,049	0,059	0,227816	0,804056	0,671078
49	2	2,325	12	0,1	5,5	0,333248	0,4264	0,640	0,858	0,04	0,034	0,010	0,012	2,297607	8,109202	6,768065
50	12	2,510	1	1	5	0,333248	0,4592	0,617	0,789	0,44	0,351	0,099	0,119	1,345661	4,749391	3,963915
56	18	2,112	5	0,98	5,64	0,333248	0,164	0,574	1,402	0,30	0,239	0,068	0,081	2,968289	10,47632	8,743694
70	5	1,072	4	1	4	0,333248	0,0984	0,473	1,568	0,09	0,075	0,021	0,025	2,6403	9,318706	7,777535
72	7	2,335	4	1	3,5	0,333248	0,2952	0,662	1,123	0,24	0,193	0,055	0,065	1,428361	5,041275	4,207526
73	8	2,494	3	1	14,5	0,333248	0,3936	0,655	0,926	1,19	0,946	0,268	0,321	0,332889	1,174903	0,980592
83	6	1,682	6	0,9	3	0,333248	0,2296	0,633	1,258	0,12	0,097	0,027	0,033	2,44563	8,631634	7,204094

JICA Study Team

(d) Incidents

Incidents in the sewerage network are analyzed with “Operational Incident Management System (SGIO, in Spanish)”.

The SGIO system solves various statistical queries, provides data for, and carries out other functional operations that allow for “improving management of the users’ areas”.

This system is made up of various modules, including the “Incidents” module that generates, gives maintenance and follow-up to, and checks incidents.

Though these incidents have been recorded since 2006; they are not a representative sample of the population size, as there are been incidents and repairs to the secondary network systems that have not been registered under SGIO. Therefore, registered incidents are not a statistical sample but a supporting tool to carry out a diagnostics to both the water supply and sewerage systems.

Incidents are reported when a user makes a complaint to SEDAPAL, and the incident is identified with a service identification number (NIS: Numero de Identificación de Servicio). It has been found that this form of identifying the incident does not necessarily imply that the incident is related with the address recorded on the complaint, or that the cause of the incident is related to that sewer branch or the house connection.

Generally, the reports are classified as clogs, floods, etc., but not necessarily as the aforementioned “Collapses.”

In the majority of cases reported, the clogs exist because inability of the sewerage networks to evacuate solid materials. Another cause that has been found frequently is clogs of industrial drains or non-domestic drains; that because of their characteristics affect the network, and in this case, cause clogs as a consequence of oil, grease, or sediment spills.

It has also been found that many floods that have shown up as incidents in the sewerage network have been caused by breakages in a water network or diversions for irrigation canals.

In that sense, it has been found that SEDAPAL has a fairly extensive classification of incident assignments, allowing for the identification of more than 30 types of incidents.

This type of incident identification makes it fairly difficult to consider the number of incidents in the data base, as in many of the cases the percentages do not reach 2% of the total number of incidents, and some of them do not even reflect 0.1% of the total, as shown in Table 2.5.9-15.

A modification of this incident identification is recommended according to the following activities:

- Incidents relating to Operation and Maintenance
- Unexpected incidents

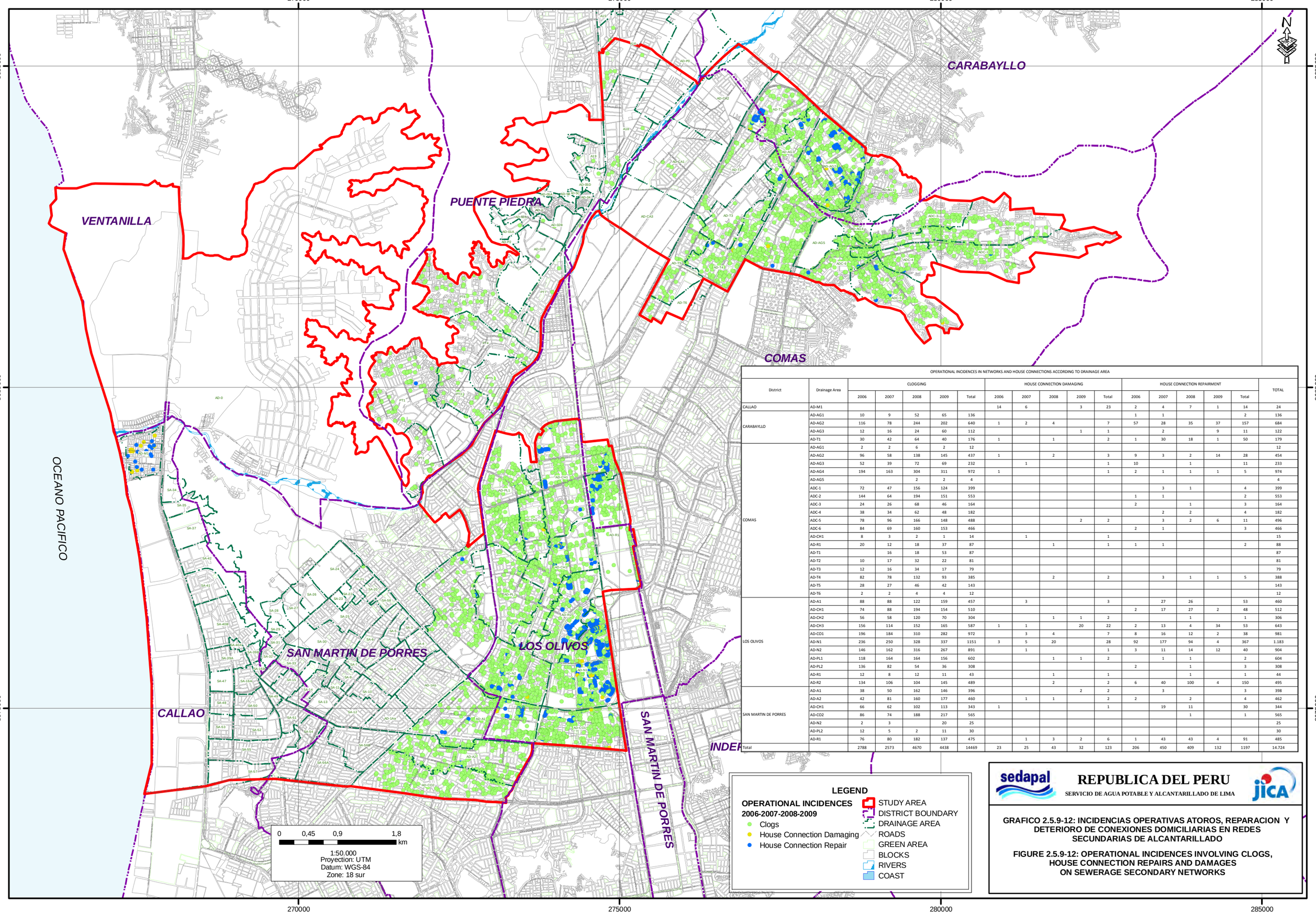
- Inadequate use of the sewerage network
- Capacity or condition of piping
- Non-domestic discharge

Table 2.5.9-15: Classification by Type of Incidents, 2006-2009

Description	Quantity	%
Clogged connection	5,129	44.69
Clogging	1,377	12.00
Mechanical maintenace in collectors with bucket machine	1,064	9.27
Clogging in the network	1,056	9.20
Repair of sewerage house connection: connection change without excavation	749	6.53
Flooding	643	5.60
Sewer water infiltration	389	3.39
Flooding due to clogging	232	2.02
Repair of house connection: connection change without excavation	203	1.77
Pipes replacement up to 10"	141	1.23
Repair of house connection: connection change without excavation	100	0.87
replacement of sewerage house connection pipes 6" and 8" up to 12 meters	70	0.61
Big flooding	53	0.46
Repair of sewerage house connection: repair of connection to collector pipe	42	0.37
Repair of house connection: repair of connection to collector pipe	39	0.34
replacement of sewerage house connection pipes 6" and 8"	32	0.28
Repair of house connection: connection pipe	31	0.27
Repair of manhole, replacement of manhole roof	25	0.22
Repair of house connection: connection pipe	25	0.22
Pipe replacement up to 10"	23	0.20
Repair of pipe up to 10"	22	0.19
Installation of house connection sewarage pipe of 6" and 8"	6	0.05
Repair of manhole, replacement of manhole roof	5	0.04
Replacement of house connection sewarage pipe of 6" and 8"	3	0.03
Repair of house connection: connection change	3	0.03
Repair of sewerage house connection: connection change	3	0.03
Enlargement of sewerage connection pipe diameter with F/S	2	0.02
Replacement of pipes without trench up to 12"	2	0.02
Repair of manhole, replacement of manhole structure	2	0.02
Replacement of pipes from 12" to 14"	1	0.01
Construction or reconstruction of solid retaining manholes	1	0.01
Construction or reconstruction of small manholes	1	0.01
Repair of house connection box with excavation	1	0.01
Repair of house connection box	1	0.01
Repair of house connection with excavation	1	0.01
Remove of sewerage house connection from 6" to 8"	1	0.01
TOTAL	**11,478**	**100**

Source: SEDAPAL Cadastre and JICA Study Team

Figure 2.5.9-12 shows all the description by type of incidents presented according to the SEDAPAL's NIS.



OPERATIONAL INCIDENCES IN NETWORKS AND HOUSE CONNECTIONS ACCORDING TO DRAINAGE AREA

District	Drainage Area	CLOGGING					HOUSE CONNECTION DAMAGING					HOUSE CONNECTION REPAIRMENT					TOTAL
		2006	2007	2008	2009	Total	2006	2007	2008	2009	Total	2006	2007	2008	2009	Total	
CALLAO	AD-M1						14	6		3	23	2	4	7	1	14	24
CARABAYLLO	AD-AG1	10	9	52	65	136						1	1			2	136
	AD-AG2	116	78	244	202	640	1	2	4		7	57	28	35	37	157	684
	AD-AG3	12	16	24	60	112				1	1		2		9	11	122
	AD-T1	30	42	64	40	176	1		1		2	1	30	18	1	50	179
COMAS	AD-AG1	2	2	6	2	12											12
	AD-AG2	96	58	138	145	437	1		2		3	9	3	2	14	28	454
	AD-AG3	52	39	72	69	232		1			1	10		1		11	233
	AD-AG4	194	163	304	311	972	1				1	2	1	1	1	5	974
	AD-AG5			2	2	4											4
	ADC-1	72	47	156	124	399							3	1		4	399
	ADC-2	144	64	194	151	553						1	1			2	553
	ADC-3	24	26	68	46	164						2		1		3	164
	ADC-4	38	34	62	48	182							2	2		4	182
	ADC-5	78	96	166	148	488				2	2		3	2	6	11	496
	ADC-6	84	69	160	153	466						2	1			3	466
	AD-CH1	8	3	2	1	14		1			1						15
	AD-R1	20	12	18	37	87			1		1	1	1			2	88
	AD-T1		16	18	53	87											87
	AD-T2	10	17	32	22	81											81
	AD-T3	12	16	34	17	79											79
	AD-T4	82	78	132	93	385			2		2		3	1	1	5	388
	AD-T5	28	27	46	42	143											143
	AD-T6	2	2	4	4	12											12
LOS OLIVOS	AD-A1	88	88	122	159	457		3			3		27	26		53	460
	AD-CH1	74	88	194	154	510						2	17	27	2	48	512
	AD-CH2	56	58	120	70	304			1	1	2			1		1	306
	AD-CH3	156	114	152	165	587	1	1		20	22	2	13	4	34	53	643
	AD-CO1	196	184	310	282	972		3	4		7	8	16	12	2	38	981
	AD-N1	236	250	328	337	1151	3	5	20		28	92	177	94	4	367	1.183
	AD-N2	146	162	316	267	891		1			1	3	11	14	12	40	904
	AD-PL1	118	164	164	156	602			1	1	2		1	1		2	604
	AD-PL2	136	82	54	36	308						2		1		3	308
	AD-R1	12	8	12	11	43			1		1			1		1	44
	AD-R2	134	106	104	145	489			2		2	6	40	100	4	150	495
SAN MARTIN DE PORRES	AD-A1	38	50	162	146	396				2	2		3			3	398
	AD-A2	42	81	160	177	460		1	1		2	2		2		4	462
	AD-CH1	66	62	102	113	343	1				1		19	11		30	344
	AD-CO2	86	74	188	217	565								1		1	565
	AD-N2	2	3		20	25											25
	AD-PL2	12	5	2	11	30											30
	AD-R1	76	80	182	137	475		1	3	2	6	1	43	43	4	91	485
Total		2788	2573	4670	4438	14469	23	25	43	32	123	206	450	409	132	1197	14.724

LEGEND

OPERATIONAL INCIDENCES
2006-2007-2008-2009
- Clogs
- House Connection Damaging
- House Connection Repair

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

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GRAFICO 2.5.9-12: INCIDENCIAS OPERATIVAS ATOROS, REPARACION Y DETERIORO DE CONEXIONES DOMICILIARIAS EN REDES SECUNDARIAS DE ALCANTARILLADO

FIGURE 2.5.9-12: OPERATIONAL INCIDENCES INVOLVING CLOGS, HOUSE CONNECTION REPAIRS AND DAMAGES ON SEWERAGE SECONDARY NETWORKS

It is important to distinguish the previous incidents from the newer incidents for the purpose of using this data as a tool in the rehabilitation planning. One alternative could be applying a weight factor to the incidents, where a higher weight should be applied for recent years, in anticipation of some of the incidents might have been taken care of.

It can be mentioned that if the piping in a street shows repeated incidents of clogging, that piping needs to be changed either because of inadequate hydraulic capacity or improper condition of the piping. Table 2.5.9-16 shows as an example, the repeated incidents per street, evaluated from January to June of year 2009.

Table 2.5.9-16: Repeated Incidents per Street in June 2009

Nº	SECTOR	NIS_RAD	CLIENTE	MUNICIPIO	LOCALIDAD	CALLE	ACT	TIPO_AVISO
450	212 B	5315551	HERNANDEZ	DE PORRES	ASOC PROP URB LOS ALISOS	AV A	B	Atoro
1193	346	3800109	AYQUIPA	COMAS	URB PINAR, EL	AV A	B	Atoro
1197	346	3799967	JULIO AGUILAR ALVARADO	COMAS	URB PINAR, EL	AV A	B	Atoro
8734	84 B	3794932	AMADEO LUNA ESCOBAR	LOS OLIVOS	A.H SAN MARTIN	AV A	B	Atoro
9265	84 B	3790960		LOS OLIVOS	A.H VILLANUEVA, ARMANDO	AV A	B	Atoro
9269	84 B	3790960		LOS OLIVOS	A.H VILLANUEVA, ARMANDO	AV A	B	Atoro
9270	84 B	3790960		LOS OLIVOS	A.H VILLANUEVA, ARMANDO	AV A	B	Atoro
9285	84 B	3790960		LOS OLIVOS	A.H VILLANUEVA, ARMANDO	AV A	B	Atoro
9355	84 B	3796743	VERA	LOS OLIVOS	A.H SAN MARTIN	AV A	B	Atoro
9776	84 B	3790960		LOS OLIVOS	A.H VILLANUEVA, ARMANDO	AV A	H2	REPAR. ACOMETIDA
8735	84 B	3794932	ROLDAN, ISABEL FELICITA	LOS OLIVOS	A.H SAN MARTIN	AV A 0 147-02 CONFRATE	B	BALDE - SEDAPAL
8737	84 B	3794932	ROLDAN, ISABEL FELICITA	LOS OLIVOS	A.H SAN MARTIN	AV A 0 147-02 CONFRATE	B	BALDE - SEDAPAL
619	212 B	5050036	MIGUEL	DE PORRES	ASOC VIRGEN DEL ROSARIO	AV A 0 E 42	H2	ATORO EN CONEXION
622	212 B	5045330	BERNARDINO	DE PORRES	ASOC VIV. EL ROSARIO DEL	AV A 0 Q-40	H2	ATORO EN CONEXION
624	212 B	5045324	JUANA MARTINA	DE PORRES	ASOC VIV. EL ROSARIO DEL	AV A 0 Q 34 LECTUR	H2	ATORO EN CONEXION
625	212 B	5045330	BERNARDINO	DE PORRES	ASOC VIV. EL ROSARIO DEL	AV A 0 Q-40	H2	ATORO EN CONEXION
627	212 B	5045330	BERNARDINO	DE PORRES	ASOC VIV. EL ROSARIO DEL	AV A 0 Q-40	H2	ATORO EN CONEXION
633	212 B	5045330	BERNARDINO	DE PORRES	ASOC VIV. EL ROSARIO DEL	AV A 0 Q-40	H2	ATORO EN CONEXION
635	212 B	5045331	RAQUEL	DE PORRES	ASOC VIV. EL ROSARIO DEL	AV A 0 Q 41	H2	ATORO EN CONEXION
659	212 B	3836929	EMPERATRIZ LEOPOLDINA	DE PORRES	ASOC SEÑOR DE LOS	AV A 0 L-04	H2	ATORO EN CONEXION
1105	345	5458720	RODY	COMAS	URB ALAMEDA DEL PINAR 2	AV A 0 L 22	B	ANIEGO
1196	346	3799968	,	COMAS	URB PINAR, EL	AV A 0 M1-42 LECTUR	B	ANIEGO POR ATOROS
1223	346	3799968	,	COMAS	URB PINAR, EL	AV A 0 M1-42 LECTUR	B	ATORO EN RED
1380	346	3799969	RUBIO ACUÑA, FERNANDO	COMAS	URB PINAR, EL	AV A 0 M1-43 PARCELA C	H2	ATORO EN CONEXION
1387	346	3799969	RUBIO ACUÑA, FERNANDO	COMAS	URB PINAR, EL	AV A 0 M1-43 PARCELA C	H2	ATORO EN CONEXION
1390	346	3799969	RUBIO ACUÑA, FERNANDO	COMAS	URB PINAR, EL	AV A 0 M1-43 PARCELA C	H2	ATORO EN CONEXION
4167	350	3787651	BAUTISTA A	COMAS	A.H GERANIOS, LOS	AV A 0 D-11 LECTUR	H2	ATORO EN CONEXION
4219	350	3787583	,	COMAS	A.H GERANIOS, LOS	AV A 0 F-03	H2	ATORO EN CONEXION
4744	368 A	5339418	ALONSO VERGARA, MARIO	PIEDRA	ASOC VIV JARDINES DE	AV A 0 Ð2-02A 2DA ETAPA	B	ATORO EN RED
4763	368 A	5339418	ALONSO VERGARA, MARIO	PIEDRA	ASOC VIV JARDINES DE	AV A 0 Ð2-02A 2DA ETAPA	B	ATORO EN RED
4781	368 A	5339418	ALONSO VERGARA, MARIO	PIEDRA	ASOC VIV JARDINES DE	AV A 0 Ð2-02A 2DA ETAPA	H2	ATORO EN CONEXION
4782	368 A	5339418	ALONSO VERGARA, MARIO	PIEDRA	ASOC VIV JARDINES DE	AV A 0 Ð2-02A 2DA ETAPA	H2	ATORO EN CONEXION
4791	368 A	5339418	ALONSO VERGARA, MARIO	PIEDRA	ASOC VIV JARDINES DE	AV A 0 Ð2-02A 2DA ETAPA	H2	ATORO EN CONEXION
4804	368 A	5339415	AMES CAMPOS, PEDRO	PIEDRA	ASOC VIV JARDINES DE	AV A 0 N2-31 2DA ETAPA	H2	ATORO EN CONEXION

Source: SEDAPAL Cadastre and JICA Study Team

By analyzing the data base of the incidents, it was found that in the majority of the time, the operation and maintenance actions and/or user complaints do not provide sufficient information about the actions taken at the root cause of the incidents. Assuredly many of these incidents do not have direct relation to the condition of the pipe.

The incidents were analyzed to evaluate which are the actions that directly influence the condition of the pipes, and it was determined that the only incidents that could define a direct action affecting the condition of the pipe were the replacement of pipes that SEDAPAL ordered Concyssa to carry out. (Concyssa is the contracting company that carries out operation and maintenance work in North Lima)

These actions defined as collapses, and the analysis of the collapses was able to provide a better knowledge of the condition of the pipes. Knowing the number of collapses can give an idea of the places where the sewerage system is most deteriorated.

Figure 2.5.9-13 is a flow diagram showing the way to distinguish the types of incidents

directly relevant to the condition of the pipes. The "Replacement or repositioning of pipe" is the activity that allows to infer the condition of the pipes in adjacent zones.

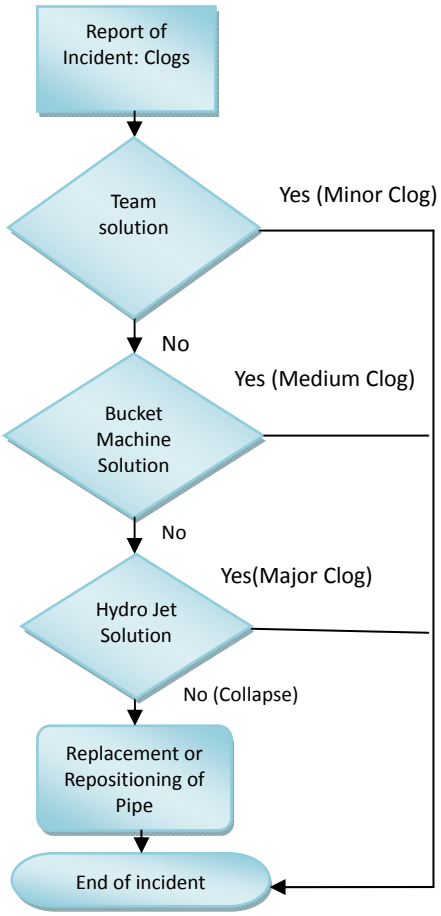
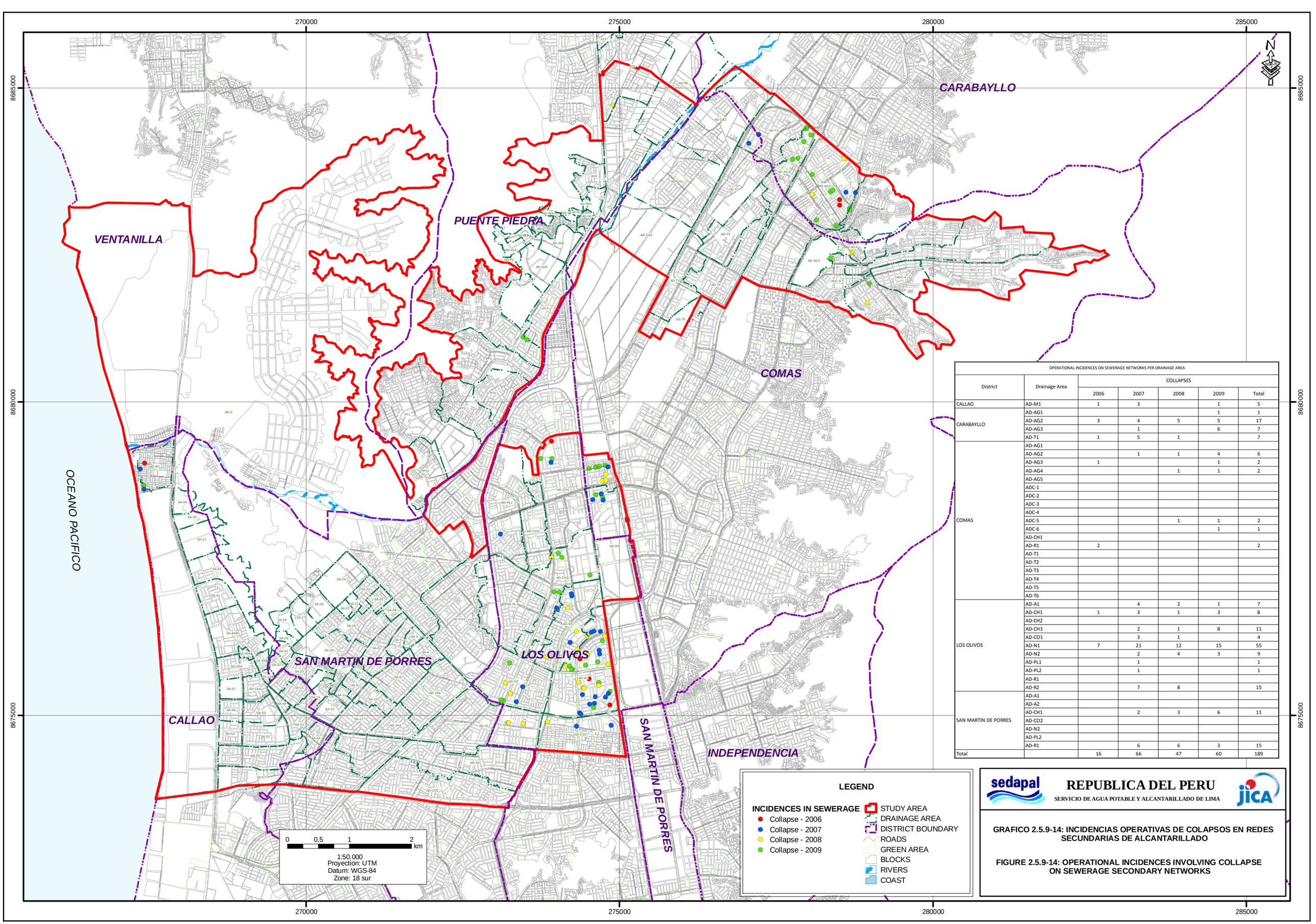


Figure 2.5.9-13: Flow Chart for Collapses

Figure 2.5.9-14 shows the location of these incidents, which have been called "Collapses."



OPERATIONAL INCIDENCES ON SEWERAGE NETWORKS PER DRAINAGE AREA

District	Drainage Area	COLLAPSES				
		2006	2007	2008	2009	Total
CALLAO	AD-M1	1	3		1	5
CARABAYLLO	AD-AG1				1	1
	AD-AG2	3	4	5	5	17
	AD-AG3		1		6	7
	AD-T1	1	5	1		7
COMAS	AD-AG1					
	AD-AG2		1	1	4	6
	AD-AG3	1			1	2
	AD-AG4			1	1	2
	AD-AG5					
	ADC-1					
	ADC-2					
	ADC-3					
	ADC-4					
	ADC-5			1	1	2
	ADC-6				1	1
	AD-CH1					
	AD-R1	2				2
	AD-T1					
	AD-T2					
	AD-T3					
	AD-T4					
	AD-T5					
	AD-T6					
LOS OLIVOS	AD-A1		4	2	1	7
	AD-CH1	1	3	1	3	8
	AD-CH2					
	AD-CH3		2	1	8	11
	AD-CO1		3	1		4
	AD-N1	7	21	12	15	55
	AD-N2		2	4	3	9
	AD-PL1		1			1
	AD-PL2		1			1
	AD-R1					
	AD-R2		7	8		15
SAN MARTIN DE PORRES	AD-A1					
	AD-A2					
	AD-CH1		2	3	6	11
	AD-CO2					
	AD-N2					
	AD-PL2					
	AD-R1		6	6	3	15
Total		16	66	47	60	189

LEGEND

INCIDENCES IN SEWERAGE
- Collapse - 2006
- Collapse - 2007
- Collapse - 2008
- Collapse - 2009

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

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GRAFICO 2.5.9-14: INCIDENCIAS OPERATIVAS DE COLAPSOS EN REDES SECUNDARIAS DE ALCANTARILLADO

FIGURE 2.5.9-14: OPERATIONAL INCIDENCES INVOLVING COLLAPSE ON SEWERAGE SECONDARY NETWORKS

Table 2.5.9-17 shows the list of incidents of collapse.

Table 2.5.9-17 : Incidents per Pipe Collapse

Year	2006	2007	2008	2009
Carabayllo	5	11	7	17
Comas	0	0	3	5
Los Olivos	10	45	30	39
Total	15	56	40	61

Source: SEDAPAL Cadastre and JICA Study Team

In Table 2.5.9-18, classification for pipes conditions by collapse incidences is shown.

Table 2.5.9-18: Definition of Pipe Condition based on Incidents by Collapse

Incidents /km/year	Condition of Pipe
Higher than 0.1	Very Deteriorated
Between 0.05 and 0.09	Deteriorated
Between 0.01 and 0.04	Not Deteriorated

Source: JICA Study Team

These incidents were analyzed together with the other field criteria in order to recommend their rehabilitation or replacement.

Since the pipe quantity in the Study area is 487.09 km, incidences per Km/year are shown in Table 2.5.9-19 per drainage area, corrosion level, and number of incidents per collapse. Table 2.5.9-20 groups drainage areas by corrosion level in the pipelines. It must be pointed out that incidents per collapse are not a tool that establishes the condition of a pipe in the drainage area. That is the case in the AD-T4,AD-T5,AD-T6, and AD-CH2 drainage areas that do not show any incident values by collapse. However, the manhole and pipe studies and the test pit study have established that there is an intermediate level of corrosion in these drainage areas.

Table 2.5.9-19: Corrosion level, Index of Incidents by Length of CSN Pipes According to Drainage Area (Unit/km)

Drainage Area	Incidents Per Year				Incidents Per Year Collapses	Length of Pipeline (km)	Length of CSN Pipeline (km)	Index of Incidents per Length of Pipes According to Drainage Area (Unit/km)				
	Collapses							Index of Collapses				
	2006	2007	2008	2009				2006	2007	2008	2009	Annual Average
AD-A1		4	2	1	7	30,315	18,945		0,13	0,07	0,03	0,06
AD-A2					0	24,163	19,610					
AD-AG1				1	1	4,676	1,921				0,21	0,05
AD-AG2	3	5	6	9	23	29,910	26,523	0,10	0,17	0,20	0,30	0,19
AD-AG3	1	1		7	9	12,129	11,998	0,08	0,08		0,58	0,19
AD-AG4			1	1	2	26,435	24,097			0,04	0,04	0,02
AD-AG5					0	0,000	0,000					
ADC-1					0	10,078	10,078					
ADC-2					0	13,514	13,495					
ADC-3					0	4,974	4,974					
ADC-4					0	6,906	6,906					
ADC-5			1	1	2	13,693	13,657			0,07	0,07	0,04
ADC-6				1	1	11,376	11,368				0,09	0,02
AD-CH1	1	5	4	9	19	32,115	24,166	0,03	0,16	0,12	0,28	0,15
AD-CH2					0	12,574	12,016					
AD-CH3		2	1	8	11	21,884	21,762		0,09	0,05	0,37	0,13
AD-CO1		3	1		4	20,844	19,992		0,14	0,05		0,05
AD-CO2					0	26,833	21,699					
AD-M1	1	3		1	5	13,419	11,754	0,07	0,22		0,07	0,09
AD-N1	7	21	12	15	55	24,785	19,041	0,28	0,85	0,48	0,61	0,55
AD-N2		2	4	3	9	23,531	22,503		0,08	0,17	0,13	0,10
AD-PL1		1			1	22,179	22,179		0,05			0,01
AD-PL2		1			1	22,585	20,149		0,04			0,01
AD-R1	2	6	6	3	17	14,814	13,886	0,14	0,41	0,41	0,20	0,29
AD-R2		7	8		15	17,360	16,435		0,40	0,46		0,22
AD-T1	1	5	1		7	14,533	11,078	0,07	0,34	0,07		0,12
AD-T2					0	6,819	2,330					
AD-T3					0	0,035	0,035					
AD-T4					0	12,574	12,392					
AD-T5					0	10,062	10,062					
AD-T6					0	2,606	2,606					
Grand Total	**16**	**66**	**47**	**60**	**189**	**487,722**	**427,659**	**0,03**	**0,14**	**0,10**	**0,12**	**0,10**

Condition of Pipe: Very Deteriorated
Condition of Pipe: Deteriorated
Condition of Pipe: Not Deteriorated

Source: JICA Study Team

Table 2.5.9-20: Corrosion level, Index of Incidents by Length of CSN Pipes According to Drainage Area (Unit/km)

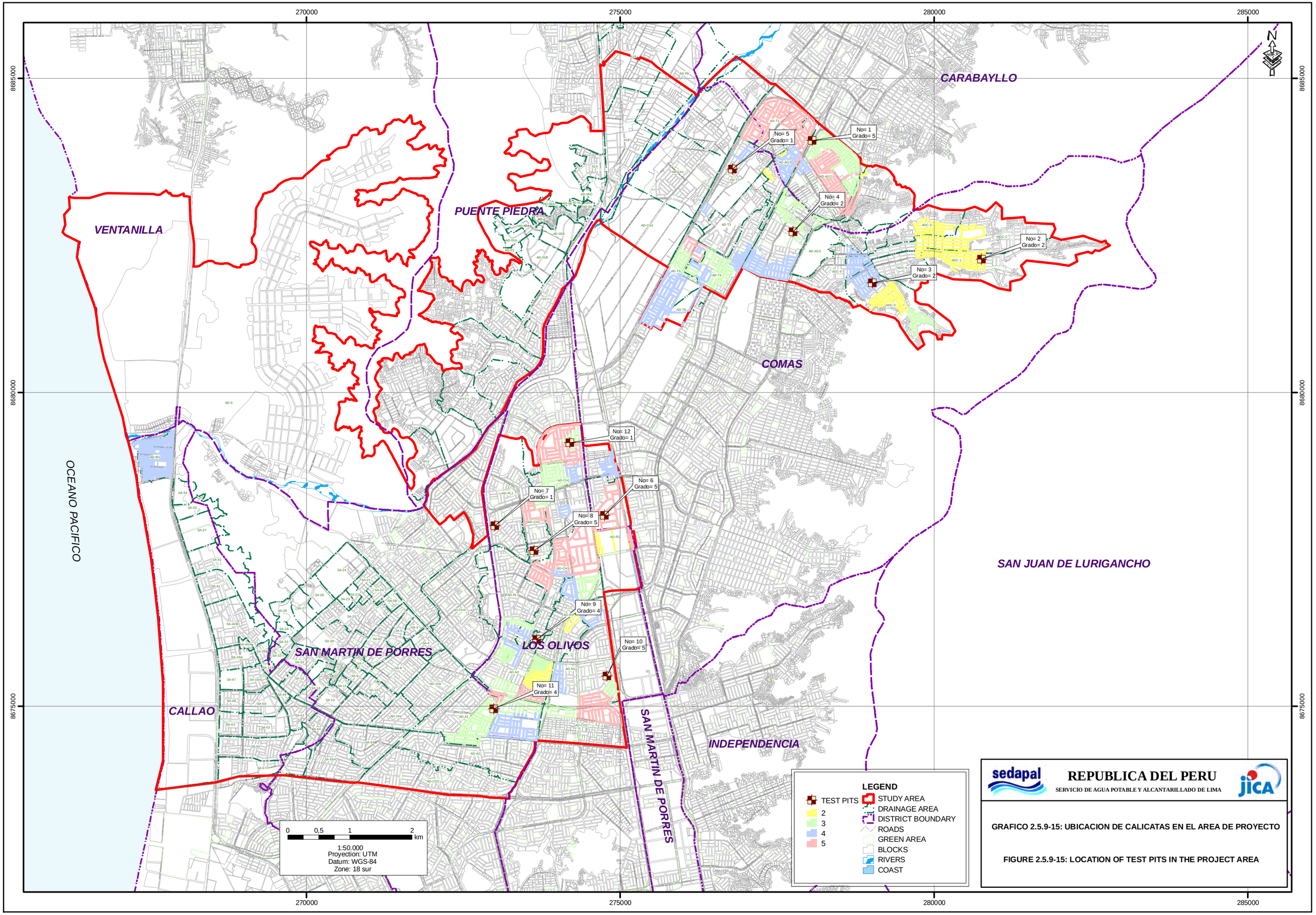
Drainage Area	Incidents Per Year				Incidents Per Year Collapses	Length of Pipeline (km)	Length of CSN Pipeline (km)	Index of Incidents per Length of Pipes According to Drainage Area (Unit/km)				
	Collapses							Index of Collapses				
	2006	2007	2008	2009				2006	2007	2008	2009	Annual Average
AD-N1	7	21	12	15	55	24,785	19,041	0,28	0,85	0,48	0,61	0,55
AD-R1	2	6	6	3	17	14,814	13,886	0,14	0,41	0,41	0,20	0,29
AD-R2		7	8		15	17,360	16,435	0,00	0,40	0,46	0,00	0,22
AD-AG2	3	5	6	9	23	29,910	26,523	0,10	0,17	0,20	0,30	0,19
AD-AG3	1	1		7	9	12,129	11,998	0,08	0,08	0,00	0,58	0,19
AD-CH1	1	5	4	9	19	32,115	24,166	0,03	0,16	0,12	0,28	0,15
AD-CH3		2	1	8	11	21,884	21,762	0,00	0,09	0,05	0,37	0,13
AD-T1	1	5	1		7	14,533	11,078	0,07	0,34	0,07	0,00	0,12
AD-N2		2	4	3	9	23,531	22,503	0,00	0,08	0,17	0,13	0,10
Total	15	54	42	54	165	191,062	167,393	0,08	0,28	0,22	0,28	0,22
AD-M1	1	3		1	5	13,419	11,754	0,07	0,22	0,00	0,07	0,09
AD-A1		4	2	1	7	30,315	18,945	0,00	0,13	0,07	0,03	0,06
AD-AG1				1	1	4,676	1,921	0,00	0,00	0,00	0,21	0,05
AD-CO1		3	1		4	20,844	19,992	0,00	0,14	0,05	0,00	0,05
AD-AG4			1	1	2	26,435	24,097	0,00	0,00	0,04	0,04	0,02
AD-PL1		1			1	22,179	22,179	0,00	0,05	0,00	0,00	0,01
AD-T6					0	2,606	2,606					
AD-T5					0	10,062	10,062					
AD-T4					0	12,574	12,392					
AD-CH2					0	12,574	12,016					
Total	1	11	4	4	20	155,684	135,964	0,01	0,07	0,03	0,03	0,03
ADC-5			1	1	2	13,693	13,657	0,00	0,00	0,07	0,07	0,04
ADC-6				1	1	11,376	11,368	0,00	0,00	0,00	0,09	0,02
AD-PL2		1			1	22,585	20,149	0,00	0,04	0,00	0,00	0,01
AD-T3					0	0,035	0,035					
AD-T2					0	6,819	2,330					
AD-CO2					0	26,833	21,699					
ADC-4					0	6,906	6,906					
ADC-3					0	4,974	4,974					
ADC-2					0	13,514	13,495					
ADC-1					0	10,078	10,078					
AD-AG5					0	0,000	0,000					
AD-A2					0	24,163	19,610					
Total	0	1	1	2	4	140,976	124,302	0,00	0,01	0,01	0,01	0,01

(e) Exploration Pits

Another methodology used for the evaluation of pipes in the Study Area was exploration pits. During the geotechnical study for the foundation of the primary and secondary water and sewerage system network, this study of exploration pits was also carried out. In this investigation, 12 points were selected for exploration pits for the purpose of verifying the results obtained in the ‘manholes and pipes study’.

The results of these exploration pits confirmed the results obtained in the ‘manholes and pipes study’.

Figure 2.5.9-15 shows the location of the exploration pits in the Study area.


270000
275000
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285000
8685000
8680000
8675000
N
CARABAYLLO
PUENTE PIEDRA
VENTANILLA
COMAS
SAN JUAN DE LURIGANCHO
SAN MARTIN DE PORRES
LOS OLIVOS
CALLAO
INDEPENDENCIA
SAN MARTIN DE PORRES
OCEANO PACIFICO
No= 1
Grado= 5
No= 2
Grado= 2
No= 3
Grado= 2
No= 4
Grado= 2
No= 5
Grado= 1
No= 6
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No= 7
Grado= 1
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Grado= 4
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No= 11
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0
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1
2
km
1:50.000
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Zone: 18 sur
LEGEND
TEST PITS
2
3
4
5
STUDY AREA
DRAINAGE AREA
DISTRICT BOUNDARY
ROADS
GREEN AREA
BLOCKS
RIVERS
COAST
sedapal
REPUBLICA DEL PERU
SERVICIO DE AGUA POTABLE Y ALCANTARILLADO DE LIMA
JICA
GRAFICO 2.5.9-15: UBICACION DE CALICATAS EN EL AREA DE PROYECTO
FIGURE 2.5.9-15: LOCATION OF TEST PITS IN THE PROJECT AREA

Table 2.5.9-21 shows the results of the corrosion pipe condition found in the exploration pits survey.

Table 2.5.9-21: Exploration Pits

Number	Type	Specification	Material	Location	Corrosion
1	Sample	ALC-T1	CSN	Comas	High
2	Sample	ALC-T2	CSN	Comas	Low
3	Visual	ALC-V3	CSN	Comas	Low
4	Visual	ALC-V2	CSN	Comas	Low
5	Visual	ALC=V1	PVC	Comas	Low
6	Sample	ALC-T3	CSN	Los Olivos	High
7	Visual	ALC-V6	PVC	Los Olivos	Low
8	Sample	ALC-T4	CSN	Los Olivos	High
9	Visual	ALC-V4	CSN	Los Olivos	High
10	Visual	ALC-V5	CSN	Los Olivos	High
11	Sample	ALC-T5	CSN	Los Olivos	High
12	Sample	ALC-T6	PVC	San Martin	Low

Source: JICA Study Team

The detailed results of the exploration pits is presented in Appendix A5.2.2.

(f) Pipe Gradient

The project has identified two different areas regarding pipe gradient:

- The area of low slopes is the Los Olivos zone, which is called as the Low Gradient Zone.
- The area of high slopes is the area of Collique and Comas, which is called the High Gradient Zones.

In the high gradient zones, such as the Collique zone, manholes have been found full of sediment such as aggregate, sand, and stones; this situation takes place first because of the lack of lids for house connections, which allows for the disposal of materials and waste into the system; and second, because of the deterioration of the CSN pipes inside the homes, which allows for the constant transport of stones and pebble aggregate.

It must be highlighted that SEDAPAL has been able to control this sedimentation through the construction of solid retention chambers before the main manhole.

Another problem found is the great quantity of sedimentation from solid waste; as the people has been using the sewerage networks for the disposal of organic and inorganic waste, including plastics, clothing, dead animals, and pieces of organic waste, among other things.

In many cases, these elements cause clogging in the sewerage networks. But the clog does not cause direct problem in the pipe; this contributes to the generation of the

elements that cause corrosion.

(g) SEDAPAL's preventive maintenance data

Preventive maintenance of the sewerage networks will allow the pipes to have a greater service life; the lack of this maintenance generates retention of solid waste, that in turn generates a greater transformation of sulfates into sulfides and hydrogen sulfide, which generates sulfuric acid and causes corrosion of CSN pipes.

Due to the lack of preventive maintenance (currently only corrective maintenance is performed), in addition to the deterioration due to ageing the pipes have suffered much more deterioration than expected.

(5) Network operation that has been affected by discharges to the sewerage networks from high consumers.

Data has been gathered from Special Client Operation Team on consumers and clients having their own source. These clients were identified in sector 85 B2, of the Industrial Molitalia urbanization, in the Los Olivos district. Report submitted by the Special Client Team provided the following information:

Table 2.5.9-22: List of Special Clients

N°	NOMBRE	NIS	CSMO PROM	CSMO PROM POR EMPRESA (m3)	OFICINA	CALLE	NUMERO	DUPLICADOR	CGV	MZA	LOTE	URBANIZA	DISTRITO	CODLOTEP	CUA	DES_CUA
1	CORPORACION FABRIL DE CONFECCIONES S A	2400371	4452	8729	5111	CA SAN GENARO	222					URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013080240	0421	INDUSTRIA TEXTIL
		3635333	107		1001	CA SAN GENARO	222			D	03	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013080240	0421	INDUSTRIA TEXTIL
		3704042	1254		1001	CA SAN ANDRES	6267	6299		D		URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013080240	0421	INDUSTRIA TEXTIL
		3713404	2916		1001	CA SAN ANDRES	6194	D 03		D	03	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013080240	0421	INDUSTRIA TEXTIL
2	CIA INDUSTRIAL TEXTIL CREDISA	3656426	655	655	1001	AV MENDIOLA, ALFREDO	6148			C	13	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013130110	0421	INDUSTRIA TEXTIL
3	FARMAGRO S A	3630878	535	535	1001	AV MENDIOLA, ALFREDO	6068			C	12	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013130100	0451	INDUSTRIA QUIMICA
4	INSTITUTO DE CIENCIAS Y HUMANIDADES	3634781	1340	1899	1001	AV UNIVERSITARIA NORTE	0	CDRA 63		C	09	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013130070	0606	UNIVERSIDAD PARTICULAR
		5861540	559		1001	AV UNIVERSITARIA NORTE	0	CDRA 63		K	10 A	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013130050	0606	UNIVERSIDAD PARTICULAR
5	MOLITALIA S A	3619648	6740	7227	1001	AV UNIVERSITARIA NORTE	6464			C	05	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013130060	0418	FABRICA DE HELADOS, CHOCOLATES Y AR
		3621431	487		1001	AV UNIVERSITARIA NORTE	6464	MZC LT10		C	10	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013130060	0328	DEPOSITOS Y ALMACENAMIENTO DE EMBAL
6	POLICÍA NACIONAL DEL PERÚ	3664848	627	1789	1001	AV PANAMERICANA NORTE	0	C 14		C	14	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013130010	0551	COLEGIO ESTATAL
		3714290	1162		1001	AV PANAMERICANA NORTE	0	C 14		C	14	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013130010	0551	COLEGIO ESTATAL
7	SAN JORGE INDUSTRIAL S A	3623104	447	447	1001	CA SAN ANDRES	6134			B		URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013160010	0421	INDUSTRIA TEXTIL
8	TRANSPORTES LAS VEGAS S.A.	3657629	136	136	1001	AV MENDIOLA, ALFREDO	6200			D		URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013080260	0352	VENTAS DE COMBUSTIBLES, LUBRICANTES
9	UNIVERSIDAD CESAR VALLEJO S.A.C.	3725819	1235	3049	1001	CA SAN GENARO	250			D	04	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013080250	0606	UNIVERSIDAD PARTICULAR
		3831525	1814		1001	AV MENDIOLA, ALFREDO	6232					URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013080250	0606	UNIVERSIDAD PARTICULAR
10	UNIQUE S.A.	3635630	2601	2601	1001	CA SAN ANDRES	0	A 06		A	06	URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013090160	0472	OTROS PRODUCTOS METALICOS
11	YOBEL SUPPLY CHAIN MANAGEMENT S.A.	3622114	464	4322	1001	CA GENARO, SAN	150	0				URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013090160	0430	FABRICA DE DETERGENTES Y JABONES
		3626292	3858		1001	CA GENARO, SAN	150		A	A		URB INDUSTRIAL. MOLITALIA	LOS OLIVOS	039013090160	0430	FABRICA DE DETERGENTES Y JABONES

Source: JICA Stdy Team

It was found that sewage from these clients causes problems in the network, and the Special Client team scheduled an inspection visit to to the above mentioned clients.

According to the information provided and the calculations made, the following situation is set out:

- Insufficient capacity:
  - ❖ San Andrés (Between the San Bernardo and San Genaro avenues)
  - ❖ San Genaro (Between the Gerardo Unger and Alfredo Mendiola streets)

- Insufficient gradient
  - ❖ Alfredo Mendiola

- Cleaning and maintenance issues:
  - ❖ San Andrés (Between the San Genaro avenue and the Gerardo Unger street)

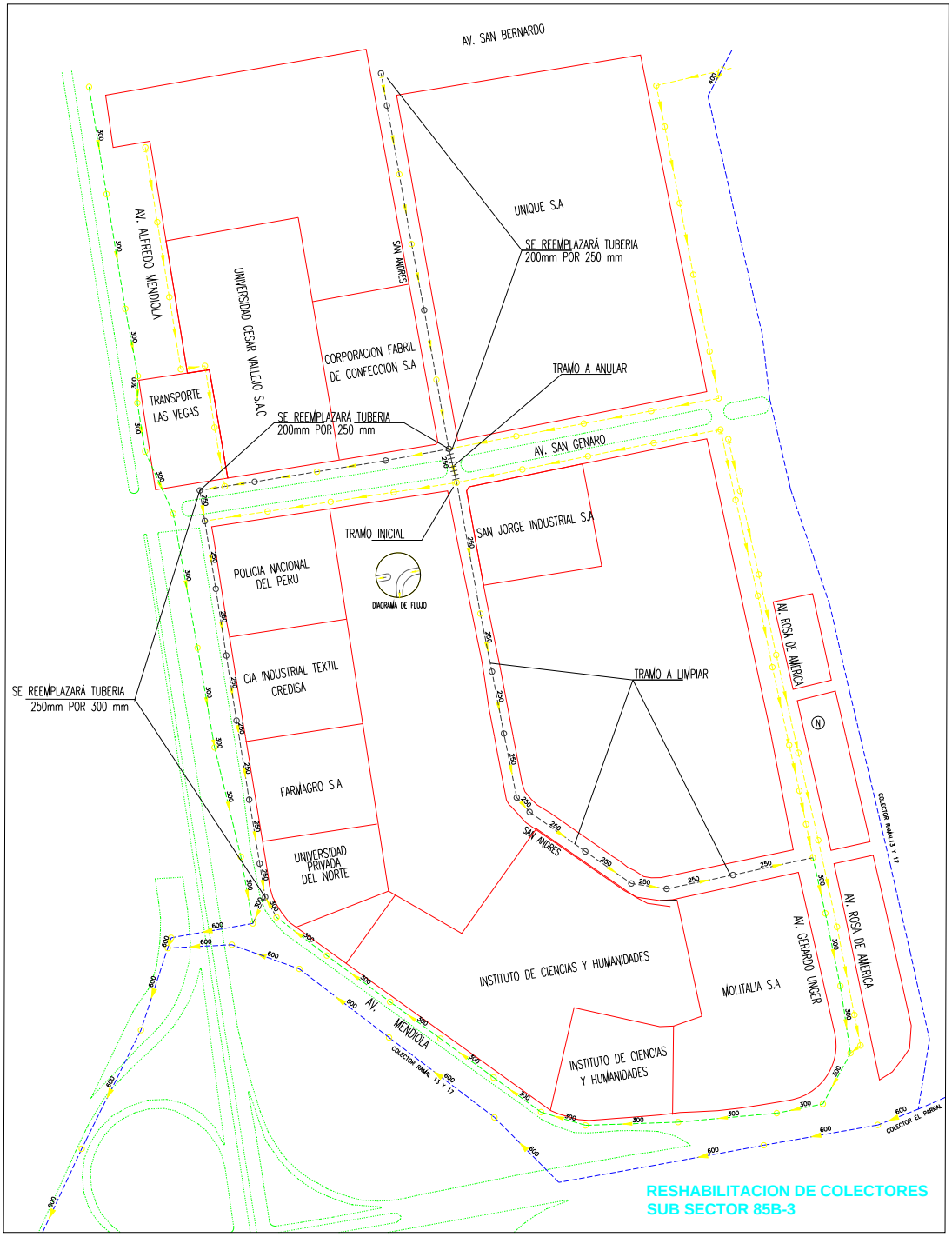

Figure 2.5.9-16: Collector rehabilitation in Sub Sector 85B-3

(6) Incident caused by industrial discharges to the sewerage network

Sewerage networks are designed for domestic sewage. Non-domestic sewage with substances that directly or indirectly affect the network will absolutely and directly damage the sewerage pipelines.

In order to safeguard the sewerage pipelines' lifespan, SEDAPAL's Wastewater Quality Control Team has been monitoring wastewater quality for the last 20+ years, both at industrial and commercial sewage level.

The Central Government has relevant regulations aiming at this. At present, there is a National Industrial Sewage Regulation (DS.028-60-S.A.P.L) that requires that all industrial and / or commercial users condition their sewage before discharging to the public network. Basic parameters being monitored include: pH, SS, BOD, COD, and grease.

The Wastewater Quality Control Team coordinates along with the Comas Operative Center's Operation and Maintenance Team to identify those users discharging non-domestic, untreated sewage to the public sewerage network.

In addition, in an attempt to protect sewerage collection installations (including all sanitation collection infrastructure, such as sewerage networks, sewage pumping stations, and treatment plants), the Ministry of Housing, Construction, and Sanitation has passed a S.D (Supreme Decree) 021-2009-VIVIENDA that states maximum admissible values for non-domestic wastes to be discharged in domestic sewerage. At present, its enforcement is expected to be by 2011.