MUNICIPAL WASTEWATER TREATMENT: A COMPARISON OF THE PERFORMANCE OF PUBLIC SECTOR AND CONTRACT OPERATED PLANTS

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Abstract

Municipal wastewater treatment plants are among the main sources of discharges of pollutants to the environment. How well these plants are managed and perform does have a significant impact on the ambient quality of the environment. The focus of this research is on the performance of public sector managers as compared to that of private sector managers.

In Canada, virtually all Ontario's municipal treatment plants emitting to Lake Erie and Lake Ontario did not only comply with the existing emission standards for Biochemical Oxygen Demand (BOD), Suspended Solids (SS) and Phosphorus, but most performed considerably better than what was required. This observed phenomenon may be called "voluntary overcompliance". Findings based on interviews with municipal treatment plant superintendents, recently retired plant superintendents, plant chemists, and other industry officials, clearly indicated that public sector managers have quite a number of different rationales for overcompliance.

Can private sector managers be expected to do the same, or do they yield to pressures to reduce costs at the expense of environmental quality? Does it make a difference whether or not the variable costs for electricity, chemicals, and sludge disposal are pass through costs to the municipalities? Furthermore, what are the major advantages of contracting? Are there any drawbacks And will contracting result in cost-savings? These questions will be answered on the basis of the results of a nationwide survey of over 100 contract operated plants in the United States.

OUTLINE

I INTRODUCTION: INSTITUTIONAL ARRANGEMENTS

II CONTRACTING FOR WASTEWATER TREATMENT

- MAIN ADVANTAGES
- MAIN DRAWBACKS

III WILL CONTRACTING RESULT IN COST-SAVINGS?

IV EFFLUENT QUALITY: PUBLIC vs PRIVATE SECTOR PERFORMANCES

V SUMMARY AND CONCLUSIONS

I INTRODUCTION: INSTITUTIONAL ARRANGEMENTS

Throughout the world, privatization of water supply and sewerage services is a controversial topic of political debate. Any nationalization, privatization, or alteration in the regulating regime constitutes a significant change of the institutional mechanism of water management. The focus of this paper will be on the institutional arrangements most commonly found in Canada and the United States. For the sake of clarity and contrast the main historical developments in England and Wales will be briefly outlined at the outset.

Prior to 1973, as Table 1 shows, there were 29 Statutory (private) water companies and a complex mixture of public sector groups, including municipal utilities, in England and Wales. In 1973, the municipally owned industry was restructured on the basis of geographic rather than political or administrative boundaries, and the Water and Sewerage Authorities were created based in and serving ten regions in England and Wales. These ten publicly owned Water Authorities were reconstituted in 1989 as private companies owning the infrastructure network and assets of the industry. They were then floated on the Stock Exchange as ten companies whose main subsidiary supplied water and sewerage services. Due to takeovers and mergers the number of statutory water only companies was reduced from 29 to 19 by April 1996. Economic regulation is being carried out by a national organization, The Office of Water Services (OFWAT). Comprehensive assessments of the performance of this newly privatized water industry can be found in Shaoul, (1997) and Letza and Smallman, (2001).

In Canada and the United States, two principal modes of producing local government services are in-house provision by government employees, and contracting out to private suppliers, also known as privatization. Compared to the British context, the term privatization now has quite a different meaning. Under a purchase-of-service contract, the public authority retains ownership but awards a competitive bid to a private vendor for operating and maintenance. There is now no need for systematic economic regulation. Only emission standards and staffing levels (in some cases) are imposed by provincial and state levels of government.

As Table 1 shows, in both countries the water supply is managed in-house by approximately 80% of all utilities. In the remaining 20%, it is provided by private

companies in the case of the United States. In Ontario, however, the Ontario Clean Water Agency, a public sector agency, manages water supply on behalf of 18% of the water utilities. In only 2% of the municipalities do private companies supply water.

As far as wastewater treatment is concerned the public sector-private sector breakdown in Ontario is the same as for water supply: 98% vs 2%. Here the Ontario Clean Water Agency (OCWA) plays a greater role, managing more than half of all facilities. OCWA actively competes with private companies for contracts. It's success in winning contracts explains, in part at least, the very limited role of private firms in Ontario.

In the United States contracting for wastewater treatment started in the early 1980's (Holcombe, 1991). By now private firms have a market share of about 3%. Many municipal officials are satisfied with this arrangement. However, there were others, as we shall see, who were not. This resulted in the cancellation and/or non-renewals of contracts.

Table 1 **WATER SUPPLY AND WASTEWATER TREATMENT:**

INSTITUTIONAL ARRANGEMENTS

GREAT BRITAIN

Before 1973:	**WATER SUPPLY**	**WASTEWATER TREATMENT**
29 STATUTORY WATER COMPANIES (private sector monopolies)	25%	-
A COMPLEX MIXTURE OF PUBLIC SECTOR GROUPS, INCL. MUNICIPAL UTILITIES	75%	100%
Water act of 1973		
29 STATUTORY WATER COMPANIES (private sector monopolies)	25%	-
10 REGIONAL WATER AUTHORITIES	75%	100%
Water act of 1989		
29 (NOW 19) STATUTORY WATER COMPANIES	25%	-
10 WATER SERVICE PUBLIC LIMITED COMPANIES (Large private sector monopolies)	75%	96%

CANADA (Ontario only) – 657 WATER SUPPLY SYSTEMS

454 WASTEWATER TREATMENT SYSTEMS

FACILITIES OPERATED BY	**WATER SUPPLY**	**WASTEWATER TREATMENT**
MUNICIPAL UTILITIES	519 (70%)	209 (46%)
ONTARIO CLEAN WATER AGENCY*	123 (18%)	234 (52%)
PRIVATE COMPANIES	15 (2%)	11 (2%)

*ONTARIO CLEAN WATER AGENCY is a PUBLIC SECTOR AGENCY

UNITED STATES - 34,000 WATER SUPPLY SYSTEMS and,

15,000 WASTEWATER TREATMENT SYSTEMS

FACILITIES OPERATED BY:	**WATER SUPPLY**	**WASTEWATER TREATMENT**
MUNICIPAL UTILITIES	80%	97%
PRIVATE COMPANIES	20%	3%

II. CONTRACTING FOR WASTEWATER TREATMENT: ADVANTAGES AND DRAWBACKS

MAIN ADVANTAGES:

In order to become informed about contract operations for wastewater treatment some 240 city and municipal authorities all across the United States were contacted with the request to complete a four-page questionnaire. In total the response rate was close to fifty percent. Fully completed questionnaires were received covering 91 contracts and a further 16 were received from places that had decided to discontinue contracting in the recent past. In this latter group one or more reasons for non-renewal were given by a municipal official. Although the questionnaires were sent to municipal officials, the clients, out of the 91 a total of 65 were completed by a municipal official and the remaining 26 by their contractor.

A summary of the main advantages as perceived by 65 municipal officials is found in Table 2A. It comes as no surprise that the list is headed by gaining the benefits of the Contractor's Resources. These include expertise, experience, knowledge, trained staff and quality personnel, and professional services and technical support.

Second in terms of response frequency are Cost Savings (in 15 cases), and Cost Control (in 7 cases). Administrative Convenience is also acknowledged by a fair number of respondents, as well as Liability Protection and Risk Shifting. It is somewhat surprising perhaps, in light of the acknowledged contractors' quality resources, that Higher Quality Service was mentioned only in a few cases. In the last part of the paper we will take a closer look at this and learn that the contracting firms do very well in terms of meeting emission requirements.

MAIN DRAWBACKS:

Table 2B summarizes the views of municipal officials pertaining to drawbacks of contracting. The responses included here are those of 65 administrators where contracts are still in force and those of 16 administrators of operations where contracts had not been renewed. The main reasons cited for non-renewal were Inadequate Contractor Performance in 7 cases, and Higher Cost in 13 cases. Higher Cost, or the Possibility of

Higher Cost were noted in a further 8 cases. A third frequently mentioned drawback related to control, either as Reduced Control or Loss of Control.

Surprisingly few municipal officials mentioned Negotiating a Contract or Contract Management and Monitoring. With contracts in place and lasting, in the majority of cases, 5 years or longer, contract negotiation was often a matter of the past. Therefore, we learned from a different questionnaire question that relatively few major changes were made at contract renewal time. Contract management and monitoring resources were arranged for in at least 35 (out of 91) municipalities.

TABLE 2A **MAIN ADVANTAGES OF CONTRACTING**

1.	**CONTRACTOR'S RESOURCES**	
	➢ EXPERTISE, EXPERIENCVE, KNOWLEDGE	18
	➢ PROFESSIONAL STAFF, QUALITY PERSONNEL	6
	➢ PROFESSIONAL SERVICES, TECHNICAL SUPPORT	5
2.	**COST SAVINGS AND COST CONTROL**	
	➢ COST SAVINGS	15
	➢ FIXED COST, COST CONTINUITY, LEVELING	7
3.	**ADMINISTRATIVE CONVENIENCE**	
	➢ NO STAFF TRAINING, SUPERVISION, HASSELS	6
	➢ DAY-TO-DAY OPERATIONS BY OTHERS	4
	➢ ABILITY TO FOCUS EFFORTS ELSEWHERE	1
4.	**LIABILITY PROTECTION AND RISK SHIFTING**	
	➢ CONTRACTOR IS UP-TO-DATE WITH NEW RULES AND REGULATIONS	5
	➢ INCREASED LIABILITY PROTECTION, SOME RISK SHIFTING	4
5.	**HIGHER QUALITY OF SERVICES**	
	➢ IMPROVED PERFORMANCE, COMPLIANCE	3
	➢ BETTER SAFETY RECORDS	1
	➢ BETTER SERVICE TO THE PUBLIC	1

TABLE 2B **MAIN DRAWBACKS OF CONTRACTING**

1. INADEQUATE CONTRACTOR PERFORMANCE

- REASON CITED IN 7 OUT OF 16 CASES OF NON-RENEWAL 7
- CONTRACT DELIVERABLES ARE NOT ACHIEVED 1
- LOW SERVICES TO INFRASTRUCTURE 1

2. HIGHER COST

- REASON CITED IN 13 OUT OF 16 CASES OF NON-RENEWAL 13
- HIGHER COST (4), POSSIBLY HIGHER COST (4) 8

3. REDUCED CONTROL OR LOSS OF CONTROL

- REDUCED OR LOSS OF CONTROL 12
- RESPONSE TIME TO CRITICAL WORK 1
- KEEPING CONTRACTOR MOTIVATED; POOR LEADERSHIP POSSIBLE 1

4. **NEGOTIATING A CONTRACT**

- WITH CLEAR LANGUAGE THAT ADDRES ALL ISSUES 1
- TIME CONSUMING, COSTLY, POLITICAL VOLATILE 1

5. CONTRACT MANAGEMENT AND MONITORING

- AT LEAST 35 PLACES (OUT OF 91) CHOSE TO INCUR OVERHEAD COSTS ASSOCIATED WITH CONTRACT MANAGEMENT AND MONITORING 3

6. NONE 16

III WILL CONTRACTING RESULT IN COST-SAVINGS?

In the preceding section dealing with Advantages and Drawbacks we saw that among municipal administrators who have experience with contracting there is no clear prevailing view one way or the other. About as many indicated a clear cost savings advantage, as there were persons, who took the opposite view, that contracting does not result in cost savings. How can this be understood? And what further evidence exists in relation to this question?

It can be argued that a contractor can generate cost saving by, among other things:

- cutting staff through mechanization
- offering more training opportunities
- improving energy efficiency
- economies of scale in purchasing

Savings in these areas would clearly lower the total cost of operating the utility. However, this lower cost is not what is being charged. The contracting firm has a head office which charges contract "overhead" and a profit margin. Municipal administrators indicated that the order of magnitude for these two items is around 15%. Furthermore, prudent municipalities also incur contract management and monitoring costs. Therefore, the total cost for the municipality would only be less if the cost-savings identified above exceed the contracting firm's overhead-charge and profit margin plus the municipality's contract management and monitoring costs. The next question is: is there a literature on cost comparison?

In contrast with privatization of water supply, no systematic studies examining cost comparisons of wastewater treatment could be found. To the general question, "Can public employees compete with private ownership?" Spulber and Sabbaghi (1994) responded that in their view:

> "Public ownership is not inherently less efficient than private ownership, and public ownership carries less risk. For utilities, inefficiency often stems from isolation from effective competition rather than ownership per se" (as quoted in Shanker and Rodman, 1996, p. 106.)

Peterson (1994) states:

> "Ensuring cost-effectiveness, not just the lowest cost, requires thorough evaluation. Yet, many public entities realize cost-savings. In most contract operations, 10% to 15% of budget will be saved, and in others savings of 25% or more are reached" (pp. 59,60.)

Unfortunately, for the purpose of comparison, Peterson was unable to attach magnitudes to the public sector savings he referred to. Illustrations of such savings and the importance of a sense of competition can be found in Robinson (1998). In her article, Robinson profiles three large public water agencies that had answered the competitive wake-up call and are changing the way they do business. These changes resulted in public sector cost savings

Peterson's statement illustrates a fundamental methodological point. The relevant cost comparison is not one of before-and-after, but rather one of without-and-with contracting. Over time as improvements are made, cost-savings can well occur under either regime. What ultimately matters is under which regime, public sector or private sector management, are such cost-savings the largest.

A very simple and crude illustration of this methodological point is found in Shaoul (1997). The numbers employed in the water industry in England, and Wales in 1989, just prior to privatization, were 47,810. By 1995 this number had declined, in part due to privatization, to 37,555. Efficiency gains? Perhaps. However, to put this in perspective, it should be noted that in 1981 the labor force was 62,385, almost 15,000 more than in 1989. Like the private sector, the public sector had also managed to reduce the labor force substantially.

Returning to our basic question whether contracting wastewater treatment will result in cost-savings, the short answer that perhaps explains the absence of systematic analysis is found in Wright, Rubin and Powers (1996). They point out that:

> "Fears and myths surrounding wastewater privatization are rampant these days because there isn't a lot of objective data on its cost effectiveness." (p.24)

There is no lack of data pertaining to the United States water supply industry. We saw in Table 1 that the private sector has a market share of about 20%. A number of

comparative efficiency studies have been conducted and published since the mid-1970's. Donahue (1989) reviewed seven studies, listed below, and concluded:

> "The weight of evidence, then, favors the conclusion that there is no tendency for private water utilities to be any more productive" (p.75)

Water Supply Efficiency

Study	Conclusion
Mann and Mikesell, 1976	Public more efficient
Crain and Zardkoohi, 1978	Private more efficient*
Bruggink, 1982	Public more efficient
Feigenbaum and Teeples, 1983	No significant difference
Feigenbaul, Teeples, and Glyer, 1986	No significant difference
Byrners, Grosskopf, and Hayes, 1986	No significant difference
Teeples and Glyer, 1987	No significant difference

Source: Donahue (1989)

Lambert, Dichen, and Raffiee, 1993	No significant difference
Bhattacharyya, Harris, Naraynan and Raffiee, 1995	Public more efficient on average

* Due to a methodological question this finding is not supported by Bhattacharyya et al (1994.)

The studies by Lambert et al (1993) and Bhattacharyya et al (1995) examine more recent data. Their findings are consistent with those of the earlier studies.

IV EFFLUENT QUALITY: Public vs Private Sector Performance

The goals of a firm are commonly assumed to be profit maximization and, indirectly, cost minimization. What are the goals of the public sector manager? We will skip the theoretical literature on this subject and go directly to the results of our survey of opinions. First, we will briefly examine the performance results.

In Table 3 we find the performance levels of 155 municipal operations in Ontario over a six-year period, 1992 – 1997. What is striking about the results is that many plants emit even less than 25% of what the permit would allow for BOD, Suspended Solids and Phosphorus. The group of plants that emits 50% or less, consists of 84% of the plant in the case of BOD, 61% in the case of Suspended Solids and 52% in the case of

Phosphorus. These results amount to what may be labeled a substantial "voluntary over compliance."

TABLE 3

COMPLIANCE OF ONTARIO MUNICIPALITIES WITH 1997 STANDARDS AND GUIDELINES FOR THE PERIOD 1992 – 1997

All Plants (n = 155)

ACTUAL / REQUIRED	BOD		SUSPENDED SOLIDS		PHOSPHORUS		OVERALL	
RANGE	No.	%	No.	%	No.	%	No.	%
0 – 25%	67	43.2	32	20.5	18	11.6	22	14.2
26 – 50%	63	40.6	69	44.5	62	40.0	83	53.5
0 – 50%	130	83.8	101	65.1	80	51.6	105	67.7
50 – 75%	22	14.2	35	22.6	55	35.5	38	24.5
76 – 100%	3	2.0	9	5.8	9	5.8	7	4.5
>100%	0	0.0	10	6.5	11	7.1	5	3.2
TOTAL	155	100.0	155	100.0	155	100.0	155	100.0

Why do we see consistently such excellent results? We gained some insight into this question by interviewing a number of persons who are, or had been, directly or indirectly involved in the decision making process. The offices held by the public sector decision- makers that were interviewed are listed below. The main explanations given for voluntary overcompliance are found in Table 4.

- Current treatment plant superintendents
- Recently retired treatment plant superintendents
- Treatment plant chemists
- A privatization contact supervisor (former plant superintendent)
- A regional water and wastewater division manager
- Two regional coordinators

Table 4 VOLUNTARY OVERCOMPLIANCE: EXPLANATIONS

1. "EXPECTED TO MEET THE STANDARDS ALL THE TIME"
   (In contrast with achieving annual and monthly averages; weekly samples to be sent to Toronto…)
2. "FEAR OF LOSING JOB; ALWAYS ON THE DEFENSIVE"
   (If you screw up, you are on your own…")
3. 'NOT ENOUGH CONTROL (OVER THE PROCESS) TO ALLOW FOR HIGHER NUMBERS"
4. "OPERATOR PRIDE AND SATISFACTION; CONFERENCE AWARDS"
5. "EXTRA COSTS RELATIVELY SMALL; NO NEED TO SAVE THE EXTRA COST"
6. "AS A PUBLIC SERVANT, DO THE BEST WE CAN FOR OUR PUBLIC EVEN IF IT COSTS A LITTLE MORE"
7. "OPERATE TO THE BEST CAPABILITY OF THE FACILITY"
   (Ontario Clean Water Agency – operating plants)
8. "WE ARE DOWNSTREAM FROM OURSELVES"
   (Drinking water inlet – wastewater outlet; avoid odor/algae trouble)
9. "TO 'STRETCH' TREATMENT CAPACITY"
   (To enable further housing and industrial development)

The explanations given represent a variety of motivations. They range from playing safe (#1 - #3); to operator pride and satisfaction (#4), to serving the public interest even when this involves some additional cost (#5 - #9). By way of contrast, which of these motivations would play a role for a private sector manager? The answer is quite possibly limited to #3, "not enough control", and #4 "operator pride and satisfaction". On the basis of this we would predict that contract operated plants will not perform nearly as well as their public sector counterparts. Is this consistent with the facts? As we see in Table 6A the answer is a clear "No". Simply put, the degree of

voluntary overcompliance by 73 United States contract operated plants for which we have data is about the same as that of Ontario's public sector plants (Table 5, summary of Table 3).

TABLE 5

COMPLIANCE OF ONTARIO MUNICIPALITIES WITH 1997 STANDARDS AND GUIDELINES FOR THE PERIOD 1992 – 1997

All Plants (n = 155)

ACTUAL REQUIRED	BOD	SUSP. SOLIDS	PHOSPHORUS	OVERALL
RANGE	%	%	%	%
0 – 25%	43.2	20.5	11.6	14.2
26 – 50%	40.6	44.5	40.0	53.5
0 – 50%	83.8	65.1	51.6	67.7
50 – 75%	14.2	22.6	35.5	24.5
76 – 100%	2.0	5.8	5.8	4.5
>100%	0.0	6.5	7.1	3.2

TABLE 6A

COMPLIANCE OF U. S. CONTRACT OPERATE PLANTS IN 2001

All Plants (n = 73)

ACTUAL REQUIRED	BOD (n=73)	S. SOLIDS (n = 73)	PHOSPHORUS (n = 11)
RANGE	%	%	%
0 – 25%	33.3	36.1	18.2
26 – 50%	36.2	41.7	18.2
0 – 50%	69.5	77.5	36.4
51 – 75%	15.9	13.9	36.4
76 – 100%	11.6	5.6	27.3
>100%	2.9	2.8	0

This unexpected and rather surprising finding leads to a follow up question. About one-half of these 73 plants pass through the electricity cost (and some other costs) to the municipality. Clearly electricity costs are performance related, and one would expect that in cases where the contracting firm can pass these costs on, the performance would be better. In Table 6B, the two groups of plants, without and with pass through costs, are side-by-side. The table shows that this expectation is also not born out by the facts. Again the performance of these two sub-groups of contract operated plants is about the same. In other words, whether or not the contracting firm bears the electricity costs, etc., appears to make no difference.

TABLE 6B

CONTRACTS WITHOUT AND WITH PASS THROUGH COSTS

ACTUAL REQUIRED	**WITH NO PASS THROUGH COSTS (n = 37)**		**WITH PASS THROUGH COSTS (n = 36)**	
	BOD	**SUSP. SOLIDS**	**BOD**	**SUSP. SOLIDS**
RANGE	**%**	**%**	**%**	**%**
0 – 25%	**40.5**	**37**	**22.2**	**32.5**
26 – 50%	**35**	**39.5**	**36.1**	**43.3**
0 – 50%	**75.5**	**76.5**	**58.3**	**75.7**
51 – 75%	**13.5**	**13.5**	**16.7**	**13.5**
76 – 100%	**5.5**	**2.5**	**16.7**	**8.1**
> 100%	**5.5**	**5.5**	**8.3**	**2.7**

At this point a word of caution is in order. The Ontario group of plants consists of all plants, which emit wastewater directly, or indirectly into Lake Erie or Lake Ontario. On the other hand, the group of United States plants is only a sample, and not necessarily a random sample. There may well be an element of self-selection among the ones who responded and the ones that did not respond to our request to complete the questionnaire.

We did gain some insights regarding low level emissions from additional comments made by three contractors. One contractor put it as follows:

> "The contractor achieves the lowest discharge standards possible. With a sequential batch reactor design there are no additional electrical costs associated with the lower emissions. In fact, achieving lower BOD and SS levels allows the plant to lower chemical costs"

The other two comments focussed on the installation of bubblers.

> "The contractor persuaded the City to install several energy savings projects including fine bubble diffusers. Addition of the bubblers also improved the discharge quality."

In these cases there are chemical cost savings and electrical cost savings in concert with a higher quality effluent. Unfortunately we do not know to how many cases these explanations apply.

There are at least two further possible general explanations for voluntary overcompliance by contract operators.

1) The incremental costs of achieving these excellent results are relatively small.
2) Contractors are also public interest oriented and value the goodwill that stems from their high-level performance.

In the absence of data on performance related incremental cost or what, in detail, motivates the managers of private sector firms, we are unable to determine the significance of these considerations. What is clear is that pure and simple short-run profit maximization does not appear to rule the day-to-day decision-making.

A final question is what, if anything do the excellent performers have in common? Three criteria were examined: 1) volume, represented by average daily flow; 2) capacity utilization rate, and 3) relative cost of operation per million gallons a day of average daily flow. We found that at each performance level 0-25%, 26-50%, etc. there are plants of all sizes, plants with high capacity utilization rates, and there are plants whose unit costs are low, medium and high relative to the unit costs in their size class

V SUMMARY AND CONCLUSION

The main conclusions of this study can be summarized as follows:

1. The privatization of the water industry in England and Wales in 1989 is commonly referred to as complete privatization. Ten large regional wastewater supply and wastewater treatment firms, regulated by a national agency, were created. In Canada and the United States privatization of wastewater treatment usually takes the form of public-private partnership where service provision is contracted out for a specified number of years to a private firm. The scope for regulation is much more limited compared to under complete privatization.
2. Few municipalities in Ontario engage private firms to provide water supply or wastewater treatment services. This can in part be explained by the presence of the Ontario Clean Water Agency, a public sector agency, which actively competes for contracts with private sector firms.
3. Contracting for wastewater treatment is a relatively new phenomenon in Canada and the United States. Major advantages of contracting can explain why some municipalities have decided to engage the services of a private firm. Major disadvantages, on the other hand, explain why there are also municipalities that have terminated their contract or have decided not to renew.
4. Whether or not contracting for wastewater treatment services results in a cost savings is unclear. Over time, and in particular in the presence of competition, both public sector management and private sector management can improve operational efficiency and generate cost-savings. Lack of objective data on cost-effectiveness underlies the absence of systematic analysis,
5. A number of earlier as well as two more recent studies of the United States water supply industry find no evidence to support the claim that private water utilities are more efficient than their public sector counterparts.
6. The effluent quality of Ontario's public sector plants and the sample of United States contract operated plants in this study is by-and-large excellent. Under both management regimes a large majority of plants emits less than one-half of BOD, Suspended Solids and Phosphorus allowed by the permit. Interviews with a number of public sector officials generated a list of motivations for this

"voluntary over-compliance". It is unclear on the other hand why the for-profit contract operated plants produced similar excellent results. If the sample of questionnaires examined in this study is reasonably representative of the population, we can be conclude that the privatization of wastewater treatment does not pose a threat to environmental quality.

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