CHAPTER 3

POLICY OUTCOMES

The objective of this Chapter is to complement the description of the institutional and policy framework described in Chapter 2 with the description of the evolution of water quality and industrial emissions in the city prior to giving possible explanations of the choice of cost-ineffective instruments by the Uruguayan authorities. More specifically the Chapter describes four sets of variables. The first set is ambient water quality of the three main waterways of the city. The beginning of the description period is different for each waterway because of the availability of information, but it generally goes from the first half of the nineties to 2001. The second set is total cubic meters (m^3) emitted by monitored industrial plants per day. The third set is the total kg/day of the two most important pollutants emitted (BOD_5 and Chromium). In this case the description covers the period December 1996 – November 2001. The fourth set of variables describes the evolution of violations to BOD_5 emission standards. The evolution of violations is analyzed for the period July 1997 to October 2001, the same sample period of the econometric work done in the second part of this dissertation. I conclude that the quality of the main waterways in the city decreased during the period and that, with few exceptions, pollutants concentration levels do not comply with ambient standards. Also, emissions of the industrial sector have tended to decrease on average, as have the average quantity emitted of the two most important pollutants. Finally, average concentration levels of BOD_5 have also tended to decrease, but not enough to make the average level of violation decrease, when measured with respect to emissions standards that were getting stricter.

It is important to note that some of the parameters describing ambient water quality, like fecal coliforms, are not related to the effectiveness of the industrial pollution control policy.

3.1 EVOLUTION OF AMBIENT WATER QUALITY

A description of the evolution of water quality of the city streams can be tedious because one needs to conduct a separate analysis for each major stream (Carrasco, Miguelete and Pantanoso), distinguish between types of pollution, choose representative pollutants and sample locations, and compare the levels of the variables across time and locations. Also, an annual comparison of water quality could be incorrect if not complemented with information on stream volume and meteorological conditions. It is not the objective of this section to make such an exhaustive analysis, but rather to illustrate the evolution of the quality of Montevideo's main watercourses, recognizing these shortcomings.[18]

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[18] In order to solve the difficulties concerning the comparison of water quality in different points in time and space, SEINCO opted to apply a Simplified Water Quality Index (Multiservice, et. al., 2001a). The index is constructed with only five parameters (temperature, Dissolved Oxygen, Conductivity, Total Suspended Solids and Oxidization to the potassium permanganate), but it is sensitive to water conditions at all points of the stream and different seasons. I do not present the evolution of the watercourses quality according to this index because it covers a short time period (from the summer of 1999 to the winter of 2002) and therefore is less illustrative of the ambient water quality evolution.

Being aware of all these issues, and for the sake of simplicity, I have opted to present average measures of pollution concentration of the three main water bodies in Montevideo in two sample stations, one at the stream origin and the other near the outfall. Average concentrations were calculated based on the availability of information and representation of the three different types of pollution; organic (BOD_5 and oils and fats), pathogenic (fecal coliforms) and physical (chromium and lead).[19] Ambient standards that serve as references are those of Class 3 (Irrigation of products not directly consumed by humans) and Class 4 streams (Crossing urban areas).

Table 3.1: Evolution of the Carrasco stream ambient quality

Most Significant Pollutants

Source	Sampling location*	BOD5 (mg/l)	Oils and Fats (mg/l)	Fecal Coliforms (ufc/100ml)	Chromium (mg/l)	Lead (mg/l)
SEINCO Average Feb 1999 – Jul 2001	Origin	5	14	1,107	0.02	0.21
	Outfall	11	19	83,794	0.02	0.07
Raffaele, et. al. 1998	Origin	2	<50	3,000	0.01	
	Outfall	9	<50	210,000	0.01	
APRAC August 1996	Origin	5		1,400		
	Outfall	6		46,000	0.05	0.03
National Decree 253/79. Ambient Standards	Class 3 (Irrigation of products not directly consumed by humans)	10	Virtually absent	Less than 2,000 in all samples. 1,000 average.	0.05	0.03
	Class 4 (Crossing urban areas)	15	10	Less than 5,000 in 80% of the samples	0.5	0.05

Sources: Own calculations using input data from IMM (1997), Raffaele, et. al. (1998) and SEINCO (several reports).

* The selected origin sampling location is “Aº Toledo – R102” and the outfall location is “Pte. Gral. French/Pte. Av. Italia”.

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[19] The most significant pollutants are BOD_5, oils and fats, fecal coliforms and chromium (Multiservice, et al., 2001).

In general terms there has not been a clear change in the water quality of the Carrasco stream during the period between 1996 and 2001. Some pollutant concentrations increased near the outfall, while others decreased. In fact, BOD_5 concentration levels increased near the outfall from 6 mg/l in 1996 to 11 mg/l, on average, in 1999-2001. Fecal coliforms concentration levels also increased from 46,000 ufc/100ml in 1996 to 83,794 on average in 1999-2001, with a peak of 210,000 in 1998. Although less clearly, due to lack of information, lead concentration levels also seem to have increased. On the other hand, oils and fats decreased from a level around 50 mg/l in 1998 to an average level of 19 mg/l in 1999-2001, and chromium concentration levels also decreased from an initial level of 0.05 mg/l in 1996 to an average level of 0.02 in 1999-2001, complying with ambient standards for Class 3 waterways.

It is also interesting to note that in spite of this irregular evolution of the different types of pollutants in recent years, Chromium and BOD_5 are the only pollutants at the outfall of the Carrasco stream with concentration levels that comply with the ambient standards set for watercourses crossing urban areas (Class 4). It is important to recall that BOD_5 and Chromium are the two pollutants targeted by the by the IMM and the Inter-American Development Bank.

Table 3.2: Evolution of the Miguelete stream ambient quality

Most Significant pollutants

Source	Sampling location*	BOD_5	Oils and Fats	Fecal Coliforms	Chromium	Lead
		(mg/L)	(mg/L)	(ufc/100ml)	(mg/l)	(mg/l)
SEINCO Average Feb 1999–Jul 2001	Origin	2.7	26	3,303	0.05	0.07
	Outfall	122.4	57	3,951,375	0.13	0.04
UEI, IMM August 5,1998	Origin	2.0	50		0.10	
	Outfall	120.0	110		6.30	
LH-IMM May 1993-Jun 1994	Origin	2.3	39		0.05	
	Outfall	22.0	50		0.05	
National Decree 253/79 Ambient Stds.	Class 3 (Irrigation of products not directly consumed by humans)	10	Virtually absent	Less than 2,000 in all samples. 1,000 average.	0.05	0.03
	Class 4 (Crossing urban areas)	15	10	Less than 5,000 in 80% of samples	0.5	0.05

Sources: Own calculations using input data from IMM (1998b), IMM (1994b) and SEINCO (several reports)

* The selected origin sampling location is “O. Rodríguez” and the outfall location is “Coraceros/ Agraciada”.

The Miguelete presents a clearer evolution toward worsened ambient quality. There is no information regarding the evolution of fecal coliforms and lead concentration levels, but the concentration levels of the rest of the pollutants increased on average near its outfall between May 1993-June 1994 and February 1999-July 2001. BOD_5 levels increased from an average level of 22 mg/l in 1993-1994 to an average level of 122.4 mg/l in 1999-2001, that is 456%. Oils and fats increased from an average level of 50 mg/l in 1993-1994 to 57 mg/l in 1999-2001, reaching 110 mg/l in 1998. Chromium levels increased 160% from 0.05 mg/l in 1993-1994 to 0.13 mg/l in 1999-2001.

Lastly, none of the pollutants concentrations levels near the outfall of the Miguelete comply with ambient standards set for Class 3 (Irrigation of products not directly consumed by humans) and only lead concentrations are lower than the standard set for Class 4 waterways (Crossing urban areas).

Table 3.3: Evolution of the Pantanoso stream ambient quality

Most Significant pollutants

Source	Sampling location*	BOD_5 (mg/L)	Oils and Fats (mg/L)	Fecal coliforms (UFC/100ml)	Chromium (mg/L)	Lead (mg/l)
SEINCO Average Feb 1999 - Jul 2001	Origin	21.3	26.9	1,237,063	0.03	0.02
	Outfall	47.8	26.0	2,045,625	0.10	0.11
UEI, IMM, Apr 1997	Origin	330.0	50.0			
	Outfall	100.0	60.0			
LH, IMM Average Sept 1994–Mar 1995	Origin	180.8	32.3	2,700,000	0.05	
	Outfall	22.8	15.5	1,494,000	0.05	
National Decree 253/79 Ambient Standards	Class 3 (Irrigation of products not directly consumed by humans)	10	Virtually absent	Less than 2,000 in all samples. 1,000 average.	0.05	0.03
	Class 4 (Crossing urban areas)	15	10	Less than 5,000 in 80% of samples	0.5	0.05

Sources: Own calculations using input data from IMM (1995,1997), SEINCO (several reports)
* The selected origin sampling location is “Cno. Colman” and the outfall location is “Pte. C. M. Ramirez/Pte. R1”.

In the case of the Pantanoso stream the data is somewhat mixed, as it is with the Carrasco stream. In this case there is no information on the evolution of lead pollution, however organic pollution has increased at the outfall as measured by the average concentration level of BOD_5 and oils and fats. In effect, the Pantanoso average concentration of BOD_5 near the outfall in 1994-1995 was around 23 mg/l and rose to 48 mg/l in 1999-2001, with a peak of 100 mg/l in 1998. Oils and fats show a similar evolution. Chromium also seems to have increased its concentration levels near the outfall from 0.05 mg/l in 1994-1995 to 0.10 mg/l in 1999-2001.

Ambient water quality of the Pantanoso stream does not comply with ambient standards for waterways crossing urban areas in none of its pollutants near its outfall. The forthcoming solution from regulators is the construction of the extensions of the sewage pipeline system to the west part of the city to redirect its pollution into the sea (Río de la Plata). (see Raffaele, et. al., 1997 and Multiservice – Seinco – Tahal (2001a).

The conclusions that can be drawn from these descriptions are the following. First, with very few exceptions (like oils and fats in the Carrasco stream and chromium in the Carrasco stream), ambient water quality of the three major streams of Montevideo has worsened with respect to 1993-1994 levels near their outfalls.[20] Second, with the exception of chromium and BOD_5 concentration levels for the Carrasco stream, and lead concentration levels in the Miguelete stream, none of the pollutants concentration levels comply with the ambient standards set for streams crossing urban areas at their outfalls.

It is important to note that this decrease in water quality does not necessarily mean a failure in the control of industrial emissions. Apart from pathogenic pollution, which is obviously not industrial pollution, the estimated contributions of the different sources of organic pollution are 16 to 20 tons of BOD_5 per day from industrial sources, 50 tons per day from domestic sewage, and 120 tons per day from nonpoint sources. The last is from 300 tons of solid wastes dumped into the waters by squatters at their margins. This amounts to 25% of the total waste generated by the city. In other words, around 60% of organic pollution results from informal dumping of waste and only around 10% originates from industrial sources (IMM, 2002). This is the reason why water quality of the city streams of Montevideo could have decreased even with decreasing industrial

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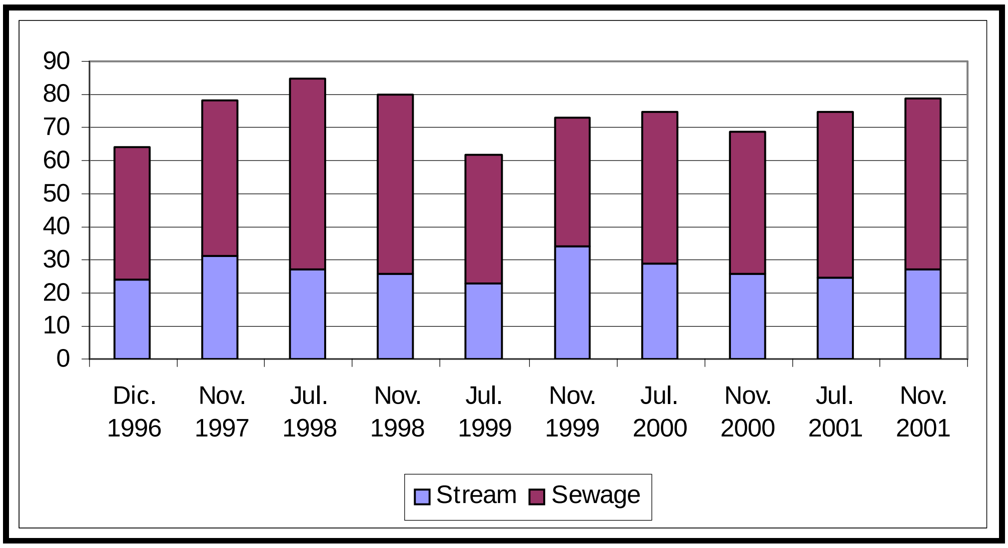
[20] In the case of the Carrasco stream the first information gathered corresponds to August 1996.

emissions. In this sense, the growth of irregular settlements in Montevideo during the nineties created a new and different problem for the regulators of water pollution in the city. Under these circumstances, not even the construction of large-scale sewage systems under the Third Stage of the Urban Sanitation Plan to divert industrial and domestic pollution directly into the sea (Río de la Plata) can assure an increase in the streams' water quality.

3.2 EVOLUTION OF INDUSTRIAL EMISSIONS

Figure 3.1 presents the evolution of the number of plants regularly monitored by the IMM during the period December 1996 to November 2001, classified by point of discharge (see also Table A.3.1 in Appendix). “Stream” indicates that the plant emits to any of the city streams or water bodies. These include not only the three major basins (Miguelete, Pantanoso and Carrasco), but also the Río de la Plata. The first observation is that the Industrial Pollution Reduction Plan of 1997 implied an important increase in monitoring efforts with respect to previous levels. In effect, while in December 1996 the IMM regularly monitored 64 plants, this number rose to 78 in November 1997, just a couple of months after the implementation of the Plan. A second observation is that in July 1999 the IMM decreased its monitoring efforts considerably when the Monitoring Program began in April 1999, taking advantage of the fact that the private consortium started to monitor plants. 1999 was also the year in which the Uruguayan economy started a recession that lasted for five years.

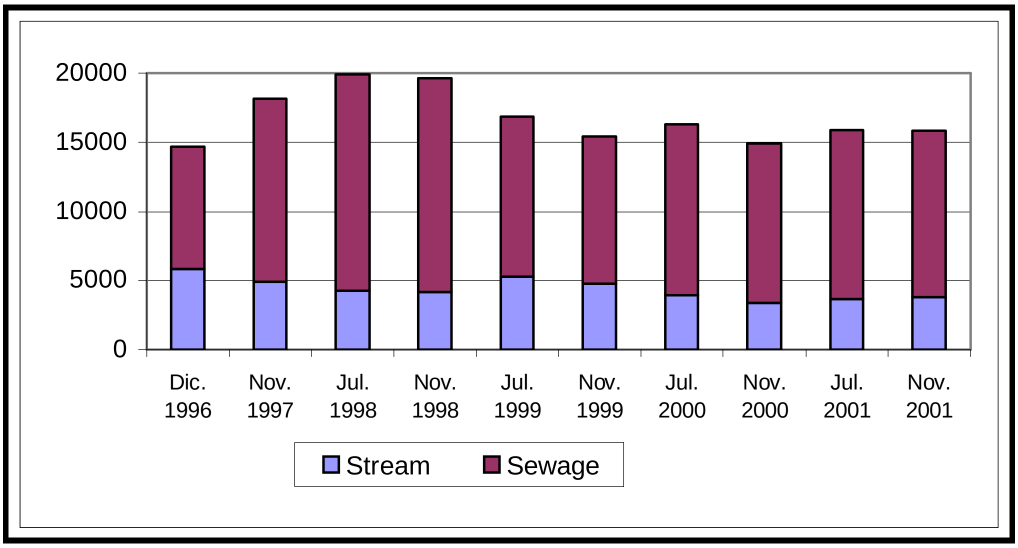
Figure 3.1: Number of industrial plants monitored by the IMM



Source: Table A.3.1

The figure does not show the number of plants closed during the period, an argument frequently mentioned by inspectors and policy makers as a an important determinant of the decrease in industrial emissions. Nevertheless, Figure 3.2 seems to show that total discharges from industrial plants decreased despite the fact that the number of monitored industrial plants was not constant.

Figure 3.2: Evolution of Industrial Discharges (m^3/day)

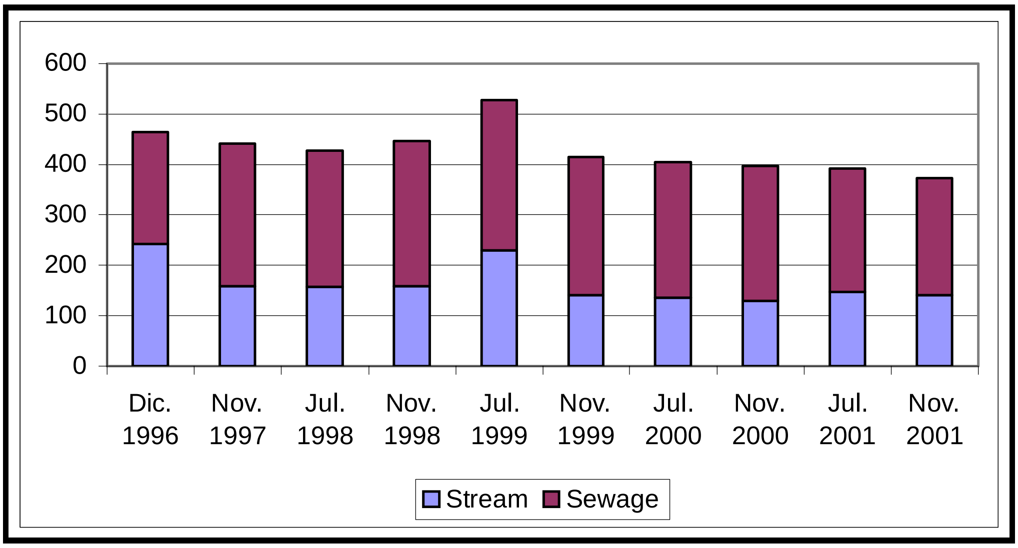


Source: Table A.3.1.

The evolution of the average level of emissions by monitored plant in Figure 3.3 draws a better picture in this respect. The figure shows that the average level of emissions per plant tended to decrease slowly. At the beginning of December 1996 the average level of emissions of the monitored industrial plants was 464 m^3/day while in November 2001 it was 372 m^3/day. This translates into a decrease in average emissions of 20%.

November 1998 and specially July 1999 are exceptions to the decreasing trend. It is very interesting to note that July 1999 is precisely the same month when the IMM eased their monitoring frequency in favor of the private consulting firm. In this month industrial plants increased their average emissions level to 527 m^3/day, by far the largest average level of the period. Being monitored by a private firm without enforcement power may have changed their incentives. Furthermore, the increase in the monitoring frequency in November 1999 and July 2000 coincides with the decrease in average emissions back to pre-1999 levels.

Figure 3.3: Average m^3/day per Plant



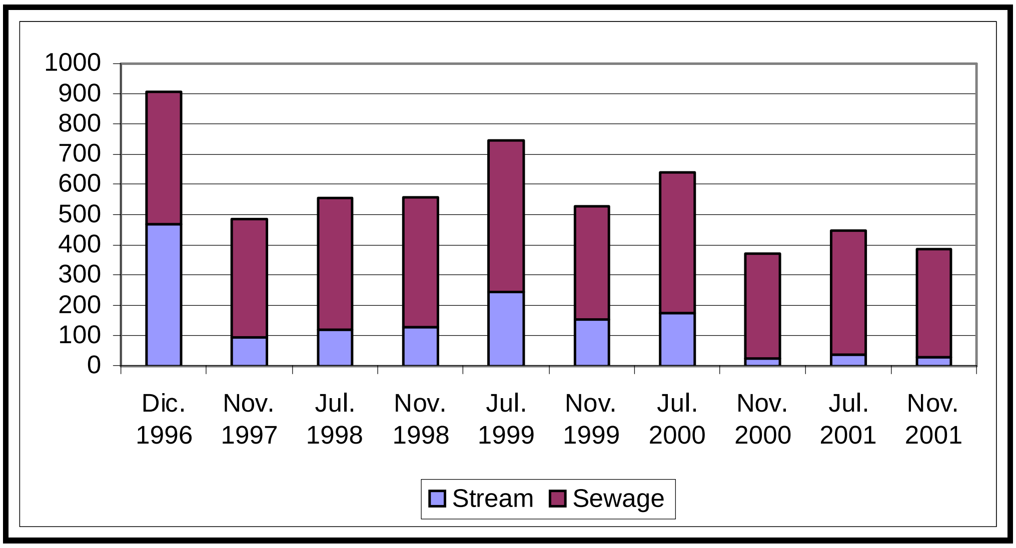
Source: Table A.3.2.

Lastly, Figures 3.4 and 3.5 show the evolution of the average quantity of emissions of the two targeted pollutants, BOD_5 and Chromium, per plant. In the first case the drop is significant if we compare the level in December 1996 (908 kg/day per plant) with the level in November 2001 (387 kg/day per plant). In other words, average discharge of BOD_5 decreased 57%. Nevertheless, the drop is only 20% when compared to November 1997 levels. In other words, the bulk of the decrease was attained at the beginning of the study period. Even more, the trend of BOD_5 is very irregular. For example, emissions were 53% higher in July 1999 than they were in November 1997.

This trend is consistent with the evolution of the number of plants monitored by the IMM. BOD_5 loads decreased in 1997 when the number of plants increased, increased in 1999 when inspections decreased, and decreased again in 2000 when the IMM increased the number of inspected plants.

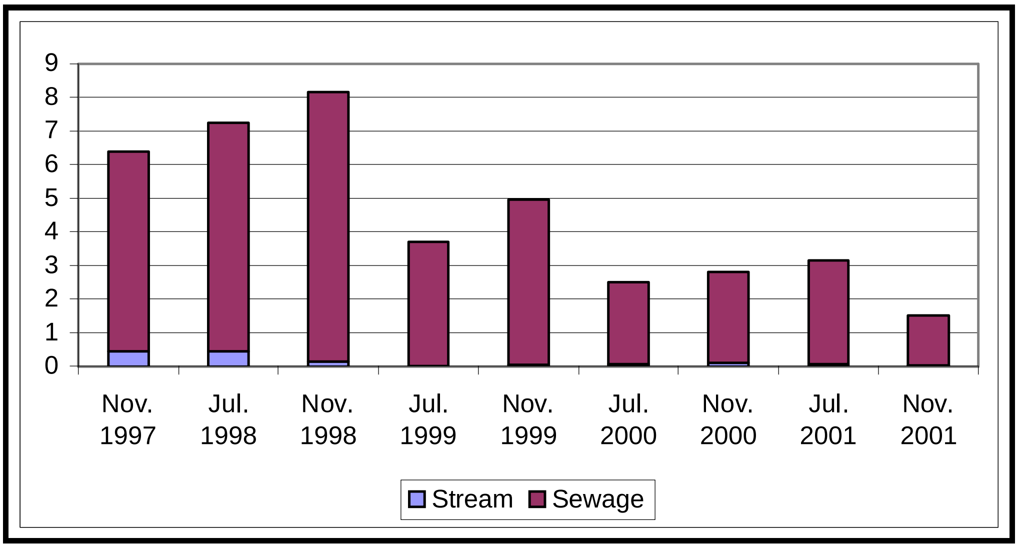
In the case of chromium the decrease is larger in percentage terms and the downward trend, although not regular, is clearer. The average level of chromium emissions per monitored industrial plant in November 1997 was 6.4 kg/day, while it was 1.54 kg/day in November 2001. This 76% decrease is the result of adoption of abatement technology on the part of bovine and ovine skin tanneries, responsible for 100% chromium emissions. (Multiservice-Seinco-Tahal, 2001c). But, as stated by the same IMM inspectors, the sector contraction that started in 1999 also contributed to this decrease. (Raffaele, et al., 1999).

Figure 3.4: Evolution of BOD_5 (Kg/day) emitted per Plant



Source: Table A.3.2.

Figure 3.5: Evolution of Chromium (Kg/day) emitted per Plant



Source: Table A.3.3.

Finally, it is also very important to note that emissions of BOD_5 and chromium directly to water streams have practically disappeared. This pollution now goes directly to the city sewage system and finally to the sea (Río de la Plata). This is not a minor point because the IMM committed itself to decrease concentrations levels of these two pollutants in the waterways when signing the Inter American Development Bank loan that financed the construction of the city sewage system. It may be that the IMM strategy to achieve its goal is to simply divert this pollution into the sea (Rio de la Plata).

3.3 EVOLUTION OF VIOLATIONS

The above descriptions concern the quantitative evolution of emissions, either total emissions or for selected pollutants like BOD_5 and Chromium. But, what about the evolution of the extent and number of violations to the emission standards? The question is important because emission standards are stated in terms of concentrations, not in terms of quantities emitted of pollutants. It could happen, for example, that there are less emissions but more violations.

In order to see the evolution of the extent and number of violations, I examine the evolution of the reported levels of BOD_5. These reported levels are not public. They were obtained exclusively for this research from IMM's records of sixty nine industrial plants that are responsible for more than 90% of the industrial emissions in the city.[21] As already stated BOD_5 is among the most important pollutants and is one of the two pollutants targeted by the IMM and the Inter American Development Bank. It is also a pollutant that all plants emit and have to report; therefore there is more information about it than there is for chromium, for example.

As a first step toward the description of the evolution of violations I present the descriptive statistics of the variable "extent of the violation" in Table 3.4, equal to emissions of BOD_5 (mg/l) minus the concentration standards set in the legislation, censored at zero, and a compliance status variable equal to one if the plant reported a violation and zero otherwise. The data cover the time period July 1997 - October 2001. The calculations are done using the original standards during the entire period and also using the laxer standards of the Industrial Reduction Plan during July 1997 – December 1999.

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[21] See Chapter 6 for a detailed description of the data set and the sample selection.

Table 3.4: Descriptive statistics for violations

	Extent of the Violation (Censored at zero)		Compliance Status (Violation = 1, Compliance = 0)	
	Original Standards	Plan’s Standards	Original Standards	Plan’s Standards
Mean	641.5	338.8	0.5421	0.4069
Median	20.0	0.0	1.0	0.0
Maximum	38143	17125	1.0	1.0
Std. Dev.	1906.7	1124.1	0.4983	0.4914
Observations	2699	2192	2699	2192

Figure 3.6: Percentage of Violations over Total Reports

July 1997 - October 2001

Plants Ordered by Violation rate

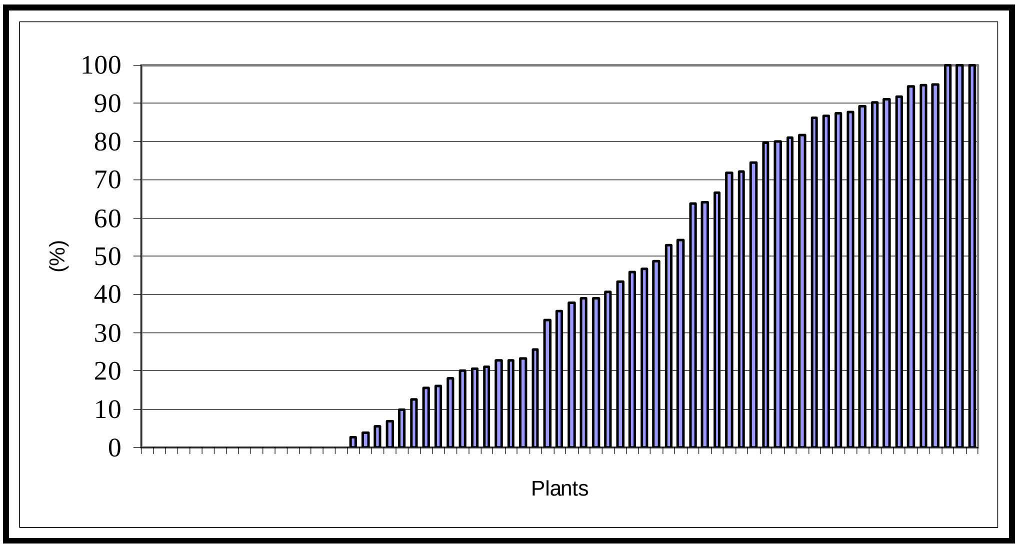


Figure 3.7: Number of Violations as Percentage of the Number of Reports

July 1997 - October 2001

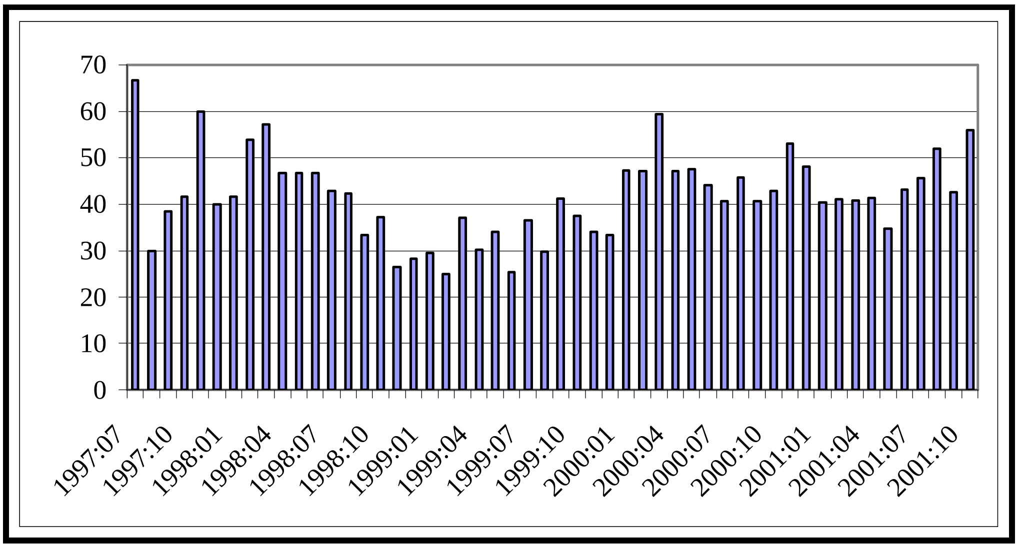


Table 3.6 and Figures 3.6 and 3.7 show that violations were frequent, even when measured as emissions in excess of the laxer standards. Forty one percent (41%) of the reported BOD_5 levels were out of compliance with the Plan's standards, and only twenty six (26) plants of the total sixty-nine (69) reported to be in violation less than twenty percent (20%) of the time. The number of violations as a percentage of the number reports never decreased below 25%, or 41% if we consider the original standards.

Figure 3.8: Mean and Median level of reported BOD_5

July 1997 - October 2001

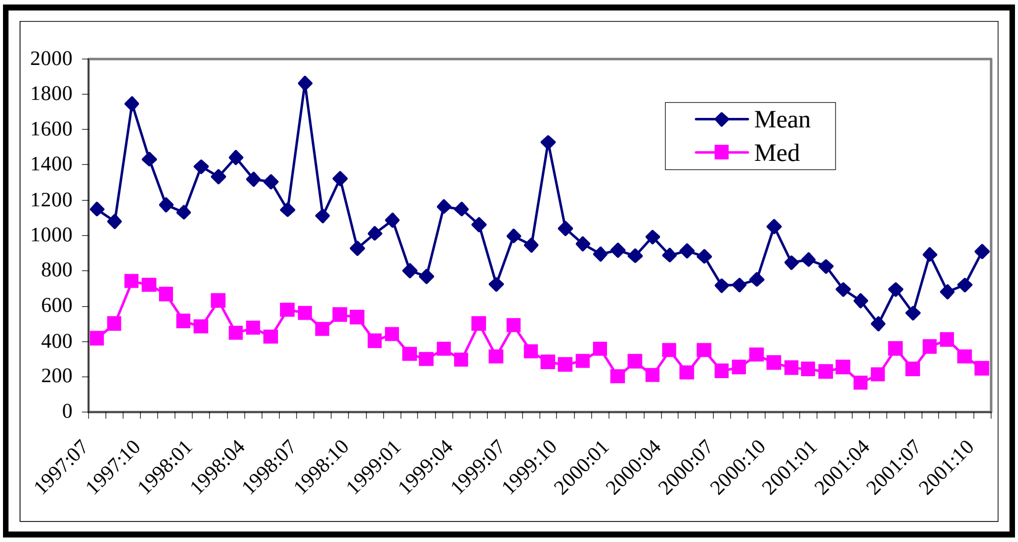


Figure 3.9: Mean and Median Extent of Reported Violations

Censored at Zero

July 1997 - October 2001

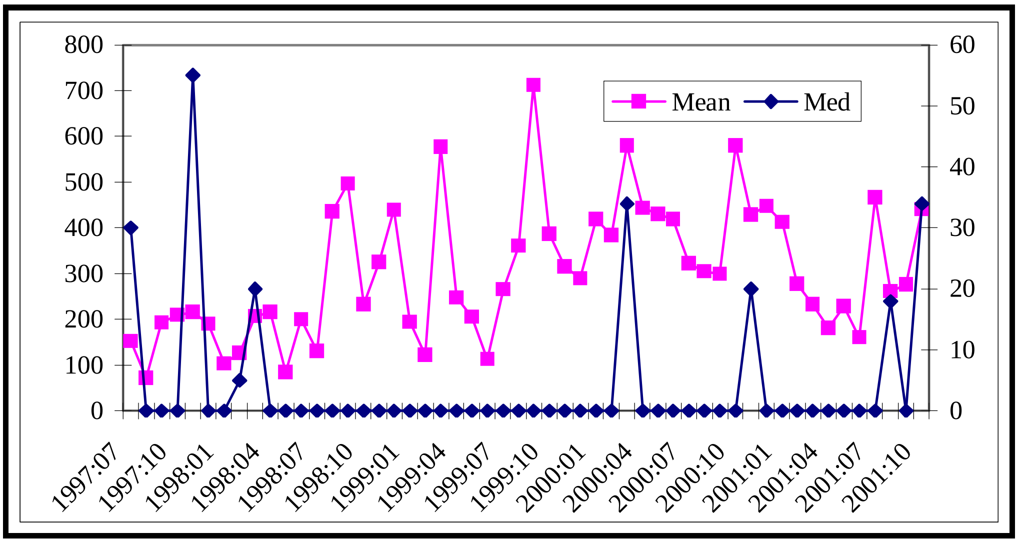


Figure 3.8 shows that BOD_5 concentrations have decreased on average. In July 1997 the monitored plants were emitting 1,150 mg/l of BOD_5 on average while in October 2001 this number was 910 mg/l, representing a 21% fall.

Figure 3.9 shows that the decrease in average BOD_5 concentration levels of emissions was not enough to produce a decrease in the average extent of the violations. It has to be remembered that violations are calculated with respect to the laxer standards of the Industrial Pollution Reduction Plan during 1997 – 1999 and that these standards were getting stricter, converging again to the original levels during this period. This is the reason why average levels of BOD_5 decreased on average while violations increased. The average violation increased 188%, from 153 mg/l to 441 mg/l.

This result may be due simply to the fact that it the unwritten goal of the enforcement policy over the period was not to increase compliance, but to decrease the extent of the violations. Actually, this was acknowledged by the Director of the DCA in an interview. The goal was attained if one looks at the distribution of emissions around the original standards. This is shown by Figures 3.10, 3.11 and 3.12. Figure 3.10 shows that the average extent of the violation decreased when measured with respect to the original standards from 828 mg/l in July 1997 to 537 mg/l in October 2001; that is, by 35%. It also shows that the median of the extent of the violation decreased more sharply. In fact, it decreased 85% from 260 mg/l to 38mg/l. This drop is the result of a decrease in the dispersion of emissions around the standard, as shown by Figures 3.11 and 3.12. In these figures each dot is a plant. Some of them are highlighted with their corresponding number in the seventy-four plant sample. Figure 3.12 shows the distribution of average emissions between July 2000 and June 2001. It can be seen that emissions are more clustered around the standard than they are in Figure 3.11, which shows the same distribution for July 1997 – June 1998.

Figure 3.10: Mean and Median Extent of Reported Violations

with respect to original standards

Censored at Zero

July 1997 - October 2001

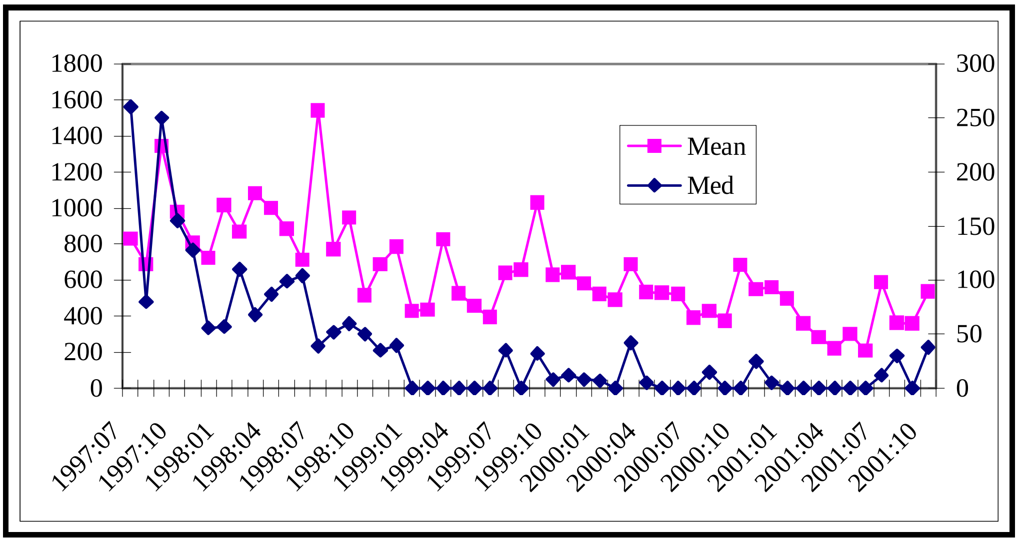


Figure 3.11: Distribution of Violations

Mean July 1997 – June 1998

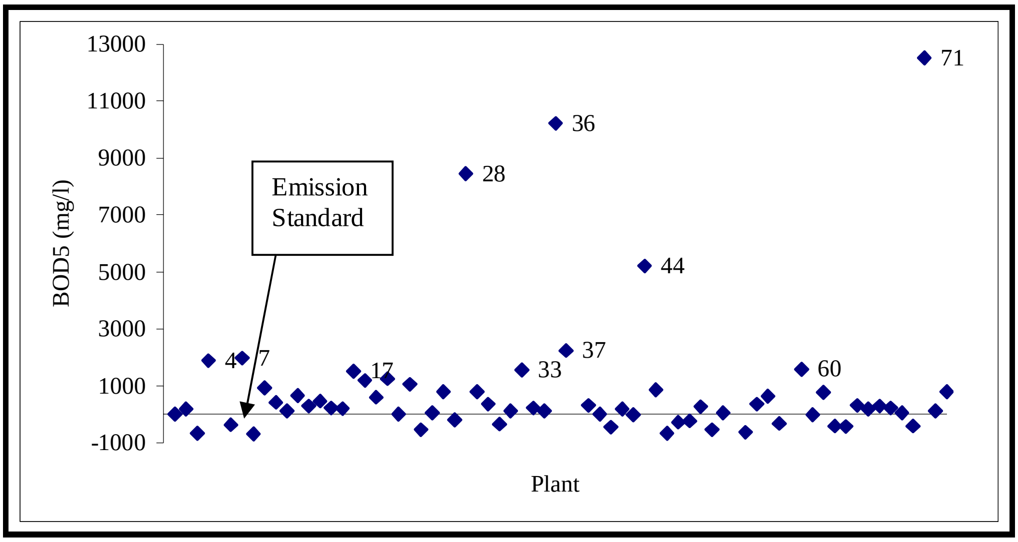
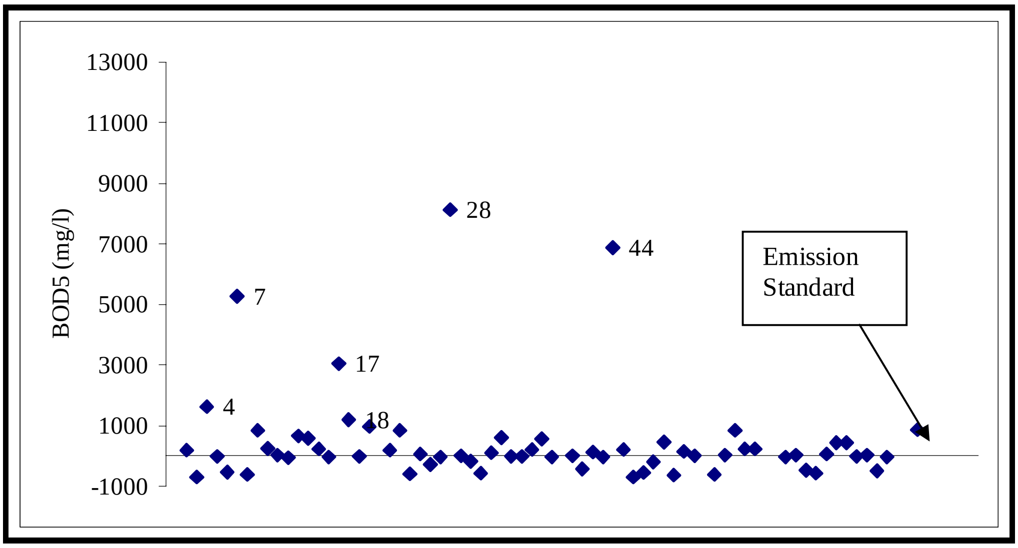


Figure 3.12: Distribution of Violations

Mean July 2000 – June 2001



It is not the purpose of this Chapter to explore the effects of the monitoring and enforcement policy on the evolution of emissions and violations. This is left for Chapter

8. However, it is important to recall that fines were very infrequent. Between July 1997 and October 2001 these same sixty nine industrial plants received a total of only eleven fines from the IMM and four from the DCA. Given this, and based also on what inspectors of both offices declared in interviews, one can conclude that the enforcement strategy during the period seems to have been to closely monitor firms, but to tolerate violations to the standards while negotiating gradual abatement with firm owners/managers. It is interesting to note here that some plants (#4, #7, #17, #28, #44 in Figures 3.11 and 3.12) seem to have not responded to this policy. Inspectors and policy makers interviewed were very aware of the distribution of plants' emissions around the standards, particularly the existence of these "difficult" plants.

3.4 CONCLUSIONS

This Chapter presented the outcomes of the enforcement policy described in Chapter 2 on four sets of variables: ambient water quality of the three main waterways of the city; total emissions measured in terms of total m^3 emitted by monitored industrial plants per day; total kg/day of the two most important pollutants (BOD_5 and Chromium), and finally, violations of BOD_5 emission standards.

With very few exceptions (like oils and fats in the Carrasco stream and chromium in the Carrasco stream), ambient water quality of these three majors streams in Montevideo worsened during the period. Furthermore, with the exception of chromium and BOD_5 concentration levels in the Carrasco stream and lead concentration levels in the Miguelete stream, none of the pollutants concentration levels comply with the ambient standards set for streams crossing urban areas at their outfalls.

This decrease in the water quality of the city streams could have taken place even with decreasing industrial emissions because of the exponential growth of irregular settlements in Montevideo during the nineties, which created a new and different problem for the regulators of water pollution in the city.

The Industrial Pollution Reduction Plan of 1997 implied an important increase in monitoring efforts with respect to previous levels. The average volume of emissions per plant exhibits a decreasing but irregular trend. Inspections may have had some influence on this trend.

The evolution of the average discharge of emissions of BOD_5 shows a more irregular trend. Discharges decreased 57% between December 1996 and November 2001, but only 20% with respect to November 1997. Even more, in July 1999 they reached levels 53% higher than those in November 1997. The evolution of the average discharge of Chromium shows a larger percentage decrease (76%) and a clearer downward trend. Emissions of BOD_5 and chromium also appear to have reacted to inspections. In particular, they decreased in 1997 when the number of plants monitored by the IMM increased, they increased in 1999 when inspections decreased, and they decreased again in 2000 when the IMM increased the number of inspected plants. Also, in order to comply with the targets agreed to the Inter American Development Bank, the IMM seems to be re-directing emissions of BOD_5 and chromium to the sewage system, which discharges directly into the sea (Río de la Plata).

Violations are frequent, even when measured with respect to the laxer emission standards of the Industrial Reduction Plan. The percentage number of reported violations with these standards never fell below 25%, and they have not tended to decrease. With respect to the original standards, violations as a percentage of reports decreased 24% but started from a very high level (76%)). Presently, more than 50% of the reported emissions of BOD_5 are in violation of emission standards.

Nevertheless, average BOD_5 emissions concentrations have tended to decrease and the plants' emissions have tended to cluster around the standard. This evolution is consistent with the actual objective of regulators, which was not to increase compliance but to decrease the extent of violations.

APPENDIX 3.1

Table A.3.1: Evolution Of Industrial Discharges

December 1996 – November 2001

Month	Point of Discharge	# Plants	Effluent Volume (m^3/day)	BOD_5 (Kg/day)	Cr. (Kg/day)
Dic. 1996	Stream	24	5803	11268	
	Sewage	40	8882	17555	
	Total	64	14685	28823	
Nov. 1997	Stream	31	4922	2941	14
	Sewage	47	13240	18387	279
	Total	78	18162	21328	293
Jul. 1998	Stream	27	4228	3243	12
	Sewage	58	15685	25240	394
	Total	85	19913	28483	406
Nov. 1998	Stream	26	4148	3339	4
	Sewage	54	15490	23135	433
	Total	80	19638	26474	437
Jul. 1999	Stream	23	5287	5616	0,3
	Sewage	39	11585	19488	144
	Total	62	16872	25104	144,3
Nov. 1999	Stream	34	4791	5251	2
	Sewage	39	10671	14622	191
	Total	73	15462	19873	193
Jul. 2000	Stream	29	3949	5085	2
	Sewage	46	12347	21362	112
	Total	75	16296	26447	114
Nov. 2000	Stream	26	3383	631	3
	Sewage	43	11524	14859	116
	Total	69	14907	15490	119
Jul. 2001	Stream	25	3667	921	2
	Sewage	50	12237	20461	153
	Total	75	15904	21382	155
Nov. 2001	Stream	27	3812	759	1
	Sewage	52	12031	18655	77
	Total	79	15843	19414	78

Source: IMM(2002)

Table A.3.2

Month	Average m3/day per Plant		Average Kg/day BOD5 per Plant	
	Stream	Sewage	Stream	Sewage
Dic. 1996	242	222	469	439
Nov. 1997	159	282	95	391
Jul. 1998	157	270	120	435
Nov. 1998	160	287	128	428
Jul. 1999	230	297	244	500
Nov. 1999	141	274	154	375
Jul. 2000	136	268	175	464
Nov. 2000	130	268	24	346
Jul. 2001	147	245	37	409
Nov. 2001	141	231	28	359

Source: IMM (2002)

Table A.3.3

Month	Average Kg/day Chromium per Plant	
	Stream	Sewage
Nov. 1997	0.5	5.9
Jul. 1998	0.4	6.8
Nov. 1998	0.2	8.0
Jul. 1999	0.0	3.7
Nov. 1999	0.1	4.9
Jul. 2000	0.1	2.4
Nov. 2000	0.1	2.7
Jul. 2001	0.1	3.1
Nov. 2001	0.0	1.5

Source: IMM (2002)