Incentives and Disincentives for Adoption of Pollution Prevention Measures Under the Water Program

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EXECUTIVE SUMMARY

This study examines the key regulatory, economic, technical, and institutional incentives and disincentives affecting decisions by industry to adopt pollution prevention measures. The objective is to assist EPA and other regulatory agencies in designing programs to encourage and support companies to consider and implement pollution prevention approaches--specifically, in the context of determining how best to meet water quality and effluent discharge obligations. Much of past water program efforts have been driven, if not by direct "end-of-pipe" requirements, then by an "end-of-pipe" mentality or approach to interpreting such requirements. Fuller understanding of the incentives and barriers faced by industry should help regulators build pollution prevention into their regulatory and compliance programs in a more meaningful way.

While there are a range of factors that affect decisions by facilities to either adopt or fail to adopt pollution prevention measures, it seems there is often one key motivator--or "trigger" incentive--which can make the other acting incentives more compelling, and which has the power to overcome the other disincentives. Trigger incentives will vary depending on facility size and type, compliance history, and regulatory motivation for pollution prevention. In many instances, enforcement actions that are coupled with a goal of working with the company (in terms of both regulatory flexibility and technical assistance) towards a pollution prevention solution has been a strong trigger incentive.

General Findings

The key motivational incentives and disincentives we found during the course of this study are the following:

- **Flexibility**

  Flexibility is perhaps the most important incentive to emphasize with respect to any regulatory or compliance program interested in fostering pollution prevention. Those involved in developing regulations, permit writers who must translate those regulations and requirements into permit conditions, and compliance/enforcement personnel need to be aware of pollution prevention opportunities--and they must be willing to work with companies to overcome both technical barriers and rigid regulatory interpretations. Flexibility achieves its optimum value within a multi-media framework. Multimedia inspections, for example, encourage a comprehensive examination by both plant and compliance personnel for cross-media environmental improvements. This reduces the risk of narrow, single-media solutions that can simply produce shifting of pollution.

- **Economic Realities**

  Clearly, economic considerations are of paramount importance. Companies are profit-motivated and while pollution prevention can hold the promise of future cost savings, if capital is needed for such changes, companies can find themselves in a Catch-22 type situation. Lower operating costs could improve profits, but the extra capital may simply not be available to pay for the necessary improvements. This is especially true of firms with low profit margins and who are perceived by lenders to be a bad investment risk. For those companies who can raise the capital, pollution prevention measures still hold an element of risk--they can be technically more complex, require higher skills level to operate and maintain, and they sometimes fail to provide the kind of compliance "certainty" an end-of-pipe system can engender.

- **Technical and Financial Assistance**

  Technical/informational incentives can work together to facilitate pollution prevention. Particularly for small companies that do not have the resources, personnel, or expertise to pursue and obtain reliable pollution prevention information, a network of technical assistance is vital. Whether the assistance comes from state programs, POTWs, EPA, trade associations, or vendors, is not as important as the fact that a system of information dissemination and technical expertise is out there reaching companies who need it. Larger companies have more technical resources on hand to experiment with in-process changes. Small and medium-size firms may need both technical assistance and financial incentive mechanisms--tax breaks, low-cost loans, matching grants, etc.--to move them toward pollution prevention.

- **Open Communication**

  An open door policy that allows all stakeholders to have a say in how best to optimize pollution prevention opportunities is key. This is true for both companies and regulatory agencies. Upper management support for the principles of pollution prevention can make all the difference when either regulatory staff (permit writers, inspectors) or plant-level personnel (engineers, shop foremen, workers) have ideas they would like to see put into practice. Innovation and effective communication will always remain the heart of pollution prevention.

Specific Findings

Our study indicates that for metalfinishers and platers who may be considering pollution prevention the following motivational factors are most important:

- **Categorical standards** are outdated and increasingly irrelevant for metalplaters because non-technology based standards (e.g., limits based on Water Quality Criteria) have superseded them in most cases.

- **Mass-based standards** are motivators for pollution prevention; however, there has been difficulty in implementing them. Regulators should be allowed the flexibility to use either mass- or concentration-based standards to achieve their goals.

- When **enforcement and compliance** activities are tied to a strong pollution prevention message, they can be a key motivator for facilities to adopt pollution prevention.

- **Economic factors** have the potential to be key motivators, but there are also significant barriers.

- **Zero-discharge systems** hold much promise for platers seeking to maximize water efficiency and plating chemical recycling/re-use, but there are both regulatory and technical/informational barriers.

- **Flexibility** in the regulatory network, **supportive** assistance/outreach, and **collaborative** relationships between industry, regulators, and the public can foster continuous, industry-wide improvement in pollution prevention.

1 INTRODUCTION

1.1 Purpose and Objectives

EPA's Pollution Prevention Strategy establishes pollution prevention, including both source reduction and toxics use reduction, as the priority approach for reducing releases of pollutants into the environment. As part of EPA's emphasis on pollution prevention, the Agency set aside 2% of the FY91 and FY92 contract budgets for new pollution prevention initiatives. The Industrial Pollution Prevention Project (IPPP), for which this report was written, is one of the Agency's 2% set-asides. The IPPP is an Agency-wide, multi-media project, the objectives of which are to: 1) incorporate pollution prevention into industrial effluent guidelines; and 2) reach out to industry and the public to spread and establish the pollution prevention ethic.

This study examines some of the key regulatory, economic, technical, and institutional incentives and disincentives affecting decisions by industry to adopt pollution prevention measures. While the analysis was approached from a multi-media perspective, a focal point of the study was to examine incentives and disincentives that are driven by EPA, state, and local water program requirements and objectives. Because incentives and disincentives that affect decisions to adopt (or not adopt) pollution prevention need to be considered within the concrete context of specific alternatives faced by particular facilities, this study focused on a single industry. We were asked to focus on the Metal Finishing Industry in particular. Since the majority of metalplaters discharge industrial wastewater to Publicly Owned Treatment Works (POTWs), the principal emphasis was on incentives and disincentives faced by indirect dischargers; however, direct dischargers (i.e., those with NPDES permits) were also examined.

The objective of the incentives study is to present information and findings that would help the Agency better understand aspects of decision-making with respect to industrial dischargers. Much of past water program efforts have been driven, if not by direct "end-of-pipe" statutory and regulatory requirements, then at least by an "end-of-pipe" mentality or approach to interpreting statutory and regulatory requirements. While some of these requirements may have promoted materials substitution, process change, or better operating and maintenance (O&M) practices, some have been neutral towards promoting pollution prevention over conventional control, and still others may have actually discouraged companies from exploring or adopting pollution prevention alternatives--even when those alternatives could have been more economically beneficial. The objective of this study is to assist EPA and other regulatory agencies in designing programs to encourage and support companies to consider

and implement pollution prevention approaches in the course of determining how best to meet their water quality and effluent discharge obligations.

1.2 Study Approach and Data/Information Sources

The technical approach focused on providing--to as great an extent as possible--both specific information about decisions to adopt (or not adopt) pollution prevention measures at individual metalfinishing facilities, and more general information on choices faced by a broader range of facilities, including other metals dischargers and the POTWs themselves. This involved on-site visits to six facilities and three POTWs in the Massachusetts and Rhode Island areas (summarized in Appendix A). The site visits were undertaken in order to obtain a fairly detailed assessment of particular decisions at a limited number of facilities, including record review (where possible), tour of plating shops, tour of wastewater treatment plants, and in-depth interviews and meetings with facility personnel and knowledgeable EPA regional, state, local, and POTW representatives.

In addition to the detailed assessments, more general assessments of decisions at a larger number of facilities were undertaken, largely through telephone interviews and database or literature searches. Over 100 metalfinishing case studies from EPA's Pollution Prevention Information Clearinghouse (PPIC) database were reviewed; however, the PPIC case studies are technology-oriented, rather than behavior-oriented, and seldom provide useful information about motivational aspects of the pollution prevention alternative (such as why the company had explored pollution prevention in the first place and whether or not it was ever implemented). Although there were many relevant PPIC case studies, only 5 representative PPIC cases are presented in Appendix B. Literature data and other case study reports were obtained from a variety of sources, including the California Department of Health Services and the Massachusetts Department of Environmental Management.

In addition to the site visits, case studies, and literature reviewed, telephone contacts were made with metalplaters and state and local (both regulatory and non-regulatory) personnel in other geographic regions, including California, Florida, Illinois, Minnesota, and North Carolina, to obtain a broader perspective on the national range of incentives and disincentives faced by platers. Members of the IP3 focus group have reviewed and provided comments on early drafts of this report. Subsequently, follow-up contacts were made with both industry and POTW representatives on the focus group to clarify comments and further explore ways to improve upon the report.

1.3 Organization of Report

Section 1 is a brief introduction to the study. Section 2 presents an overview of four major incentives/disincentives areas: regulatory, economic, technical/information, and management/institutional factors that can act upon the decision matrices of companies thinking of adopting pollution prevention measures. Section 3 gives a detailed discussion of the study's findings of the key motivating factors relative to pollution prevention for metalplaters. Section 4 offers a detailed case example of a regulatory POTW program that illustrates how incentives and disincentives can function together to motivate a change to pollution prevention.

The Appendices contain more specific information about the case studies and site visits completed for this project. Appendix A covers the industrial and POTW site visits in Rhode Island and Massachusetts. Appendix B presents the selected PPIC case studies and discusses their relevance to this study. Appendix C is a matrix of completed telephone contacts.

We present here four summary tables and a general discussion of the range of factors that affect decisions by facilities--specifically, metalplaters--to either adopt or fail to adopt pollution prevention measures. Generally, these factors can be viewed as either behavioral incentives or disincentives; however, that is not to say that one single factor, acting alone, will push a company either toward or away from pollution prevention. A facility will most likely adopt pollution prevention measures when it is being acted upon by an array of incentives. Likewise, it will be the cumulative effect of a number of disincentives which makes a company decide to not do pollution prevention. Sometimes, incentives and disincentives tend to cancel each other out--i.e., they have equal weight in the decision process--the result being no progress is made toward pollution prevention. For example, the economic incentive of potential cost savings due to decreased environmental management expenditures (lower disposal fees for less toxic waste, lower chemical usage, etc.) is oftentimes counterbalanced by the fact that the capital needed to implement the changes cannot be raised. This is especially true of certain metalplating firms which have low profit margins and are perceived by lenders to be a bad investment risk.

Sometimes, it seems there is one key motivator, or "trigger" incentive which, once activated, makes the other acting incentives more compelling, and which has the power to overcome the various disincentives. Enforcement--whether in the context of bringing a firm into compliance or implementing new requirements (e.g., more stringent discharge limits)--is one example of a "trigger" (some would say a "hammer" motivator), in that a behavioral decision is forced to occur. If the enforcement or compliance message supports pollution prevention and is flexible towards allowing for the necessary time and resources a facility needs to explore and implement such solutions, then the disincentive hurdles may be lowered just enough to make the facility "go for it."

Table 2.1 Regulatory Factors in Pollution Prevention Decisions

REGULATORY INCENTIVES	REGULATORY DISINCENTIVES
• flexible, multi-media regulatory framework	• single-media regulatory framework
• specific toxics use reduction laws or facility planning statutes that encourage firms to do P2 opportunity assessments and audits	• single-media permits that focus on end-of-pipe requirements
• compliance inspections where NOVs are tied to a pollution prevention message (e.g., referral to state technical assistance program)	• single-media inspections with no pollution prevention message (i.e., quick-fix, end-of-pipe compliance focus)
• flexibility within compliance and enforcement programs (e.g.,extended compliance schedules phased to pollution prevention activities, "soft landings" for technical failure of innovative technologies)	• inflexible approach to media-specific enforcement actions that allows no time for process innovation or exploration of pollution prevention solutions
• strict local limits, with POTW ordinance authority to implement/enforce	• reliance on EPA categorical limits which may be outdated and set too low a compliance level
• regulatory pressures on POTWs such as EPA sludge regulations, or air toxics reduction requirements, motivating POTWs to push upstream sources to lower metals in wastewaters--ideally through pollution prevention measures	• specific regulatory "barriers" such as RCRA Part B permit requirements for facilities implementing reuse/recovery technologies or "zero discharge" systems

• SEPs with pollution prevention requirements; promotion of pollution prevention alternatives in enforcement case context	• guidance documents used by permit writers that may be outdated and focus on end-of-pipe solutions
• mass-based or total loadings-based standards--especially for water intensive industries--that may encourage water reclamation/recycling/re-use	• concentration-based standards that may discourage water reclamation/recycling/re-use

Table 2.2 Economic Factors in Pollution Prevention Decisions

ECONOMIC INCENTIVES	ECONOMIC DISINCENTIVES
• lower facility operational costs that may include: -- environmental management cost savings (e.g., from eliminating RCRA sludges, or decreased wastewater treatment costs) -- production or process cost savings due to lower material or chemical use -- utility cost savings due to lower water, sewer, and energy usage -- lower liability costs	• capital investment requirement difficult or impossible for many firms: -- firms may have limited or no capital availability due to low profit margins, competing investment priorities, or too much environmental liability (a "bad risk" for lenders) -- "sunken investments" in conventional pollution control equipment -- many small firms--especially "job shops"--cannot tolerate down-time for equipment upgrades or process change/experiments
• fee structures based on pollutant loadings (permit fees, POTW fees, etc.) can act as economic incentive for pollution prevention	• economies of scale for some technologies may not be realistic at smaller firms (e.g., metal recovery technologies, automatic systems vs. batch)
• R & D challenge grants, low interest loans, tax breaks for equipment upgrades, and other funding assistance mechanisms can be powerful incentive--but only if message gets to company about availability and if application process is not onerous	• R & D costs for new technologies and/or process modifications may be difficult to bear--also, firm must be concerned with potential enforcement related costs if technology fails
• enhanced product quality and/or corporate image may lead to higher revenues	• customer dissatisfaction with changed product may mean loss of revenue

• full/total cost accounting methodologies can help firms identify economic savings and opportunities not readily apparent--but there is a real need for simpler, user-friendly, methods such as a quick checklist or worksheet that small firms can use	• full/total cost accounting to justify pollution prevention expenditures can be complex, time-consuming, and expensive (especially for small firms)

Table 2.3 Technical/Informational Factors in Pollution Prevention Decisions

TECH/INFO INCENTIVES	TECH/INFO DISINCENTIVES
• technical assistance to facility via state TAP or POTW pretreatment programs can overcome many informational barriers	• facility unfamiliar with pollution prevention and potential for in-process changes
• targeted outreach to a particular industry sector via pollution prevention workshops, seminars, or training--provide forum for industry to share success stories and concerns	• facility uncertain of pollution prevention's ability to meet discharge limits; afraid to be first or to take risk
• vendor lists or certification programs to assure prospective purchasers/service users that vendor is both reputable and knowledgeable about pollution prevention technologies	• unscrupulous vendors who misinform, misrepresent and/or install inferior equipment; so-called "pollution prevention experts" who sell a product then disappear when the system fails and the facility falls out of compliance
• detailed knowledge of waste generation and chemical usage via facility audit/ opportunity assessment	• lack of detailed knowledge of waste streams and extent of in-process use of toxic chemicals
• trade and industry associations that encourage and disseminate pollution prevention information	• customer satisfaction concerns--potential impacts of pollution prevention on product quality, appearance, or performance that could translate into loss of customer acceptance

• permit writer and inspector training on how pollution prevention can achieve, maintain, or even go beyond compliance	• chemical or product substitution concerns: will it: a) do the job; b) be consistently available; c) not become expensive; and d) not trigger some other unforeseen regulatory nightmare
	• proprietary information concerns--disincentive to sharing information, data, and/or experiences with new processes

Table 2.4 Management/Institutional Factors in Pollution Prevention Decisions

MGMT/INSTIT. INCENTIVES	MGMT/INSTIT. DISINCENTIVES
• corporate policy supporting pollution prevention or incorporating it into strategic planning	• no upper management commitment to pollution prevention
• accountability within management structure for integrated (i.e., across departments, groups, or divisions) environmental responsibility	• lack of coordination and accountability among different groups in the company (e.g., process engineers/product design engineers not talking to environmental engineers)
• willingness to take risks	• low tolerance for failure; policy of risk avoidance
• willingness to engage in open dialogue with both regulators and technical assistance personnel	• closed shop mentality; afraid to ask questions--"What I don't know won't hurt me."
• TQM programs that empower employees to seek pollution prevention opportunities	• bean-counting disincentives at regulatory agencies that tie performance reviews to number of enforcement cases, number of permits, etc. instead of rewarding quality environmental results
• potential for favorable publicity; pollution prevention helps present a "good guy" image; like to show progress (e.g., lower TRI numbers)	• do not want to call attention to themselves--e.g., if company has been "burned" once by EPA, will be reluctant to try anything new which might draw more attention

• supportive environment within (and between) regulatory agencies; openess to pollution prevention	• inertia: "If it ain't broke, don't fix it."

2.1 Regulatory Incentives and Disincentives (Table 2.1)

Flexibility is the most important incentive to emphasize with respect to any regulatory or compliance program interested in fostering pollution prevention. On the permitting side, those involved in developing regulations, as well as the permit writers who must translate those regulations and requirements into permit conditions, need to be aware of the range of pollution prevention opportunities available for the industry sector under question. Unlike standard, end-of-the pipe, pollution control options, pollution prevention techniques and technologies may require more research and lead time to implement. On the compliance end, inspectors and enforcement personnel must be willing to work with those companies who are seeking pollution prevention rather than simply control solutions--no industry will try anything innovative if threatened with loss of both capital and costly enforcement actions in spite of their best efforts. Many of the firms we visited would not have even attempted pollution prevention alternatives if they did not have the support of both regulators and compliance personnel.

Although flexibility is key, even within a single media regulatory framework, it achieves its opt<u>imum</u> value--pollution prevention-wise--when it occurs within a multi-media framework. Multimedia inspections, for example, may identify opportunities or threats to more that one media and reduce the risk of narrow, single-media solutions that can simply produce media shifting of pollution. Multimedia inspections encourage a comprehensive examination by both plant and compliance personnel for total environmental management opportunities. When such inspections are augmented by technical assistance programs--especially for small to medium-sized firms--there is a higher likelihood of a facility actually adopting pollution prevention measures.

On the other hand, the largest disincentive for any firm considering pollution prevention is concern about the difficulty (real or perceived) of working with permitters and inspectors who are inflexible, who might not listen to their innovative ideas, who may--regardless of intent or potential for quality environmental benefits down the road (e.g., from permanent reduction of toxics via process changes)--enforce so strictly that the firm's only safety will be to, in the end, install or upgrade pollution control equipment anyway.

This is also where a single media regulatory and compliance framework works as a disincentive. A facility may have an air permitter or inspector willing to listen and work with them on pollution prevention, but unless they are equally confident about the other media programs' support of the concept, they may be unwilling to try something new for fear of either falling out of compliance on those permits during the "trial and error" stage of process changes, or of bringing themselves into new regulatory realms. A case in point is the issue of threatened RCRA Part B permitting for those facilities considering "zero discharge" solutions. Unless all the media programs present a unified, ⟶ ?

2.2 Economic Incentives and Disincentives (Table 2.2)

Clearly, economic considerations are of paramount importance to industry. Companies are profit-motivated, and while pollution prevention measures can hold the promise of future cost savings, if capital investment is needed for such changes, companies--especially low profit margin platers--can find themselves in a Catch-22 type situation. Lower operating costs could improve profits, but extra capital may not be available to make the necessary improvements. We visited one firm, New England Plating (see Appendix A), that spent 14% of their annual sales income on keeping an overtaxed, 20-year old, wastewater treatment system operational. In addition to the "sunken investment" that system represented, the firm operated on such a low margin, they could not tolerate downtime for major equipment changes. There were also space considerations--multiple rinse tanks would take up more linear space than available in the current location. Moreover, their financial situation was so precarious that no bank would consider them for a loan. The pollution prevention economic incentive "carrot" in such cases is therefore quite useless unless accompanied by some means of facilitation--such as low cost loans or tax breaks for equipment upgrades.

In a very competitive industry, customer satisfaction is key. The "job shop" service sector of the surface finishing industry lives and dies by serving the needs of a variety of customers. The job shop that gives the best turnaround time at the lowest per part cost will get the most business. The customer wants quality plating at low cost according to his time schedule--he is usually not really interested in how that is done (i.e., whether in the most environmentally friendly way.) In considering pollution prevention measures, especially those involving changes in plating chemistry, concern about potential customer dissatisfaction with the new product or with longer turnaround times is real and a very potent disincentive. One plater spoke about how his largest customer wanted the insides of a computer housing cabinet plated with copper cyanide (one of the more toxic plating chemistries). because he was presenting the item at a trade show and wanted the inside of the cabinet to show off "that pretty blue color." The realities of trying to satisfy customer requirements can sometimes prevent companies from taking pollution prevention actions.

There is a difference between large and small companies in terms of the level of capital investment and their ability to raise it. Large companies with captive plating shops, such as in the aerospace industry, can absorb more risk--both in terms of investment and in the regulatory arena. They also have more technical resources on hand to experiment with in-process changes. However, both large and small companies cannot ignore customer satisfaction concerns.

2.3 Technical/Informational Incentives and Disincentives (Table 2.3)

All of the technical/informational incentives work together to facilitate pollution prevention. Particularly for small companies that do not have the resources, personnel, or expertise to pursue and obtain good technical information, a network of technical assistance is vital. Whether the technical assistance comes from state programs, POTWs, EPA, trade associations, or vendors, is not as important as the fact that a system of information dissemination and technical expertise is out there reaching companies who need it. As success stories build and innovative technologies become more commonly used, a domino effect can ripple through an industry. Five years ago, aqueous parts washing systems were fairly new, used by only the more adventurous firms. Today, with the phase out of TCA and other ozone depleters, as well as growing regulatory discouragement towards chlorinated solvents of any kind, aqueous systems are finding their way into even the most staid shops. This is due to the concerted effort of all technical outreach channels.

Continued, coordinated technical assistance and outreach are the most appropriate tools for industry-wide progress in pollution prevention. As discussed in section 2.1, compliance mechanisms can be a key motivator for pollution prevention, but one characteristic of such "hammer" incentives is that their application and effect does not necessarily promote pollution prevention consistently either industry-wide or across all media. Pollution prevention may take place because of an enforcement action, but not all facilities industry-side face such actions. Technical assistance and outreach is the best way to reach all facilities--including those in compliance--and show them how to not only "meet their limits," but go beyond.

One of the biggest disincentives, however, in the technical/informational area, is concern about the unscrupulous vendor. One bad "horror story" about a vendor who installs a so-called pollution prevention technology then skips town when the system fails and EPA or the state starts breathing down the company's neck can also ripple through an industry, turning them away from trying anything new. This is a problem faced mostly by smaller companies who rely more on outside expertise. Any vendor can set himself up as a pollution prevention "expert." Companies selling pollution prevention equipment proliferate seemingly overnight, often with little basis in capital or technology. The problem is the vendor who sells the equipment then either goes out of business or renegs on his guarantees. One way to deal with this issue is to provide facilities with approved vendor lists or to initiate some sort of vendor certification program (perhaps through one or more trade associations).

2.4 Management/Institutional Incentives and Disincentives (Table 2.4)

An open door policy that allows all stakeholders to have a say in how best to optimize pollution prevention opportunities can be a key factor. This is true for both companies and regulatory agencies. Upper management support for the principles of pollution prevention can make all the difference when either regulatory staff (permit writers, inspectors) or plant-level personnel (engineers, shop foremen, workers) have ideas they would like to see put into practice. If you don't think your boss will be receptive, you won't risk opening your mouth. The same goes for interactions between regulators and the regulated industry. If there is an atmosphere of mistrust, even good questions won't get asked. At one facility we visited, Parker Metals (see Appendix A), the Environmental Coordinator was forbidden by his management to call EPA with questions because of an incident in the past when one of those "innocent little questions" caused a party of inspectors to come pay an unscheduled visit. That is why Massachusetts' technical assistance program, MassOTA, is housed in a non-regulatory agency. They want it clearly understood that facilities can come to them with problems and questions without fear of retribution.

For larger companies, an incentive for undertaking pollution prevention is the opportunity for improving their public image. For TRI reporters, reducing the release of toxics and moving lower down on the list of "top polluters" can be a way to demonstrate corporate environmental progress. Such good press can often translate into increased revenues as the company becomes perceived as being pro-environment, or at least more environmentally conscious than other competitors. Governor's awards and other publicity-related incentives are also part of this reward system. EPA's 33/50 program, "Green Lights" program, and other public-private partnerships have been most successful in harnessing this need for good press and motivating companies to voluntarily reduce toxic discharges and emissions. Even for smaller companies, any kind of positive reinforcement--such as articles in the local paper or in a trade journal--can make a difference and encourage them to continue pursuing the goals of pollution prevention.

3 DISCUSSION OF POLLUTION PREVENTION INCENTIVE/DISINCENTIVE FINDINGS FOR METALPLATERS

We discuss here some of the key findings our study indicates are important for metalplaters who may be considering pollution prevention. These findings are based on case studies, site visits, industry and POTW/regulatory agency contacts, as well as discussions involving the IP3 focus group. The six main findings are:

- **Categorical standards** are outdated and increasingly irrelevant for metalplaters because non-technology based standards (e.g., limits based on Water Quality Criteria) have superseded them in most cases.
- **Mass-based standards** are motivators for pollution prevention; however, there has been difficulty in implementing them. Regulators should be allowed the flexibility to use either mass- or concentration-based standards to achieve their goals.
- When **enforcement and compliance** activities are tied to a strong pollution prevention message, they can be a key motivator for facilities to adopt pollution prevention.
- **Economic factors** have the potential to be key motivators, but there are also significant barriers.
- **Zero-discharge systems** hold much promise for platers seeking to maximize water efficiency and plating chemical recycling/re-use, but there are both regulatory and technical/informational barriers.
- **Flexibility** in the regulatory network, **supportive** assistance/outreach, and **collaborative** relationships between industry, regulators, and the public can foster continuous, industry-wide improvement in pollution prevention.

3.1 Categorical Standards Are Outdated and Irrelevant

The current national categorical standards for electroplaters and metal finishers were promulgated in June, 1983, and have not been revised since. Most platers can and do now achieve much lower numbers. Local limits placed on them by their POTWs (many platers are indirect dischargers and thus do not have their own NPDES permits) are increasingly governed by water quality criteria, which very often translates into lower limits than the categorical standards.

Another consideration for POTWs is compliance with the new sludge regulations: high metals in sludges may limit what options POTWs have for sludge disposal. Even where POTWs have not set their own lower local limits--due to either sludge quality or other local considerations--NPDES permit renewals for POTWs are increasingly utilizing water quality standards for toxics resulting in both newer, more chemical-specific limits and lower limits overall. Through their pretreatment programs, POTWs will push for source reductions from their service area users--including metalplaters--to help them comply with tighter NPDES permit conditions.

Direct dischargers also have not escaped from the recent push towards water quality based limits. Implementation of CWA section 304(l)--which requires states to identify receiving waters where technology-based effluent limits have not resulted in achievement of water quality standards for toxics--indicates that metal-finishers are the single largest category of direct discharger sources on states' Individual Control Strategy (ICS) lists of impaired waters. In addition, many POTWs also appear on the state ICS lists, in part due to metalfinishing facilities in their service areas. The combined effect is that, for the majority of metalfinishers, compliance is increasingly dictated not by the 1983 technology-based national categorical limits, but by evolving water quality-based standards, implemented through modified NPDES permits for point sources or through pretreatment programs or local limits at their POTW. Table 3.1 compares selected local limits and categorical limits for metalfinishers.

3.1.1 Categorical Limits and Pollution Prevention

Categorical standards by design reflect what pollution reductions can be achieved using the Best Available Technology (BAT) economically achievable (33 USCA 1317, Sec. 307). EPA defines BAT as the "very best control and treatment measures that have been or are capable of being achieved." In the guideline development process, EPA may consider in-plant process changes in addition to end-of-pipe treatment measures. For new sources (New Source Performance Standards--NSPS), there should be a stronger consideration of alternative production processes, operating methods, in-plant control procedures and other major design elements that should, theoretically, encompass pollution prevention more fully.

However, for the metalfinishing categoricals developed in the early 1980's, there was essentially no difference between BAT and NSPS--with the exception of slightly lower cadmium limits. And the development document, while covering some types of in-plant process change options, in the end recommended the same chemical precipitation end-of-pipe technology for both BAT and NSPS. The

Table 3.1 Comparison of Categoricals and Local Limits

Metals	**Warwick[a] POTW Local Limits (mg/l)**	**Upper Blackstone[a] POTW Local Limits (mg/l)**	**U.S.EPA[b] Categorical Limits for Metal Finishers (mg/l)**	**Minimum Reported Local Limits for 200 POTWs[c] (mg/l)**
Cadmium	0.05	0.69	0.69	0.0019
Chromium (total)	0.5	2.77	2.77	0.05
Copper	0.7 / 0.1[d]	3.38	3.38	0.03
Cyanide (total)	0.2	1.20	1.20	nd
Lead	0.15 /0.03[d]	0.69	0.69	0.02
Nickel	0.5	3.98	3.98	0.05
Silver	0.05 /0.01[d]	0.43	0.43	0.03
Zinc	1.0	2.61	2.61	0.05
Antimony	0.5	no limit	no limit	0.02
Arsenic	0.1	no limit	no limit	nd
Beryllium	0.1	no limit	no limit	0.022
Mercury	0.03	no limit	no limit	nd
Thallium	0.1	no limit	no limit	0.2

a As of August 1991.
b Promulgated in June 1983.
c U.S. EPA National Pretreatment Program RTC, July 1991.
d Proposed changes to POTW's NPDES permit, August 1991.

legacy of this is that, even now, with the strides that have been made in waste minimization and source reduction technical assistance for platers, 97% of metalfinishers still utilize end-of-pipe chemical precipitation as their primary compliance mechanism. Improvements have been made, both to the treatment systems themselves and "up-pipe" in metalfinishing operations (some 90% of metalfinishers in a recent NAMF survey stated that they have implemented some system or in-plant improvements); however, metalfinishers do not seem likely to give up the certainty that comes with having a treatment system they know will at least keep them in compliance with BAT.

In most cases, therefore, pollution prevention measures considered by metalfinishers for their facilities need to be compatible with the chemical precipitation treatment systems they have already invested in. Radical changes, such as switching to closed-loop recycling (so called "zero-discharge" systems), may be less likely to be explored. As EPA re-visits the metalfinishing effluent category--either separately or in conjunction with the new Metal Products and Machining (MP&M) guideline (to be promulgated by May 1996)--fuller consideration may be needed of how pollution prevention measures can more fully be incorporated into the guideline development process so that facilities are allowed real choices between control and prevention. The important thing is to provide industry some measure of certainty that given configurations of either control or prevention can be used to achieve BAT or NSPS limits.

3.1.2 Local Limits and Pollution Prevention

Rather than using the categorical standards in their pretreatment program, a POTW may elect to seek passage or modification of a local sewer use ordinance to establish more stringent local limits. As pretreatment standards applicable to all nondomestic dischargers, local limits are used to ensure compliance with the general and specific prohibitions of the general federal pretreatment regulations (40 CFR 403). Because they apply to both categorical and noncategorical users, they give pretreatment programs the needed latitude to set more stringent standards than categorical standards, and regulate as wide a group of nondomestic users as necessary to protect the POTW, its workers and the environment. The POTW also has the option of developing plant-specific permits to implement its pretreatment program.

Although the development of site-specific local limits is simple in concept, implementation is often difficult and cumbersome. EPA reported in its July 1991 Report to Congress (RTC) on the National Pretreatment Program that while 90% of the pretreatment programs they evaluated had adopted local limits for one or more toxic constituents, the majority did not perform a headworks analysis as recommended by EPA to derive the limits. These POTWs either adopted a neighboring city's limits or values published in the literature. Information collection activities needed for headworks analyses include:

- identification of pollutants of concern
- determination of applicable environmental criteria (e.g., water-quality criteria)
- site-specific data (POTW data, industry data, receiving water data, etc.)

EPA's Pretreatment Implementation Review Team (PIRT) Final Report (January, 1985) found that POTWs generally did not understand the relationship between categorical and local limits, nor how to develop local limits. Largely as a result of this, the pretreatment regulations were amended in October 1988 to make adoption of technically-based local limits a prerequisite for program approval. Local limits derived from site-specific information are considered technically-based limits. More recent amendments (DSS, July 1990), require POTWs to evaluate the need for updating local limits as part of their NPDES permit renewals (i.e., every 5 years).

Because of their application to all nondomestic dischargers, local limits do provide some incentive for pollution prevention strategies. For example, local limits have been used to justify non-discharge recycling strategies for silver users and auto repair shops in Palo Alto. Local limits for metalplaters are often lower than categoricals.[1] Table 3.1 shows that local limits for metals in Warwick, R.I., as well as for some 200 POTWs nationwide, are from 15 to 350 times lower than the national standards. The July 1991 RTC notes that only 6.8% of POTWs required to have pretreatment programs use categoricals as the basis for their local limits. At our site visits in Massachusetts, one POTW (the Upper Blackstone Water Pollution Abatement District) was using the 1983 metalfinishing categorical standards for their pretreatment program local limits. However, they were also facing a NPDES permit renewal which, for the first time, would specify fairly low metal limits for the POTW. Because they felt that lowering their local limits--i.e., passing on the responsibility of reducing metal discharges to upstream sources--would be politically unacceptable, the POTW was researching how to comply with the new limits at the treatment plant itself. One option was to install a reverse osmosis system to control metals which would cost several million dollars.

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1 However, the July 1991 RTC indicated that, for some areas, use of the national categorical standards in lieu of locally derived limits would have resulted in local limits significantly higher than the minimum national standards.

The point is that there is no guarantee that by simply lowering limits you will produce a desired pollution prevention response. POTWs, such as the Upper Blackstone, could meet their NPDES and sludge limits without ratcheting down on industrial users. Or they could push industry to install conventional pretreatment systems, i.e., end-of-pipe controls. Only when the lower limits are combined with pollution prevention technical assistance and outreach will there be a greater likelihood that industries needing to comply with the lower limits will explore pollution prevention options.

Moreover, rapid regulatory changes, such as "overnight" changes in local limits may well cause a treatment response because firms (a) do not want to risk ultimately being out of compliance, (b) may not be convinced they can make the limits in time using pollution prevention, or (c) do not want to make process changes hurriedly. Another undesired response could be for companies to move their facilities (sometimes it need only be "down the street") to a less stringent POTW service area. Regulators we spoke with in Rhode Island had seen such "POTW-shopping," especially with smaller, more mobile job shop platers. Sufficient lead time for responding to regulatory changes coupled with flexibility in a pollution prevention-supportive environment seems to be key in the choice to respond to a regulatory stimulus with prevention rather than treatment.

3.2 Mass-Based Standards Are Motivators for Pollution Prevention

For metalplaters, mass-based limits (whether production-based or concentration-derived) are stronger pollution prevention motivators than concentration-based limits alone. Mass-based limits are more likely to foster rinsing process modifications and true source reduction. Many POTWs feel that having the flexibility to adapt concentration-based standards to mass-based is vital to achieving their pollution prevention goals. Concentration-based limits tend to discourage water use reduction, which is the heart of rinsing process modification and critical to many metals recovery technologies. Production-indexed mass-based limits, while supporting these types of pollution prevention technologies, can be difficult to calculate for metalplating, however. And everyone agrees that concentration-based limits are easier to implement and enforce against. Nevertheless, if EPA, states, and POTWs partner together to overcome the difficulties and allow for more flexibility in using mass-based limits, this could provide the single largest incentive for electroplaters and metal finishers to incorporate pollution prevention into their operations.

3.2.1 POTW Experience With Mass-Based Limits

In California, POTWs in Orange County, Palo Alto, and Los Angeles are either already using mass-based limits or are working to implement them. Other POTWs in North Carolina and Georgia are actively pursuing the possibility. However, in many cases, either state or EPA regional officials have been less than supportive. It appears that the POTWs are being treated less like customers and more like regulated entities, as in fact they are -- and the state/EPA positions have been that such regulated entities (POTWs) might be allowing CWA backsliding in terms of failing to meet concentration-based limits, even if total loadings decrease due to mass-based limitations. The 1987 CWA amendments contained an "anti-backsliding" provision which prohibits the relaxation of treatment requirements when an existing permit is rewritten or renewed. If the original permit condition was a concentration-based one, there is some debate as to whether switching to a mass-based standard--even one which is derived from the concentration-based limit--represents backsliding. Different states and EPA regions have held different opinions. POTWs that have been able to implement mass-based limits usually have done so only after long negotiations with their regulators.

The Orange County Sanitation Districts has been using mass-based limits since August 1990. They find it beneficial, allowing them the needed flexibility to deal with diverse technical and compliance problems. They selected mass-based limits as the compliance basis for all dischargers because of an understanding that waste minimization--reduction of water usage and recycling of wastes--is basically a concentrating process which results in an increased waste stream concentration. Orange County has found that mass limits have encouraged water use reductions (important in water-poor southern California) and have eliminated in principle the dilution of wastes.

Mass limits are not used widely at POTWs around the country. Even in California, few POTWs have taken that important step. However, the experience is that mass limits are feasible even for such large and diverse systems as the Orange County Sanitation Districts. The use of mass limits does require some retraining and "re-thinking," but the benefits are worth the effort. The important thing is to allow POTWs the flexibility to choose what works best for them--mass-based, concentration-based, or some combination. POTWs need a range of choices that they can translate into flexibility and incentives in their compliance and pollution prevention programs.

3.2.2 EPA Experience With Mass-Based Limits

In the Development Document for Existing Source Pretreatment for the Electroplating Point Source Category (August, 1979), EPA gives mass-based pretreatment standards for the electroplating category and electroless plating and printed circuit board subcategories. These limits were calculated from concentration-based standards, using median plant water usage data for the three plating categories. Water usage was defined to be the liters of water used per each square meter plated for each plating operation. "These limitations were calculated specifically to benefit a plant achieving water usage (i.e., volume of water per unit of production) lower than the median plant water usage for its plating category....In order to avoid penalizing these plants or discouraging their water conservation practices, mass-based limitations are calculated below, as an alternative to the concentration-based limitations."[2]

The Metal Finishing Point Source Category Development Document (June 1983), included electroplating as a unit operation, and in some cases, superseded the August 1979 guideline. In the 1983 document, it states that "Effluent limitations and standards are expressed in concentration units (mg/l) without accompanying production based units. Basing limitations and standards on production based units was rejected after numerous attempts failed to find production related factors which could be correlated in a statistically reliable manner with wastewater flow. This lack of correlation is understandable in light of the number and complexity of metal finishing manufacturing operations."[3]

Although early consideration of a mass-based or total loadings alternative standard (essentially derived from the concentration-based limits) seemed promising, it was abandoned for the metalfinishing category. Since 1983, therefore, the status quo for most metalfinishers has been compliance with a strictly concentration-based limitation. The new Metal Products and Machinery (Phase I) Effluent Guideline--to be proposed by November 1994 and promulgated by may 1996--is reconsidering the use of mass-based limits. The MP&M guideline will cover facilities that manufacture, rebuild or maintain finished metal parts, products, or machines. It is possible that changes to the applicability of the 40 CFR 433 (Metal Finishing) and 40 CFR 413 (Electroplating) rules will be proposed along with the MP&M proposal. That means that if mass-based limits are chosen for MP&M subcategories which overlap the 413 and 433 categories, the new limits may supersede

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[2] U.S. EPA. 1979. Development Document...Electroplating Point Source Category. pp. 396-406.

[3] U.S. EPA. 1983. Development Document...Metal Finishing Point Source category. p. I-1.

those concentration-based limits. Applicability issues have yet to be finalized.

The current MP&M development effort is focused toward gathering and analyzing data to decide between a mass-based and a concentration-based guideline. Various normalizing parameters, such as pound of metals removed (i.e., from metal machining operations), are being studied. For plating, parameters might include micrograms plated per pound of production or pounds of metal applied per square footage of production. Various surface area configurations and production scenarios may be considered. Also being studied are ways to covert typical concentration-based units, such as micrograms per liter, into a total loading-type unit, such as milligrams per day. At a minimum, EPA would like to see flow control options worked into the guideline.

Mass-based effluent guidelines are not really new for EPA--they are simply proving a little more difficult to develop for complex operations such s metal working, finishing, and plating. Of the existing metals industry guidelines, ten are already mass-based. These guidelines include Aluminum Forming, Iron & Steel Production, Nonferrous Metals Manufacturing, Battery Manufacturing, among others. Mass-based standards require more data collection and analysis, and are typically viewed as more difficult for the permit writer to implement. Concentration-based standards may be easier to implement, but without some flow control they can lead to poor water use practices to achieve compliance.

3.2.3 Mass-Based v. Concentration-Based Limits

The technical problems (of permitting and reporting mass or total loadings in addition to, or instead of, concentration) are not trivial. But when metalplaters are given the option of complying by cutting flows and improving metals management, some of them will excel at preventing pollution from their shops. A perhaps obvious question arises: if at any moment the physical reality of the mass of metal and the flow of wastewater from a facility are no different whether the limits are in terms of mass or concentration (i.e., if they are interchangeable or "convertible"), what difference does it make which units the limits are expressed in?

It turns out to make a big difference in terms of pollution prevention and planning for changes at a given facility. Concentration-based limits discourage water use reduction, which is the heart of rinsing process modification and critical to many recovery technologies. In order to do pollution prevention in the shop under a concentration-based limit, either the treatment system must be oversized or all of the changes must be very well choreographed to preclude the possibility of upset or even marginal noncompliance. This "choreography" discounts the necessity of learning from trying things out, fine tuning and adjusting in implementation. At the Parker Metals facility we visited in Worcester, MA, for example, it has taken four years of tweaking and refinement to bring the treatment process under acceptable levels of control, after they made a radical chemistry change on the line, eliminating hexavalent chromium, nickel and cyanide (See Appendix A).

Some of the programs we've contacted have argued that establishing mass-based limits would provide the most compelling incentive for pollution prevention. Such limits would allow firms to reduce water use without fear of exceeding concentration-based limits; water use reduction in turn facilitates some metal recovery techniques. The counterpunctual disincentive is that concentration-based limits discourage water use reduction. Concentration-based limits are easy to measure for compliance. Some plants (perhaps most) do not currently have the capacity to accurately measure their flow. This is not to say the technology doesn't exist, but flow measurements have not been necessary and so few shops take them.

Concentration-based limits are easier to translate from one POTW's situation to another, to apply across categories. Mass-based limits could depend on many factors, related both to each company's individual circumstance and the cumulative effect at the treatment plant. However, devices for estimating local limits based on maximum allowable headworks loadings (such as PRELIM software) may work well with either case, since they are based on a mass balance including the mass of each metal in the influent. The more dilute stream that a concentration based-limit encourages is less likely to be aquatically toxic and less likely to cause a spike or other problem at the POTW. The extent to which this is an issue depends on dilution factors globally across the system and possibly locally where the discharge enters the system.

Mass-based limits are not what most POTWs, states, or EPA are using now for metal finishers. To use them will require training; guidance documents; ordinance changes; changes to effluent guidelines--plus, in general, overcoming opposition to change. One problem arises, however--if mass-based limits are not tied to production, they might represent a ceiling so that a permit change would be required for the firm to increase production. Even if permit changes are not required, such increases might violate "no backsliding" provisions of the Clean Water Act.

3.2.4 Production-Indexed Mass Limits

Production-indexed mass-based limits can be very difficult to calculate for plating, especially in job shops where the surface area of the plated parts may vary widely. One way to get around this difficulty would be to calculate mass limits from average or maximum flow and concentrations as currently permitted. That approach raises a concern that without indexing to production level such a permit might act to restrict expansion. For example, to add a new nickel plating line in an existing shop without renegotiating the permit or the limits with the POTW, a company would have to reduce mass emissions of nickel from other sources in the plant to compensate for any addition--sort of a plant-wide bubble in pounds for each pollutant. POTWs could justify such limits by allocating loadings across sources in the community, considering treatment capacity, VOC emissions from the plant, and sludge regulations.

Alternatively, mass-based limits could be tied directly to production. This raises nightmarish visions of inspectors reviewing weekly production logs to determine the frame-of-reference of compliance. Such logs are often kept for other purposes, and their data may be proprietary. But apart from the questions about accountability, the technical capability exists for utilizing production information to calculate or normalize mass-based limits. Surface-area data is now available or calculable for plating operations, including job shops. Shops may have in place, or have access to, computers and software to quickly determine surface area for any job (such products are widely advertised in the trade literature). Lack of data or ease of calculation for surface area was an impediment for widespread use of production-based mass limits in the late 1970s or early 1980s, but it may be worth another look in 1990s to see if the impediments are that insurmountable.

To develop mass-based limits might require that EPA or other technical resources gather information on drag-out associated with part shapes, holes, threading, and other factors key to drag out of metal finishing solutions by parts from one tank to the next. This information would more accurately tie potential pollution to production rates than straight surface-area data. Why go to all this trouble? A better question might be, if the POTWs see a need and are willing to work on it, why not let them? The answer, as to why to go to all this trouble, lies in the disincentive to change that concentration-based limits provide. Concentration-based limits discourage water use reduction--why risk going out of compliance? It can be much worse for a firm to go out of compliance than to waste water. Concentration-based limits discourage rinsing process innovation--again, why risk reducing water use, thereby increasing concentrations? Concentration-based limits, by discouraging water use reduction, make it very difficult to implement recovery/treatment technologies. But the principles of pollution prevention dictate that water efficiency, energy efficiency, and toxics reductions are the goal. These goals are technically achievable. We simply need some collective will-power to make it happen.

3.2.5 Examples of Pollution Prevention Technologies Fostered by Mass-Based Limits

Technologies that rely on separating metals or other contaminants from water, such as ion exchange, electrolytic recovery, electrowinning, electrodialysis, reverse osmosis, vacuum distillation, even evaporative recovery, are generally fostered by mass-based limits and discouraged by concentration-based limits. High volume waste streams require large recovery/treatment systems requiring large capital investment. Such an expensive and radical change in a metalfinishing operation must not put the company in jeopardy of noncompliance. Implementation of water use reduction and recovery systems does not always happen all-at-once; during interim stages firms are vulnerable to violating concentration-based limits, even if total mass loadings have decreased. That is why mass-based limits are more conducive to giving facilities the added flexibility and assurance they need to make such important changes.

There is a distinguishable difference between source reduction and recycling as they apply to electroplating. Most of the following list of source reduction approaches consists of rinsing process modifications which are supported by mass-based limits; most of the activities on the list of recycling and treatment approaches are easier to do with less flow to handle.

<u>Source Reduction for Platers & Metal Finishers</u>

-- bath substitution/reformulation
-- lower bath concentrations
-- bath maintenance
-- slow withdrawal rate
-- fog/spray rinsing
-- DI water use
-- racking parts
-- other dragout prevention
-- rinsing to meet spec
-- conductivity-sensing flow controls
-- preset flow controls
-- countercurrent rinsing
-- reactive rinsing

<u>Recycling/Recovery/Other Treatment for Platers & Metal Finishers</u>

-- dragout return (with evaporation)
-- modular & global ion-exchange
-- plate-out cells/electrowinning
-- vacuum distillation
-- electrodialysis
-- in-process cyanide destruction
-- precipitation
-- volume reduction
-- filter presses & sludge dryers

3.3 Enforcement and Compliance Activities Tied to a Strong Pollution Prevention Message is Key Motivator

A strong, consistent program of enforcement, coupled with a commitment to promoting source reduction as a means of coming into compliance, can be a key pollution prevention incentive. Such a program must, however, allow for latitude in how, and at what pace, firms exploring and initiating pollution prevention measures come into compliance. While a company that is in compliance may have less motivation to consider source reduction measures, a facility that has been served notices of violation (NOVs), or is otherwise under an enforcement action by a regulatory agency, is in a very receptive position to be motivated toward pollution prevention. For enforcement programs, pollution prevention can be a means of not only bringing facilities into compliance, but potentially going beyond what could be achieved with conventional, end-of-pipe responses.

3.3.1 Pollution Prevention Action Often Triggered By Pending Enforcement

According to both regulators and technical assistance personnel we interviewed for this report, the experience is that, for many facilities, action towards investigating and implementing pollution prevention measures very often is first taken due to an outstanding or anticipated enforcement against the firm. Several metalplating shops we visited in Massachusetts took their first steps towards source reduction because of anticipated enforcement actions.

Neles-Jamesbury, a machine tool manufacturer that was originally visited by the Blackstone Multimedia Inspection Team, was found to be combining a water stream from an apparently unnecessary piece of air pollution control equipment with a categorical wastewater stream, thereby meeting their categorical limits through the effect of dilution. The inspectors deemed the practice unacceptable, and their POTW required them to lower their metals loadings. With encouragement from the Massachusetts Department of Environmental Protection (DEP) and the POTW, and with direct technical assistance provided by the state's nonregulatory Office of technical Assistance (OTA), the company chose to source reduction measures (counter-current rinses, dead rinses, flow controls, etc.) to come into compliance.

Interestingly, representatives of the firm had previously attended pollution prevention workshops, including sessions focused on the very source reduction measures Neles-Jamesbury eventually implemented. They also were offered, but had chosen not to accept, a free on-site waste reduction audit provided by the state. It took the "trigger" of an enforcement action, coupled with the knowledge that a prevention-focused solution would please the regulatory agencies, to cause action.

Another facility visited by the Blackstone Team, The Lowell Corporation, a small machine tool shop manufacturing specialty ratchets, was found to be way out of compliance on its zinc limits (4.47 mg per liter vs. the categorical standard of 2.6 mg per liter). The violations stemmed from their zinc phosphate plating line. Shutting down the line and sending parts out for plating elsewhere would have cost them an additional $26,000 per year. After referral to Mass. OTA, which provided on-site technical assistance, the company chose to install a dead-water drag-out tank on the phosphating line. The tank carried a very modest price tag and took only ten minutes to install. After that the wastewater zinc levels dropped to 1.55 mg per liter, well below the permitted limit. If the compliance message had not been tied so strongly to pollution prevention goals, the company may have faced losing a considerable part of their business. For small shops that cannot bear the expense of large pretreatment systems, such in-process modifications are often the only practical alternative for coming into compliance--other than closing down the line.

3.3.2 Flexible Compliance Mechanisms Are Needed

For many new or innovative pollution prevention technologies, difficulties in implementation may not provide assurance of a return to compliance within the time frame that a conventional treatment system might accomplish. As stated earlier, strong, consistent enforcement can promote pollution prevention by enhancing the desire of the regulated community to reduce potential liabilities and the resulting costs of noncompliance. However, efforts to achieve (and potentially go beyond) compliance through pollution prevention need to be facilitated by flexible enforcement mechanisms, e.g., extension of the compliance timelines for facilities adopting pollution prevention measures.

EPA's Interim Policy on Pollution Prevention Conditions in Enforcement Settlements and Policy on Supplemental Environmental

Projects both encourage the use of pollution prevention, recycling conditions, or innovative technologies in enforcement settlements, either as injunctive relief or as "supplemental environmental projects" (SEPs) incidental to the correction of the violation itself. In particular, if a pollution prevention activity is presented as the means of correcting the violation, the EPA settlement team may extend the compliance schedule, especially if the remedy involves innovative technology. In deciding whether to extend the compliance timeline, one of four factors Federal negotiators must consider is the reliability/availability of the innovative pollution prevention technology--the more experimental the technology, the more cautious negotiators may be about timeline extensions.

In exchange for an SEP or a pollution prevention initiative to correct the violation, the punitive portion of the penalty owed the government can be reduced. However, under no circumstances will a respondent be granted additional time to correct the violation in exchange for a SEP. However, the concept of SEP has been expanded to include innovative technology, either pollution control or prevention. Many states and EPA Regions have drafted enforcement settlements designed to promote pollution prevention. When we first began our research for this report (May 1991), the pollution prevention SEP concept was just getting off the ground. Several Regions now report (October 1993) that SEPs have since become institutionalized into their enforcement programs. There is more training for inspectors on how to look for pollution prevention opportunities, and more cases are being examined for ways to fold in pollution prevention.

In one enforcement case, Region I has worked closely with a facility seeking to address pretreatment violations via pollution prevention measures. There has been no formal enforcement so far, only section 308 letters, and many meetings between EPA, the POTW, and the company. There has been no administrative orders, no penalties, but technical assistance has been facilitated through EPA contacts and a private consultant hired by the company. The facility has implemented a range of pollution prevention process changes after doing a toxics use reduction analysis. These actions have been accomplished in a "carrot--stick" type approach, by leveraging the pollution prevention with the threat of a more formal enforcement action if the work is not done. When this approach goes as far as it can, a Compliance Order may be written (if the facility is still out of compliance) that will fold in the pollution prevention implementation requirements, along with a timeline designed to allow the facility to make incremental progress towards full implementation.

Allowance for the extended timeframe often needed to fine-tune process changes or unfamiliar systems and equipment can be crucial to the successful implementation of pollution prevention technologies. This is true not only for innovative technologies, but also for some "off-the-shelf" technologies or systems. Parker Metals, a Massachusetts metal parts manufacturer we visited, had decided to switch from nickel-chrome plating (requires highly toxic cyanide solutions) to alkaline zinc plating. Although the change-over seemed fairly straightforward--or so it was promoted by the equipment vendor and environmental consultant employed at that time--Parker found the change not only affected the plating line in unpredictable ways, but also affected the performance of their wastewater treatment systems. They found that it took at least 4 years to fully understand the chemistries to keep the limits in control. They were fined by EPA Region I for not having a pretreatment system up and running on time, and they were forced to complete the current system under a consent order. Technical uncertainties associated with changing to an unfamiliar process, coupled with the need to "meet your limits" within a specified time frame, can be an overwhelming disincentive to companies who need some measure of certainty associated with their environmental performance in order to avoid the risk of costly liabilities associated with noncompliance.

3.3.3 Pollution Prevention In Enforcement Actions

As discussed above, EPA Regions, states, and public interest groups are now drafted more enforcement settlements designed to promote or require the adoption of pollution prevention measures. EPA Region 1 has settled cases where pollution prevention measures have not only achieved, but allowed the facility to go beyond compliance. Massachusetts officials have used administrative orders to force early toxics use reduction planning under the Mass. Toxic Use Reduction Act (TURA). In California, the Orange County Sanitation Districts have used enforcement actions to encourage industrial facilities to carry out pollution prevention. While Orange County feels this has been a successful initiative, they also note that, although effective, it can be costly for POTWs to pursue. Also, many POTWs feel uncomfortable in the role of "strong-arming" action. A preferable mode would be to reach facilities with technical assistance before noncompliance escalates to the point of enforcement actions and compliance orders.

The Atlantic States Legal Foundation (ASLF), working on behalf of a citizens group seeking civil action under the CWA, settled a case with electroplaters in Fort Wayne, Indiana, that resulted in limited pollution prevention implementation. Of an original group of five platers that were cited in the suit, four chose to pay the fine and come into compliance without signing a pollution prevention agreement. Only one plater chose a reduction in fine and signed the agreement to do a pollution prevention study (at a cost not to exceed 15K). When asked why the other metalplaters did not "bite" the pollution prevention carrot, Mr. Hayes, the ASLF lawyer, said that most companies he's dealt with do not like outside entities fiddling with their product line. They do not mind so much if you put requirements on how they manage their waste, but when it comes to the process, they say "Don't tell us how to make our product."

Other problems with folding pollution prevention conditions into enforcement documents, are that the costs associated with not only the pollution prevention study, but implementing the results of the study are so open-ended. People want certainty. Their attitude is in many cases: "Pay the fine, sign the order, get into compliance quickly and they'll all get off my back." It is hard to make pollution prevention agreements self-implementing. In the Fort Wayne case, ASLF is just hoping that the study turns up some cost-saving, environmentally-beneficial pollution prevention for the facility to implement, but there are no guarantees.

We also talked to EPA Region 9 about a settlement involving pollution prevention. Settled in February 1991, the case involved Alta Plating, a small "Mom-and-Pop" operation, that was in violation of the pretreatment requirements. The settlement involved a cash penalty along with a pollution prevention SEP. It required the facility to do a waste assessment audit and waste minimization plan, to be submitted to Region 9 "for review and approval." The agreement has a default penalty such that if the facility does not implement the plan, they would have to pay a penalty of $6K. We asked what if the audit says the facility should implement a pollution prevention measures that would cost more than $6K, could Alta Plating then choose to pay the fine and not do the pollution prevention? Laurie Kermish, of the Regional Counsel's Office, said yes--but since what they are trying to do is make the facility go beyond compliance, that's the best they could get.

3.3.4 Importance of Agency Openness To Pollution Prevention

It is clear that whether a firm chooses pollution prevention or traditional end-of-pipe technology to return to compliance is highly influenced by the enforcing agency's openness to pollution prevention. While POTWs have often been criticized for their lack of aggressive enforcement,[4] they are nevertheless in a unique

[4] The 1989 GAO Report: Improved Monitoring and Enforcement Needed for Toxic Pollutants Entering Sewers (RCED-89-101), was highly critical of POTW enforcement actions stating that POTWs are reluctant to take stronger actions because: "(1) POTWs have traditionally been service-oriented toward industries and are

position to use both their close working relationship with their service area industries and their role as regulators/enforcers to promote pollution prevention in a meaningful way. Being on the "front-line," POTWs develop first hand knowledge of industries, their processes and technologies. POTWs are also in the unique position of sharing that knowledge and developing training and technical outreach programs for their service areas. POTWs themselves are regulated entities and unless their regulators (EPA and the states) are supportive of pollution prevention, the POTW may find it hard to implement the kind of quality pollution prevention program they are in the position to do.

In 1989, EPA and the Department of Justice began an major enforcement initiative against 61 large cities as a result of inadequate POTW pretreatment programs. The effort has lead many POTWs to take aggressive enforcement actions against their dischargers. POTWs are also under the gun for implementing a wide range of new, more stringent regulations, such as the DSS sludge rules, air toxics rules, new water quality limits, along with increasingly lower NPDES permit limits overall. As with industrial facilities, POTWs need time to explore pollution prevention or source reduction options. Building the concepts and practices of pollution prevention into their pretreatment programs cannot happen overnight.

States with delegated pretreatment programs may have greater latitude than non-delegated states with regard to building in such program elements as pollution prevention-focused inspections and technical assistance/outreach. In nondelegated states, EPA is responsible for inspections and enforcement of indirect dischargers, and while the EPA inspectors may be open to pollution prevention, there are serious time and resource constraints that do not allow the close, day-to-day, "collaborative" relationship that may characterize a delegated state's approach. Pretreatment programs at the Woonsocket and Warwick (Rhode Island) POTWs, for example, have been very effective in promoting source reduction, largely due to pretreatment program coordinator training and their technical understanding of industrial users (Woonsocket: textiles; Warwick: platers and casters) as well as a willingness to work on a day-to-day, one-on-one, basis with individual firms who are working towards compliance via pollution prevention measures.

A major enforcement case at Woonsocket involved the Seville Dyeing Company. Mike O'Conner, Woonsocket's Pretreatment Coordinator, worked very closely with Seville to encourage source reduction and water conservation measures as a means of coming

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uncomfortable in the role of regulators; and (2) they have received unenthusiastic enforcement support by local government officials...because of possible economic impacts."

into compliance. The facility was seriously out of compliance on BOD, largely due to high COD from chemical sources, such as polyvinyl acetate (textile sizing) and dyes. The compliance order written for Seville specifically limited the number of black dye runs (found to be the largest contributor to the high COD) the facility could do within a given time frame. Savings realized by Seville after incorporating process modifications and other source reduction measures promoted by Woonsocket were in the $150K/year range, largely from reduced water, sewer, and chemical costs.

3.3.5 Inspectors Can Play A Key Role

By inspecting firms, agencies can identify potential compliance problems and call the firms' attention to them. They can also be a first line of communication to regulated entities of the potential opportunities for, and savings achievable through, the use of pollution prevention measures. This may come via handout of technical material, brochures, or checklists; direct referral to state or POTW technical assistance programs; or coordinated, multi-media inspections, such as piloted in the Blackstone Project. Whenever regulating agencies communicate with regulated entities, they have the opportunity to reiterate the preferred waste management hierarchies and to underscore their agency's preference that firms use pollution prevention as a means of achieving compliance. The Blackstone Project illustrates how this communication can successfully occur within the context of facility inspections.

The Massachusetts DEP began planning and training for multimedia compliance inspections in coordination with the Massachusetts Office of Technical Assistance (OTA) in November 1988. With grant support from the USEPA Office of Pollution Prevention, in 1990 DEP conducted a series of multimedia inspections (coordinating the work of agency and POTW field staff specializing in air quality, industrial wastewater, hazardous waste, right-to know, and toxics use reduction) in various inspection team formats as a pilot project. Named for the river basin that served as a focus, the Blackstone Project has served as a model for multimedia inspection pilots planned by other states. While a principal goal of the Project was to test alternative ways of conducting inspections of industrial facilities and for coordinating state and local regulatory actions across the media programs, a second objective was to undertake pollution prevention-focused enforcement actions, where warranted.

DEP has initiated a number of enforcement actions to encourage firms to consider source reduction and recycling as the preferred methods for reducing releases to the environment. At our meeting with the Blackstone inspectors in June 1991, we received an update on the progress of the enforcement evaluation.

In all, team inspectors went into some 80 facilities--the vast majority were plating or metalfinishing shops. Blackstone field staff identified specific source reduction opportunities at 16 facilities and made a general referral to Mass. OTA at 30 facilities. Of those facilities, 23 did some sort of pollution prevention or toxics use reduction (20 because of enforcement letters or NOVs, plus 3 facilities with no enforcement motivator).

3.3.6 Example of POTW Implementation of New Metal Reduction Ordinance

The three major opportunities that a regulating agency has to influence behavior towards pollution prevention are: (1) when new standards are developed and come into effect; (2) when re-permitting actions occur; and (3) when a company falls out of compliance. Previous subsections have dealt with enforcement in the context of noncompliant facilities. It is important to understand that the initial tack a regulatory agency takes in implementing new, usually more stringent, regulatory requirements can set the stage for encouragement of pollution prevention--or it can put up barriers.

The Regional Water Quality Control Plant (RWQCP), a POTW operated by the City of Palo Alto (Calif.) has been successful in promoting pollution prevention with industry through a carefully developed strategy under its pretreatment program. The effort was developed in response to state waste minimization requirements, which in turn had been promulgated because of the City's violation of five heavy metal limits in its NPDES permit. In 1989, the regional plant had been discharging as much as 9 parts per billion (ppb) of silver to the South San Francisco Bay. Under new, stricter discharge limits set by the Regional Water Quality Control Board, Palo Alto's silver concentration was to be reduced to 2.3 ppb, a 75% reduction. The principal concern with silver was because of elevated concentrations found in clams and mussels near the wastewater discharge point. Elevated silver concentrations were also found in the livers and kidneys of diving ducks in the area.

Photoprocessing operations, including x-ray and microfilm development processes were determined to be the major silver sources in the area. Silver is a component of the paper and film used in these processes and is released in the fixer or bleach-fix stage of image development. The City developed a silver reduction pilot program to facilitate implementation of the Silver Reduction Ordinance, an amendment to local sewer ordinances. The ordinance regulates all dischargers of silver in spent photochemicals within the service area, and sets stringent discharge limits. The ordinance was passed by the plant's five member communities during Fall 1990 and required compliance by June 30 or September 30, 1991, depending on volume. The pilot program was developed to facilitate compliance with the stringent limits.

The pilot program has proven successful based on the following accomplishments:

- Publication of informational newsletter and other educational materials

- Public workshops to explain the need for silver reductions and compliance methods

- Sponsorship of silver waste reclamation program - the POTW has entered into agreements with photo waste haulers to operate pickup and reclamation services for spent fixer and bleach fix. This makes it economical for small generators to schedule regular pickups

- Established drop-off facility for silver-bearing photochemicals from households

- More than 90,000 gallons per year of spent fix, bleach fix, and stabilizers had been accounted for as of August 1991 - 349 facilities will haul approximately 32,000 gallons per year and 27 firms which together generate approximately 60,000 gallons per year have applied for on-site treatment permits

- Coordination of regulatory administrative requirements - POTW staff have coordinated with local fire departments, County and State Health Departments to streamline permitting and inspection procedures, minimize fees, and eliminate redundant regulation

- Successful lobbying of the State Assembly to change the state law regulating photoprocessing wastes

The success of this program can generally be attributed to its phased approach to controlling silver discharges. Rather than single-mindedly relying on enforcement of the new silver limit, the POTW first emphasized public outreach, technical assistance, and regulatory coordination. This ensured a multi-media approach to the problem and won the sympathy and support of the regulated community. It is important to note, however, that the initial action (to implement a strict silver reduction program throughout its service area) was motivated by Palo Alto's pressing need to come into compliance with tough new metal limits in the POTW's NPDES permit.

3.4 Economic Factors For Metalfinishers Have The Potential To Be Key Motivators, But There Are Significant Barriers

Metalfinishing covers the electroplating of various kinds of heavy metals, like cadmium, copper, chromium, nickel, zinc, lead, silver and gold. It also covers metal surface preparation and coating, and the anodizing of aluminum. The electroplating process is used by specific electroplating shops (job shops) as well as by manufacturing companies (captive shops). Job shops can range from extremely small, "Mom-and-Pop" operations located in a garage or basement[5], to fairly large (>100 employees) shops that have steady, on-going plating contracts, and are often located near, for example, automobile assembly plants or major computer manufacturers. Captive shops can range in size and complexity, from specialty precious metalplating shops, associated with the jewelry industry, to shops associated with manufacturing facilities, both large and small.

In short, the metal finishing industry can be characterized as being heterogeneous, with profit margins ranging all over the board. Operating costs are highly dependent on not only the type of metal plated, but on water use, energy use, volume of wastewater treated, volume of sludge treated/disposed, etc. Cost savings that can be realized by metal finishers are generally a function of the following variables:[6]

- Reduced raw material costs
- Value of recovered material
- Reuse potential of water
- Value of recovered material
- Reduction of sewer fees
- Reduction of hazardous waste disposal costs
- Reduction of liability-related costs

Although many source reduction technologies require little capital investment, several resource recovery, reuse, recycling, and alternative pollution prevention technologies require significant capital investments. For example, on-site process chemical or metal recovery systems, such as ion exchange or

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[5] A one-man shop in Rhode Island specializes in silver plating historical pieces for museums (e.g., the Smithsonian); everything is done by hand using two small batch-process tanks.

[6] NJ DEP, Design of Programs To Encourage Hazardous Waste Reduction: An Incentives Analysis, Oct. 1988, p. III-13.

electrolytic recovery, can cost over $20K to purchase and install.[7] The savings to a small company may not warrant the cost of the system. Compared to the cost of installing a wastewater treatment plant (i.e., employing conventional precipitation and sludge management technologies), which can start at around $1 million dollars, even the higher-priced pollution prevention technologies can seem attractive.

Good housekeeping practices and simple process modifications, such as countercurrent rinsing or drag-out minimization, can be implemented for little capital investment. They may however, require a dedication to maintenance of plating chemistries, monitoring of flow, drag-out time, etc., that many (especially smaller) companies may not wish to troubled with. As discussed in the following section, our findings indicate that, for metal plating facilities, the economic benefits of pollution prevention are not, by themselves, good predictors of a firm's adoption or rejection of pollution prevention measures. In many cases, it seems that financial analyses (if they were done at all) were done largely "after the fact" to rationalize a decision to implement that was motivated by other than strictly economic motives.

3.4.1 Economic Benefit of Pollution Prevention Alone Not Strong Motivator

Although there are many documented examples of profitable pollution prevention initiatives undertaken at metal finishing facilities, it is seldom a straightforward task to find out what originally motivated the facility towards pollution prevention. For example, in our Massachusetts and Rhode Island site visits, only one facility (Allied Manufacturing) appeared to have initiated source reduction based on expected cost efficiencies, rather than to address some outstanding regulatory requirement (e.g., firm out of compliance, POTW setting new limits, implementing pollution planning requirement, etc.). The closed-loop coolant/metal recovery system that was installed was estimated to have a three year payback; however, the numbers were not arrived at by a rigorous analysis, more by way of a "back of the envelope" calculation, done principally to justify the capital expenditure (i.e., they had basically already decide to do something). According to the firm's engineer, they installed the recovery system more as a good business practice, because it made more sense to recycle the coolant than to keep paying for fresh coolant. Their product also improved in quality (less scratches from metal-laden coolant that had to be reworked).

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[7] California DHS, Waste Audit Study: Metal Finishing Industry, May 1988, p.14.

We found that most companies seemed less likely to implement pollution prevention than to maintain the status quo, even when they saw potential economic benefit. Electroplaters tend to focus on compliance with wastewater treatment standards, rather than recovery technologies, even though recovery can offer a relatively short payback, economic savings, and reduced liability.[8] We were always hearing the phrase "We can meet our limits." Platers are not very interested in rocking the boat, so to speak. If they are meeting their limits via conventional pretreatment technologies, they will not risk potential noncompliance (or, worse, being pulled into regulatory limbo of potential RCRA TSD permitting).[9]

The California silver plater cited in the PPIC case studies (Appendix C) is another example of a firm that decided not to adopt pollution prevention measures, even though the economic cost/benefit data were highly favorable--*and* the facility was being pushed by its POTW to seek source reduction solutions.[10] The company's rinse-wastewater treatment plant had been frequently violating the discharge standard for silver, and the local POTW demanded a compliance plan within 30 days. The plan had to follow the preferred waste management hierarchy and explore the facility's opportunities for source reduction as a mean of achieving compliance. While incorporating opportunity assessments into compliance plans is a worthwhile activity on the part of the POTW, the 30 day time limit was a bit unrealistic for a facility that had never previously thought about source reduction. They initially adopted some in-line pollution prevention measures (e.g., more efficient air knives, electrolytic recovery cells, flow restricters on all rinses), resulting in a $470K/year savings in material and water for a mere $12K capital investment.

For the first six months, the effluent was in compliance with silver limits; however, violations gradually began to occur, returning to their previous high levels. Investigations showed that significant changes in production and inadequate maintenance of the system had eliminated the initial pollution prevention improvements. Although the problems could have been resolved with improved maintenance procedures, management decide to focus on

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[8] NJ DEP, Design of Programs To Encourage Hazardous Waste Reduction: An Incentives Analysis, Oct. 1988, p. III-38.

[9] Recovery technologies, unless they are closed-looped and hard-piped, can make a facility subject to RCRA TSD permitting.

[10] Additional detail provided here is from Rosenblum and Naser, "Heavy Metals Waste Minimization: Practice and Pitfalls," in Plating and Surface Finishing, April 1991.

installing a new, but conventional, 250 gal./min. wastewater treatment plant at an estimated cost of $1 million. Management was unhappy that the source reduction measures failed to achieve permanent, "one-shot" compliance (they disliked the need for fine-tuning and the potential of being at-risk); they also believed that building a conventional treatment system would return them to compliance faster.

3.4.2 Lack of Capital is Barrier for Many Platers

A company's efforts to prevent pollution may be stymied by a lack of capital. Unavailability of capital can prevent implementation of some pollution prevention projects with good payback potential; electroplaters and metalfinishers may have more trouble getting capital than many other industrial sectors do because of tight cashflow, low equity value of current plant, environmental issues, etc. Because metalfinishing facilities typically have limited capital resources, they often must depend on grants or bank loans to fund pollution prevention projects. For example, the before-tax profits for the metalfinishing industry in California range from 2% to 15%, averaging 5.4% overall and the return on equity ranges from 12% to 25%, averaging 19.0%.[11] Pollution prevention investments would need to produce returns exceeding this latter percentage in order to be seriously considered by the industry.

In the California study, financial assistance was identified as a significant factor influencing pollution prevention initiatives by California metal finishers. This concern over lack of funds is echoed by a metal finisher we visited in Massachusetts (New England Plating). The company blames its limited profits on the expense of building and operating an end-of-pipe treatment system needed to satisfy NPDES permit discharge requirements (New England Plating has operated a conventional metals precipitation system since the beginning of the NPDES program.) New England Plating views pollution prevention with some bitterness because of the required further capital investment needed. Lacking the necessary capital for these changes, company management points out that bank loans are unobtainable for facilities like theirs. Generally, small metal finishing operations will not demonstrate the profitability and stability necessary for bank loans.

3.4.3 Total Cost Accounting Not An Effective Tool For Smaller Firms

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[11] Thomas Barron, Evaluation of DHS Waste Audit Study Program, Cal. DHS, May 1991.

Total cost accounting (TCA)[12] is not usually an effective tool for promoting pollution prevention to small electroplaters. Requiring or even suggesting detailed TCA before implementing pollution prevention may act as a disincentive--many firms are reluctant to go to the trouble of such accounting if not otherwise required. In particular, detailing potential liabilities may pose SEC problems for publically-held companies unless they put cash in escrow to cover those liabilities once they are calculated.

A study completed for the California Department of Health Services reports that, of the industries surveyed, good payback and affordability are two dominant factors affecting industry response to waste minimization projects. This study found thatthe larger firms were further along with projects involving significant equipment purchases, while the smaller firms were found more likely to seek out and implement inexpensive and cost-effective changes first. This is noteworthy because most of the metalfinishing facilities in California are small (i.e., less than 20 employees). More complicated pollution prevention initiatives require detailed technical evaluation to arrive at reliable cost-benefit evaluations. In this regard, a consultant to metal finishers in the northeast (Peter Gallerani) noted that, in his experience, a company's orientation towards pollution prevention depends on whether or not it involves itself in long-range planning. Those companies that view their operations in the short-term are wary of changes, and prefer the security of proven profits under existing conditions.

3.4.4 Fees as Motivators for Pollution Prevention

Many pretreatment programs recuperate a portion of their expenses through fees from industrial users based on wastewater flows and strength. The potential use of fees as an economic incentive for pollution prevention is noteworthy because under the traditional regulatory enforcement of <u>limits</u> there is no mechanism to encourage facilities to continue abating pollution beyond the standard. Without such an incentive, industries discharging cleaner wastes might even be motivated to scale back on treatment costs.

POTWs may apply fees for mass loadings above a baseline which would provide a strong incentive to reduce loadings. Sliding-scale fees can provide effective incentives to change behavior. A

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[12] Several total cost accounting (TCA) approaches have been developed to facilitate analysis of pollution prevention investments: EPA's <u>Pollution Prevention Benefits Manual</u>, GE's <u>Financial Analysis of Waste Management Alternatives</u>, and <u>PRECOSIS</u>, developed by George Beetle Company.

continual scale will not necessarily make a continuum of impact, however; it is useful to identify thresholds which cause action. The Cranston, R.I., POTW that we visited, for example, uses a industrial user fee system proportional to the flow-based sewer use fee plus a surcharge which is related to the highest concentration (over the billing year) of metals, cyanide and TTO. While this does discourage high releases of certain pollutants, it doesn't force a pollution prevention response, per se. Companies could simply improve the operation of their end-of-pipe pretreatment systems to get their numbers (and fees) down.

Linking industry fees to the amount of pollution generated addresses the failure of our market system to internalize the costs of environmental pollution. Some argue that because POTWs in this country have been constructed largely with federal funds, their treatment of industrial wastes amounts to a public subsidy of industrial activity. Most importantly perhaps, economic mechanisms such as fees, tax incentives, etc., mark a break with the more confrontational nature of our current standards-based system. By internalizing the cost of environmental protection for industries, regulatory agencies can establish environmental protection more clearly as a mutual goal for industries and government alike. Making reduced sewer fees a function of improved production efficiency and wastewater quality introduces a positive profit incentive (i.e. carrot v. stick approach).

3.5 Zero-Discharge Systems Can Promote Pollution Prevention But There Are Regulatory and Technical/Informational Barriers

Pollution prevention and control systems which allow the reuse of almost all water by electroplaters and metal finishers have been promoted as one way for them to avoid the uncertainty of changing limits. Under appropriate conditions such systems can save companies a lot of money and eliminate their burden on waterways or treatment plants. However, the systems' regulatory status remains in question, and they are not to be considered pure source reduction; at the current level of market and technology development they are not appropriate for every facility.

"Zero" discharge systems are so called because they eliminate wastewater discharges from electroplating facilities. Through a variety of approaches including rinsing modifications, drag-out recovery and wastewater treatment they allow a plating shop to reuse almost all water from the process. They have been widely promoted by pretreatment coordinators and pollution prevention programs, and their installation nationwide has grown remarkably over the last decade.

Wastewater treatment steps in these systems usually include ion exchange (IX) or reverse osmosis (RO) or ultrafiltration (UF), possibly electrolytic recovery (ER) or electrodialysis, and sometimes chemical treatment and precipitation. Metals, salts, and other contaminants removed through the treatment steps are usually concentrated by evaporation and shipped off site either for metal recovery or disposal as hazardous waste. Filters and carbon adsorption units used for rinse water purification are also shipped off site. Thus although the systems allow a plating shop to run without water releases, there are definitely still solid waste and air releases; some industry representatives have suggested the phrase "zero wet discharge" as a clarification.

Pretreatment program managers and other water regulatory authorities often like the concept of systems which will eliminate toxic discharges from their influent. And for platers the idea of being immune to changes in categorical standards or local limits has similar appeal. Many of the pollution prevention programs we've contacted promote them, including programs in California, Connecticut, Florida, Illinois, North Carolina, Massachusetts, and Rhode Island. The Atlantic States Legal Fund, an environmental group based in Syracuse, NY, has promoted closed-loop systems as part of prevention-biased enforcement settlements in Fort Wayne, Indiana.

3.5.1 Zero-Discharge and Pollution Prevention

In order to successfully implement a closed-loop system a plating shop usually must reduce water use throughout the plant. Ion exchange, reverse osmosis and ultrafiltration share the distinction of becoming much more expensive to implement as the volume of water to be treated increases. Thus the capital cost to change over from no controls or hydroxide precipitation to one of these separation technologies will drive efforts to modify rinses and cut water flows. Once such a system is installed, operating costs may be markedly less than costs for end-of-pipe pretreatment systems, and product quality usually improves from better water quality control.

For example, in the case of the Robbins Company of Attleboro, MA, managers estimated that an upgraded precipitation-based treatment plant with discharge would cost about $500,000 in capital and $120,000 a year to run. (The upgrade would be required to ensure compliance and meet tighter limits.) The closed-loop system they elected to install instead cost $220,000 in capital and costs about $30,000 a year to run; they save $71,000 per year in operating costs even from what they used to spend on the old under-sized system, and the cost for a necessary change has been directly paid back in less than three years. (See also the Fernando case study in Appendix A and the Pratt & Whitney case study in Appendix B.)

From the POTW's perspective, not only are even trace amounts of plated metals eliminated from the plant's influent but also the possibly of interference or pass-through due to an upset from such a shop is eliminated. Some authorities have required that drains or sewer connections be cemented over to guarantee this advantage. Instead of costly periodic monitoring for metals the authority makes an annual site visit to assure continued compliance with a "zero discharge permit"--a permit to operate in the authority's jurisdiction without discharge, except for domestic water uses.

3.5.2 Regulatory Barriers to Zero-Discharge

3.5.2.1 RCRA Applicability

In response to the installation of substandard systems in Rhode Island, the Rhode Island Department of Environmental Management (RI DEM) raised questions of the legality of zero discharge systems with the USEPA Office of Solid Waste. If, for example, a plating shop no longer has a wastewater discharge, then the water treatment steps which allow reuse of the water in the shop may no longer fit the RCRA exemption for hard-piped processes of wastewater treatment systems. This is the tack RI DEM has taken, requiring RCRA Part B permits for such systems unless they also have no air discharge.

3.5.2.2 Facility Out of Regulatory Loop

Some officials have expressed discomfort with the idea that no permit would be needed for such a system and that they would have little oversight authority. Some POTWs make annual inspections of plants certifying that they have no process discharge. In the San Francisco Bay area the East Bay Municipal Utilities District requires facility planning to reduce hazardous materials use -- unless the metal finisher converts to a zero discharge system, in which case the requirement no longer applies. Air emissions are usually "nonmajor" (see next section), and solid wastes may go to exempted refiners and recyclers rather than to RCRA TSDFs, so that state authorities may become uncomfortable with their ostensible lack of control of a potentially risky process.

3.5.2.3 Possible Cross-Media Impacts--Air

As mentioned above, the atmospheric evaporators often used in zero wet discharge systems may be misapplied. With the argument that the only air release is steam, the air discharge from the system may be uncontrolled, without even a mist eliminator. The air streams are rarely tested to verify that no metals (or chlorides, or ammonia) are carried over. In the Robbins case, air emissions tests have detected no organics--the release is "essentially water vapor." On the other hand, RI DEM officials have seen jury-rigged evaporators from which only ash remains after extended "evaporation". Most of these sources get relatively little attention from air programs--platers and metal-finishers often fall into a second tier of nonmajor sources (less than 100 tons total air emissions) that states routinely inspect about every three years (if that often).

3.5.2.4 Zero Air And Water Discharge

Closed systems, without air releases, do exist for concentrating metals or solids and removing water. One approach is to capture the air stream from the atmospheric evaporator and recondense the water. A second process, alternatively called "vacuum distillation" or "freeze vaporization", distills water from concentrates under a vacuum at temperatures much lower than those required for atmospheric evaporation. In addition to capturing the steam for reuse as distilled water, these units are much less susceptible to corrosion because they run at lower temperatures, and may in some cases (with sufficient segregation) return a concentrate that could be further purified for reuse in the shop. Running at lower temperatures retards the breakdown of organic brighteners into undesirable byproducts. Southern California Edison published a description of a vacuum heat pump evaporator in their 2nd Quarter 1990 Research Newsletter, in a feature on "Reducing Hazardous Wastes with Electrotechnologies."

These systems have two major drawbacks: (1) high capital cost, and (2) a reputation for maintenance problems. Special corrosion-resistant alloys used in the heat exchangers and the controls necessary for operating in the proper ranges add to the initial cost. These systems were first used in metal finishing only about ten years ago, and most shop personnel still are not familiar with them; the early units were notorious for maintenance problems, especially with the vacuum pumps. Some vendors have improved both the durability and the ease of maintenance, but the reputation remains, and in comparison to the cost and ease of atmospheric evaporation presents a major hurdle.

3.5.3 Technical/Informational Barriers Associated with Zero Discharge

Despite the compelling attraction of such systems, many facilities have rejected zero discharge. The primary reason is probably technical applicability: for some shops with a diverse range of metals, the metal soup produced by combining rinse waters can be difficult to treat to a level acceptable for rinsing, especially if contaminants will be concentrated over time and dragged in from one tank to the next, impairing solution quality.

Large vacuum distillation systems are especially costly, as are large-scale IX, RO, or UF systems, running into hundreds of thousands of dollars. Unless they reduce water use, platers will find hydroxide precipitation systems cheaper to install, even though they will run into large sludge disposal costs over time. It may be easier to cover operating costs than to come up with capital, as in the case of New England Plating (see Appendix A).

In addition to the applicability question, there are technical difficulties in fine-tuning a system that manages only one or two metals, plus a technical learning curve for maintenance. Upsets are intolerable because they will shut down the whole plating operation to which the treatment system supplies water; if the system is not shut down the impure water may cause very costly parts damage, solution damage or delays. Word of the substandard systems which ruined solutions traveled fast, so that there is resistance in some quarters to the whole idea.

While resistance by a company to the whole idea of water reuse may look like an information barrier from outside a company, the same resistance may manifest within a company as a management barrier. Even if company management see the value of converting to a zero wet discharge system, operators (and managers) on the plating lines may resist changes, particularly ones so radical. In the Robbins case, for instance, the environmental manager accomplished some water use reduction early in his tenure by going around cranking down valves at night, a little at a time.

Even without organized resistance, there may be formidable buy-in and training opportunities to reduce operator-controllable waste. Operators must also cooperate in preventing contamination of the system (for example, oil slugs or chelating cleaner slugs to an ion exchange system can be fatal to the resins). Again in the Robbins case, the manufacturing manager won platers' support by explaining the financial reality -- the modifications would work or the plating would be sub-contracted, with their jobs in the balance. Once on board, the platers have made the critical difference in making the system work.

3.5.4 Problems With Vendors

Some unscrupulous or unqualified vendors have capitalized on platers' motivation to explore zero discharge by installing substandard systems. Two likely scenarios result: (1) the water discharged from the system for reuse in the shop becomes so contaminated that product quality suffers, sometimes even to the point that baths must be discarded at great expense (and great RCRA waste volume), or (2) the air releases from "overcooking" the concentrates, sludges and solids pose an unacceptable (or at best uncontrolled) threat to human health and the environment. This seems to have been a particular problem for one hub of national electroplating activity, the Providence, R.I., area--however, the problem may be more widespread than has been detected by most regulatory agencies.

Implementing the treatment technologies may distract from rinsing process modifications. From the plater's point of view (as opposed to the POTW's), this is recycling, not source reduction, although some source reduction may be done to cut costs. Running the treatment technologies similarly diverts expertise and capital from doing a better job running the rest of the shop, modifying rinses, identifying new markets, upgrading lines, or improving product quality. Platers would rather be platers than waste treaters or metal recoverers. Once the system is in place people may have a disincentive for further reduction.

One source of unqualified vendors may be people who have some expertise in wastewater treatment but little or none in air pollution control. In attempting to capitalize on the zero discharge trend, these individuals may ignore possible cross-media transfers. Regulators have expressed concern that cross-media concerns are often ignored by both vendors and facilities seeking to install such systems.

3.6 Flexibility in the Regulatory Network, Supportive Technical Assistance and Outreach; and Collaborative Relationships Overall May Be Best Way To Foster Long-Term Pollution Prevention

3.6.1 Need For Open Dialogue

There must be room in the regulatory network for open dialogue on pollution prevention. For example, a POTW must safely be able (even encouraged) to discuss questions of permitting or enforcement with their state or Regional office regulators. Collaborative relationships among individuals within the various regulatory agencies should work to promote the free exchange of information.

There is a complex of stakeholders involved in effluent guidelines and pretreatment. Among these stakeholders some relationships may currently be characterized by mistrust or fear--for example, between some pretreatment program managers and some company officials, or between some POTW officials and some state or federal officials. One problem this gives rise to is an unwillingness to innovate and a lack of support of innovation, along with crossed communications and ineffective initiatives. Innovation and effective communication are at the heart of pollution prevention.

Several management tools in use today may be brought to bear on this opportunity. The Total Quality Management (TQM) approach in vogue throughout industry and EPA includes a process known as Hoshin planning. One concept from Hoshin planning is critical here; translated from Japanese as "catch-ball," as distinct from "hardball," it refers to an openness among players at different levels of hierarchies or in different hierarchies. Within a process there is room for open communication among players, especially during deployment of objectives and development of plans, but also during regular progress reviews of execution of these plans. This aspect of relationship seemed to be missing with several of the people we interviewed, especially between some pretreatment programs and Regional Office personnel.

Although the EPA headquarters Office of Water may now consider POTWs to be "customers," the EPA Regional Offices often treat POTWs as regulated entities in adversarial relationships, marked by detailed inspections using strict measures of adequacy and little room for negotiation. These relationships impede technical transfer and discourage innovation. Management support is necessary for pollution prevention. This is true of industrial management and of governmental management, from CEOs to small business owners to foremen, and from Administrators, AAs, RAs, and Commissioners to POTW directors to program coordinators.

The training and attitude of pretreatment coordinators critically influences whether or not regulated entities will use pollution prevention as a compliance tool. Pretreatment program inspectors can fill a crucial gap in providing technical information or promoting technical assistance programs, if they find a way to do so without compromising their enforcement relationship. Several programs have done so. However, when inspectors don't dare ask "higher levels of authority" for information or support, they don't get adequately trained and they don't share the valuable information they learn in the field with people who could use it. Similarly, when POTWs don't feel safe talking with States or Regional Offices about their programs, they may end up reinventing the wheel or using policies that don't best implement the guidelines.

Possible approaches or solutions might include the following: inter-agency personnel agreements (IPAs), rotations, peer matches or loans, to allow people to see in exactly what context their counterparts operate; training activities--from brown bag lunches to off-site facilitated sessions; high-level statements of support for collaboration (for example, a vision of POTWs as "customers"); and modifying recognition/reward and accountability structures to allow people to count different beans; and modifying conditions for base grants to states. This process of opening communication channels seems to have already begun, but there may be several things the Agency can do to hasten the process.

3.6.2 Technical/Informational Channels Are Important

External (non-EPA) technical and information channels fulfill a vital role in providing technical assistance to platers and to regulatory personnel; outreach has had varied success in different areas to date, but there is a need for better diffusion. The electroplating industry is a relatively heterogeneous industry; however, source reduction, recycling, recovery and reuse technologies are largely available on the market (a few technologies are still emerging). Therefore, basic technology development is not as important as technology diffusion. There is clearly a role for vendors and trade/industry associations to educate platers and metalfinishers about the range of technical options that are currently available.

Outreach programs by government agencies, trade and professional associations have been effective in some cases in meeting the technical and informational needs of industrial users; diffusion may still be inadequate. That is, there is plenty of good information out there for the fundamentals of plating & metal finishing pollution prevention, but (a) there is probably much more good information that is not finding its way into the trade literature, (b) there are more sophisticated questions that have not been answered, and (c) some people still haven't heard the basic message in a way they understood and thus were willing to act.

Regulatory agencies at the local, state, and federal level need more technical support to understand the myriad pollution prevention options open to manufacturers at the process level. Although it is not necessary (or perhaps possible) for every permit writer or inspector to understand every process in every industry, it is important that they have access to reliable information so that they become comfortable allowing process innovations as well as end-of-pipe controls.

3.6.3 Collaborative Relationships

Experience in the San Francisco Bay and elsewhere has shown that industrial pretreatment programs are particularly well suited to promote pollution prevention to their service area industries. They provide the single closest working relationship between industries and an environmental regulatory authority. POTWs have institutional frameworks in place to promote pollution prevention. Many POTWs are increasingly using their permitting, inspection, and engineering systems to diffuse source reduction and other pollution prevention options to, not only industrial dischargers but also commercial establishments (e.g., Palo Alto POTW targeting silver reduction at photofinishing establishments).

Through the pretreatment program's permitting, and on-going inspection and sampling activities, pretreatment staff can become familiar with an industry's production process. They are then in an ideal position to promote pollution prevention through information outreach (e.g., by the inspection staff), technology transfer and diffusion (e.g., by the engineering staff), and systems design guidance (by both permitting and engineering staff). Because of the recurring presence of pretreatment staff at industrial facilities and their environmental concerns, incorporation of pollution prevention tasks into pretreatment activities is evident. Furthermore, the focus of pollution prevention provides a level of complexity and interest to the inspector's job which could be lost under the more superficial routine tasks required under the General Pretreatment Regulations.

At a recent EPA conference on pollution prevention, Dr. Philip Lo (of the Sanitation Districts of Los Angeles County, California) summarized the advantageous position POTWs are in relative to pollution prevention technology and information diffusion: "The POTW framework appears to have considerable advantages over other frameworks for promoting pollution prevention...POTW inspectors seem to command more of a presence at industrial facilities than inspectors from other agencies. POTW engineers are usually much more familiar with the industrial processes in a facility, given the experience of over a decade regulating the facility under the Clean Water Act. POTWs have traditionally asked for detailed piping plans and process flow diagrams for permit applications, and these plans can form the basic materials for identifying pollution prevention opportunities...a POTW is (therefore) in a unique position to promote and effectuate pollution prevention, both helping itself and benefiting the overall environment."[13]

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[13] Philip Lo, "Pollution Prevention: A Winning Proposition For A POTW," paper presented at the International Conference on Pollution Prevention: Clean Technologies and Clean Products, Washington, DC, June 10-13, 1990.

4 CASE EXAMPLE OF SUCCESSFUL INTEGRATION OF POLLUTION PREVENTION MOTIVATORS

We present here a fairly detailed case examples of where pollution prevention incentives have worked: a regulatory program example of the San Francisco Regional Water Quality Control Board, California. The goal is to present an integrated picture of how both the array of potential factors and the key motivators have played themselves out in the "real world."

4.1 Background: Regional Water Quality Control Board

An excellent model for requiring the inclusion of pollution prevention initiatives in local POTW pretreatment programs is provided by the experience of the California Regional Water Quality Control Board (RWQCB) - San Francisco Bay Region. The San Francisco Regional Board (hereafter referred to as the Regional Board) is one of nine regional boards which, in conjunction with the State Water Resources Control Board (WRCB), manage California's water resources, and are delegated to administer the Federal water pollution control laws.

The leverage for requiring pollution prevention activities in the Regional Board's water regulatory programs was generated by the violation of certain water quality prohibitions by the three wastewater treatment facilities serving the communities of Palo Alto, Sunnyvale and San Jose/Santa Clara. These POTWs discharge to the environmentally sensitive southern portion of San Francisco Bay.

Authority for the protection of South San Francisco Bay's water quality is provided in the Water Quality Control Plan for the San Francisco Bay Basin (the Basin Plan), which is the Region's program of actions to meet both state and federal requirements to preserve and enhance the region's water resources. The Basin Plan specifically prohibits the discharge of wastewater to South San Francisco Bay, and establishes other provisions for protecting the bay which were not being met by the three wastewater treatment plants.

In 1981, the South Bay Dischargers Authority (SBDA), a joint powers agency involving the communities served by the three wastewater treatment facilities, obtained a deferral to the Basin Plan prohibitions on grounds of excessive associated costs. A number of water quality studies and reclamation projects were required of SBDA in granting the deferral.

Continuing concern over heavy metal concentrations in the discharges from these plants, however, led to the inclusion of waste minimization requirements in their amended NPDES permits in

1988. At that time, the term waste minimization was still widely used, and was defined by the Regional Board as "the reduction in toxic pollutant generation by product substitution, recycling, and other means ...".

4.2 Approach to Implementing NPDES Waste Minimization Provisions

In a phased approach, the Regional Board first required a Metals Source Identification Study from each of the three POTWs to identify significant influent metals sources. This involved a mass balance effort in which total metals loads from regulated (i.e., monitored) industrial sources were compared to the totals measured in the plant influent. Data needs were identified to fill gaps in identifying all metals sources discharging to the plants. The quantification of mass loadings by source identified the potential for further controls under the pretreatment program.

Based on findings in the metals source studies, waste minimization studies further identified reduction target sources, feasible waste minimization technologies and measures, and estimates of the program's costs to the POTWs and targeted sources. All studies found that further reductions of metals entering the sewer system were possible through a combination of expanded pretreatment restrictions and the initiation of waste minimization efforts.

4.3 POTW Data Findings

The mass balance studies evaluated heavy metal contributions from different service area sectors. The studies compared influent loads of heavy metals with the loads measured from each individual sector. Because elevated concentrations from any one sector are dampened in influent measurements, the mass balance calculations often show loads from a specific sector exceeding the total load measured at the influent. Thus, while the mass balance calculations provide good initial estimates of pollutant loads, more accurate determinations result from longer term data collection efforts (i.e., to identify errors in measurement and compensate for extreme values resulting from spills, etc.).

The relative source contribution of the total load for each metal varied for each POTW. The flows generated from each source directly influenced pollutant loadings calculation (i.e., concentration x flow = loading). Results are summarized below:

Industrial Sources:

Palo Alto - significant source of nickel, cyanide, copper, lead and silver

San Jose - copper and lead; significant source of arsenic, cadmium, chromium, nickel and cyanide

Sunnyvale - significant source of lead, cadmium, chromium, copper, nickel and silver

Water Supply Systems:

Palo Alto - significant zinc source (most of the commercial sector); copper and nickel loads were relatively low (approximately 5% of total POTW load).

San Jose - arsenic, cadmium, mercury, zinc, and cyanide; significant copper load.

Sunnyvale - arsenic, cadmium, chromium, mercury and most significantly zinc which is added as a corrosion inhibitor.

Commercial Sources:

Palo Alto - significant source of silver, lead, zinc and to a lesser degree, copper and cyanide (approximately 20% of total POTW load).

San Jose - nickel and silver; significant source of cadmium, copper, lead, mercury, selenium and cyanide.

Sunnyvale - significant source of nickel, silver, cadmium and lead.

Residential Sources:

Palo Alto - significant source of copper[14], lead and zinc; some nickel and silver noted (approximately 5% of total POTW load).

San Jose - selenium; significant source of copper, silver, zinc, and cyanide.

Sunnyvale - significant source of copper, lead, arsenic and silver.

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[14] The copper came largely from the copper sulfate root control agents many households put down drains to kill tree roots that invade pipes and cause plumbing backups; 20% of the copper entering the Palo Alto treatment plant was estimated to come from this source.

As a result of these findings, each of the POTWs targeted different metals and sources for waste minimization initiatives, as summarized below:

POTW	Targeted Metals	Targeted Sources
Palo Alto	Silver	Commercial and industrial photoprocessors, X-Ray labs and other potentially important sources
San Jose/Santa Clara	Lead, Copper, Zinc	Radiator repair, auto parts cleaning shops and other potentially important sources
Sunnyvale	Lead, Copper, Nickel.	Metal Finishers, electroplaters and other potentially important sources

4.4 Regional Board Follow-up

The Regional Board amended its 1988 NPDES waste minimization requirements in May 1990 to reflect the metals study findings. The amended permits require that pilot waste minimization programs:

- Be tailored to address the targeted industrial sector(s)
- Establish best management practices (BMPs) and waste minimization alternatives for the targeted industries
- Include public education
- Coordinate efforts with the county toxics program to provide technical assistance to targeted firms
- Require waste minimization plans in response to industry violations and as a condition of permitting for new permit applicants
- Coordinate program development and share findings

Regional Board staff have worked closely with SBDA representatives to ensure success of the individual programs.

Based on the success of its waste minimization requirements, the Regional Board has developed similar pretreatment and waste minimization requirements under the Mass Emissions Strategy (MES), as called for in the State Water Resources Control Board's Pollutant Policy Document for the San Francisco Bay-Delta. The MES requires the Regional Board to develop limitations on the mass emissions of toxic pollutants to reduce the overall quantity of toxic emissions into the Region's watersheds.

The Regional Board's waste minimization program aims to eliminate the discharge into water of toxic wastes from manufacturing processes, commercial facilities, and the community at large. Waste minimization requirements similar to those established for SBDA would be instituted for POTWs as well as direct industrial dischargers in the San Francisco Bay region. Public outreach and educational programs would also be an important component of the Regional Board's waste minimization program.

4.5 POTW Follow-up

Differences in service area characteristics, legal authorities, administrative priorities and other factors unique to each area are reflected in the approaches adopted by each of the POTWs. Based on their experience and findings in meeting the waste minimization requirements, the SBDA cities have initiated the following significant changes to their pretreatment programs:

Palo Alto:

- Sewer Use Ordinance Revision - waste minimization audits required for permit issuance and following industry discharge violations

- Waste Minimization Study (WMS) Review Process - Industries identified as being "major contributors" of heavy metals are required to submit a WMS report to the POTW The WMS review process involves the active participation of the POTW, the POTW's consultant for the waste minimization program, and the industry. Following WMS acceptance by the POTW, the discharger must conform to the plan of action and schedule. Progress reports and Notices of Completion may also be required.

- Waste Minimization Program Status Report - these reports document program accomplishments and procedures as they develop.

- Silver Reduction Pilot Program - This program couples publicity and education with waste collection services and regulatory coordination (e.g., local Fire Department, County and State Health Departments) to ensure elimination of redundant regulation and the minimization of permit fees. The POTW now has a drop-off facility for silver-bearing photochemicals. Contracts with local waste haulers have been drawn up to facilitate industry compliance.

- Mass Discharge Limit - The POTW has developed a protocol for incorporating both mass loadings and pollutant concentrations into industry compliance determinations. Because pollution prevention initiatives often result in reduced flows, pollutant concentrations may increase as a result, despite net decreases in pollutant loadings to the POTW. This protocol recognizes this and avoids penalizing facilities that have made significant accomplishments.

San Jose:

- Revised its Sewer Use Ordinance - notably, to require waste minimization plans for permit issuance and following industry discharge violations.

- Best Management Practices - Targeted sources and significant industrial users are required to develop pollutant mass balances, best management practices, and institute material inventory controls in their waste minimization plans.

- Zero Discharge Requirements - Automotive and radiator repair shops are not allowed to discharge to the sewer system. The POTW is exploring ways of ensuring optimal management of the prohibited wastes to ensure multi-media environmental protection.

- Enforcement Hearings - To avoid time losses associated with regulatory follow-up to discharge violations, San Jose requires facility managers to appear at enforcement hearings after the first violation. These hearings circumvent a considerable amount of paper work and time loss associated with discharge violations. Agreements on penalties and compliance deadlines are set at the hearing, resulting in much faster resolution of the noncompliance. The hearings furthermore serve as effective forums to communicate the POTW's environmental concerns directly to company management.

Sunnyvale:

- Waste Minimization Audits - Sunnyvale requires waste minimization audits for permit issuance and following industry discharge violations. The Sewer Use Ordinance was found to provide adequate authority for this. Three of Sunnyvale's 68 industrial users have completed audits to date; it is expected that the remainder will be completed within three years time. The waste minimization audits are conducted either by industry personnel or by outside consultants.

- Detailed Facility Inspections - these include a detailed review of industrial processes and material storage and handling procedures aimed at promoting pollution prevention.

4.6 Relevance to Incentives Study

The Regional Board's experience provides a successful example of state imposition of pollution prevention requirements through local pretreatment programs. The difference in implementation of the three SBDA pretreatment programs demonstrates the latitude provided in the Regional Board's approach. Differences in service area characteristics, legal authorities, administrative priorities and other factors unique to each area are effectively accommodated.
Important components of the Regional Board's pretreatment program regulatory approach can be summarized as follows:

- **Establishment of a close working relationship with the local pretreatment authorities** - this has facilitated mutual understanding and the development of a logical, iterative approach to developing waste minimization strategies

- **Emphasis on monitoring and inspections** - accurate and frequent sampling, pollutant data tracking and detailed, frequent facility inspections a concerted effort to determine the source and fate of the toxic pollutants entering the system.

- **Effective enforcement** - require POTW enforcement response plans; set goal of 100% compliance; potential Regional Board enforcement against industries

- **Stringent effluent limits** - Setting high water quality objectives justifies the initiation of pollution prevention activities

- **Adequate legal authority** - the combined authority of the State administered NPDES requirements and the local Sewer Use Ordinances are adequate to establish pollution prevention requirements under the pretreatment program

Further evidence of the Regional Board's success in administering the pretreatment program is that Sunnyvale was awarded EPA's National Pretreatment Award for 1991 and other Bay Area pretreatment programs have won the award in previous years.

By encouraging information sharing between local pretreatment programs and recognizing program accomplishments, the Regional Board has generated a healthy competitiveness between the local programs. A number of other pretreatment programs in the San Francisco Bay area have now adopted pollution prevention activities on their own initiative (e.g. East Bay Municipal Utilities District, Union Sanitary District, and the Cities of San Francisco, Hayward, Benicia, San Leandro).

REFERENCES

Barron, Thomas S., Evaluation of the DHS Waste Audit Study Program, California Department of Health Services, May 1991.

Brown, Gardner and Ralph Johnson, The Effluent Charge System in the Federal Republic of Germany: An Example of the Economic Incentive Based Approach to Abating Water Pollution, 1983.

California Department of Health Services, Waste Reduction for Metal Finishers: Fact Sheet, Toxic Substances Control Program, 1989.

California Department of Health Services, Hazardous Waste Reduction Checklist and Assessment Manual for the Metal Finishing Industry, Toxic Substances Control Program, May 1989.

California Department of Health Services, Waste Audit Study: Metal Finishing Industry, Toxic Substances Control Program, May 1988.

Chen, Donna and Deborah Hanlon, Los Angeles City's Expanded Industrial Waste Pretreatment Program and Hazardous Waste Management Survey Results, 1991.

Cleary, Edward J., "Managing Water Resources: Lessons for the U.S.," in Urban Innovations Abroad, Feb. 1983.

Commonwealth of Massachusetts, FY 90 Report on the Blackstone Project, Department of Environmental Protection and Department of Environmental Management, July 23, 1990.

Dillon, Patricia S., Pizzolongo, Peter J. and Gerald J. Filbin, Industrial Environmental Management Practices: Decision Processes and Performance Measurement, U.S. EPA/Tufts University Center for Environmental Management, Workshop Proceedings, July 17, 1990.

Fromm, Carl H. and David Butler, Practical Guidelines for Estimating the Profitability of Waste Minimization Measures,

Greiner, Timothy J., Closed-Looped Metal Finishing Processes, Massachusetts Department of Environmental Management, April 1990.

Jones, Lewis S., Chapman, Nancy Jo and John F. Grittin, "A Source Control Program for Waste Minimization at Metal Finishing Facilities," East Bay Municipal Utility District (California), paper presented at the 64th Annual Water

Pollution Control Federation Conference, Oct. 6-10, 1991, Toronto, Canada.

Lo, Philip, "Pollution Prevention: A Winning Proposition for a POTW," Los Angeles County Sanitation Districts, paper presented at International Conference on Pollution Prevention: Clean Technologies and Clean Products, June 10-13, 1990, Washington, DC.

New Jersey Department of Environmental Protection, Design of Programs to Encourage Hazardous Waste Reduction: An Incentives Analysis, Final Report, Oct. 21, 1988.

Rosenblum, John and Mazen J. Naser, "Heavy Metals Waste Minimization: Practice and Pitfalls," Journal of Plating and Metal Finishing, April 1991.

Sherry, Susan, Reducing Industrial Toxic Wastes and Discharges: The Role of POTWs, Local Government Commission, Sacramento, CA, Dec. 1988.

United States Environmental Protection Agency, Report to Congress on the National Pretreatment Program, July 1991.

United States Environmental Protection Agency, "General Pretreatment and NPDES Regulations, Final Rule," Domestic Sewage Study (DSS) Regulations, 55 Federal Register 30082, July 24, 1990.

United States Environmental Protection Agency, Guide to Pollution Prevention: The Fabricated Metal Products Industry, ORD: EPA/625/7-90/006, July 1990.

United States Environmental Protection Agency, Waste Minimization in Metal Parts Cleaning, OSW, Aug. 1989.

United States Environmental Protection Agency, Waste Minimization Audit Report: Case Studies of Minimization of Cyanide from Electroplating Operations, ORD: EPA/600/S2-87/056, Jan. 1988.

United States Environmental Protection Agency, Development Document for Effluent Limitations Guidelines and Standards for the Metal Finishing Point Source Category, EPA 440/1-83/091, June 1983.

United States Environmental Protection Agency, Control and Treatment Technology for the Metal Finishing Industry--In Plant Changes (Summary Report), ORD: EPA/625/8-82/008, Jan. 1982.

United States General Accounting Office, Serious Problems Confront Emerging Municipal Sludge Management Program, GAO/RCED-91-154, July 1991.

United States General Accounting Office, Improved Monitoring and Enforcement Needed for Toxic Pollutants Entering Sewers, GAO/RCED-89-101, April 1989.

Walton, C.W., Hillier, A.C. and G.L. Poppe, "Process Options for Waste Minimization and Metal Recovery for the Metal Finishing Industry," paper presented at International Conference on Pollution Prevention: Clean Technologies and Clean Products, June 10-13, 1990, Washington, DC.

APPENDICES

Appendix A: Site Visits

Below is a matrix of site visits conducted by Kerr & Associates for the Incentives Project in June and July, 1991. Following the matrix are exerpts from our site visit memos to EPA of July 2 and Aug. 22, 1991.

Facility	Location	Type	Comments
Allied Manufacturing	Auburn, MA	Metalwork; mirror finish machining	Medium-size job shop; no plating lines
Fernando Originals	Providence, RI	Jewelry design and manufacture	Medium-size captive shop; precious metal plating
Neles-Jamesbury	Worcester, MA	Valve manufacturer	Large captive shop; tumbling, phosphating and plating lines
New England Plating	Worcester, MA	Zinc plating; some chrome plating	Large job shop; direct discharger
Parker Metals	Worcester, MA	Manufactures nails, screws, shopping carts	Large captive shop; switched to alkaline zinc plating
Seville Dyeing Co.	Woonsocket, RI	Textile manufacturer	No plating; reduced COD loadings
POTW	**Location**	**Size**	**Comments**
Cranston Water Control Facility	Cranston, RI	23 MGD	Fee system for users indexed to toxics loadings
Upper Blackstone Water Pollution Abatement District	Auburn, MA	35 MGD	Multimedia inspections with MA DEP/DEM
Warwick Sewer Authority	Warwick, RI	3.5 MGD	Strict local limits; promotes zero discharge

Allied Manufacturing
Auburn, MA

Allied does mirror-finish machining for several customers. They have installed recovery systems for most of the coolants that they use to machine and grind parts. Some metalworking companies discharge such waste streams, laden with FOG and metals, to POTWs; others ship off substantial quantities as hazardous waste. Allied uses filters and centrifuges to remove metal chips and tramp oils, and then makes up the evaporative or dragout losses with water and coolant concentrate. They have found that by maintaining the coolant, rather than allowing it to become more and more contaminated until it must be discarded, they improve the quality of the machining process and eliminate scratches which would require rework.

The company chose to install the recovery systems to save on waste disposal and fresh coolant costs. They estimated that their investment would pay back in about three years, and they believe that it has--perhaps in even less time because the coolant has lasted much longer than they expected. They did not do a rigorous economic analysis, nor will they; they had sufficient information to make their decision and they have been pleased with the outcome. One possible hypothesis would be that rough estimates to justify capital expenditures are typical not only of small- to mid-sized firms but also of some larger firms.

Fernando Originals
Providence, RI

A subsidiary of Erwin Pearl, Fernando Originals designs and manufactures costume jewelry for department stores and other upscale outlets. They have received an award from the Office of Water for their zero discharge wastewater treatment system. Recently they applied to the Narragansett Bay Commission (their POTW) for a "zero discharge permit" and have not yet had a response. Both new to this company, Michael Weinergast and Abel Santos believed the zero discharge system had been installed to cut water costs and to reduce the impact that changing regulations have on cost.

In answer to our question as to whether, as a jewelry manufacturer, they would be more insulated from recession than the job shops we had seen, they said that they have a much larger profit margin with more value added. In the first place, costume jewelry tends to be somewhat recession-proof. Secondly, they take a product from concept or sample through manufacturing and plating. If costs associated with plating go up they have many more business areas over which to distribute the cost than would a job shop. Plating actually represents less of the cost of the part than does design and tooling.

Neles-Jamesbury
Worcester, MA

Neles-Jamesbury manufactures valves for industrial and commercial use. We examined the tumbling and phosphating lines and spoke with Paul Sonier. The company had been taking advantage of a categorical designation for a defunct air pollution abatement system (a wet rotoclone) which used water to capture airborne metals from a grinding operation to dilute their categorical metal coating waste stream. During a multimedia inspection, the MA Department of Environmental Protection and Upper Blackstone Water Pollution Abatement District (UBWPAD) personnel discovered this practice and deemed it unacceptable. UBWPAD required that they drop the metal and FOG loadings from the isolated metal finishing waste stream, which would otherwise have been in violation of the categorical standard for zinc and the FOG limit. Jamesbury chose to use pollution prevention to come into compliance, with strong encouragement from the state and the POTW and with specific how-to information provided by the Mass. OTA.

The firm had previously used an ion exchange system to polish the metal finishing waste stream before combining it with the rotoclone stream; prior to the inspection they had disconnected the system without notifying the POTW because of difficulty maintaining it. They chose to implement pollution prevention options (counter-current rinsing, dead rinses, reactive rinsing, and flow controls) rather than to reinstall the resin columns. One management adjustment that they made was to raise the job grade of the operator of the metal finishing line and put a skilled, reliable person in that position.

Neles-Jamesbury's internal environmental committee is promoting a closed-loop system for installation next year at a cost of about $60K. They want to avoid the uncertainty of changing regulations and thus changing costs; they don't expect the closed-loop system to pay back on water use, but to generally cost less than other alternatives. They may not install the system now under consideration because they haven't seen it in operation and they're not sure it will meet their needs.

This case illustrates the value of enforcement in triggering pollution prevention activity. Representatives of the firm had already attended workshops describing the particular changes they eventually implemented and had not taken any action. Free on-site consultations had been offered; but they availed themselves of the opportunity only after the inspection. They chose pollution prevention to come into compliance. They implemented changes inexpensively, saved money on chemicals and labor, and no longer maintain an onerous treatment system. Their motives to change production rather than to add treatment seem to have been: a) to avoid the maintenance burden of the ion exchange system; b) to avoid spending capital on a new treatment system; and c) to please the POTW and state officials promoting pollution prevention.

New England Plating
Worcester, MA

New England Plating, a contract shop, plates primarily zinc along with some nickel and chrome. They discharge to a tributary of the Blackstone ("Mill Brook") under an NPDES permit. New England Plating installed a traditional hydroxide sludge precipitation system in the late Sixties/early Seventies when NPDES first addressed electroplaters. They spend about 14% of their annual sales on wastewater treatment, and they blame that expenditure--at least to some extent--for their current precarious financial position. They argue that competitors who elected to discharge to the POTW installed treatment systems much later than they themselves did, and so had the use of those funds for the intervening years.

New England Plating can usually meet their permit limits now, but their permit is up for renewal and they are afraid they will not be able to afford to change the plant to meet tighter limits. Both Bruce Warner and Joe Diaz are aware of pollution prevention opportunities for the shop, but do not plan to act on them. For example, they have considered switching over from cyanide zinc to alkaline zinc plating. In order to avoid blistering (a major quality problem), they would need to run lower current densities than they do now. Since plating would require more time at a lower current density, to keep the same throughput (= income) they would have to build a longer line. The payback in reduced wastewater treatment and in raw material savings should offset the construction and downtime costs in less than a year, but the firm has little cash and would not qualify for a loan.

In addition to cash position, other barriers to change at the facility include the investment in large automatic equipment (now over fifty years old). The firm's many years of experience in traditional preciptiation/sludge management may make them less receptive to technical assistance. Mr. Warner has developed his own expertise in reduction and precipitation systems to the point that he teaches classes for wastewater treatment operators.

Parker Metals
Worcester, MA

Parker Metal Corporation manufactures nails, screws, fasteners, shopping carts, and custom items on a contract basis. We saw the zinc plating line for the shopping carts and the wastewater treatment area. They had been fined by EPA Region I for failure to install a pretreatment system on schedule--they completed their current system under a consent order. They switched from nickel-chrome (requiring cyanide) to alkaline zinc plating of shopping carts a few years ago, to reduce health risks associated with cyanide and to reduce wastewater treatment costs.

Three points stood out: first, Bob Larson, the Engineering V.P., had proposed the alkaline zinc process for some time without success; when a French competitor introduced zinc-plated carts in the U.S., his management finally bought in. Second, based on previous experience with the EPA Regional Office, the Environmental Coordinator (Rod Swenson) was forbidden to call Boston with questions for fear of retribution. Lastly, when the firm made the decision to switch chemistries, it affected not only the plating line but also the wastewater treatment system design. They found it has taken four years to understand the process sufficiently to keep it in control, and they still find variations (within the limits) that they couldn't predict and don't really understand. To control the zinc concentration within the plating tanks they designed their own mechanism for controlling the exposed zinc metal surface area, and to consistently precipitate zinc their consultant and their operator have experimented with several aspects of the treatment system.

In addition to pollution prevention through material substitution, Parker Metals has reduced the volume of water treated and sludge generated by implementing Massachusetts OTA suggestions such as fog rinsing, dragout recovery, rinse flow control by conductivity, reactive rinsing, and reuse of compressor water. They also substituted hydrochloric for sulfuric acid in wastewater treatment. Their motivation has been to reduce the costs associated with running the wastewater treatment plant.

Seville Dyeing Company
Woonsocket, RI

We visited a textile mill in Woonsocket, RI, that has worked closely with its POTW (Woonsocket) to reduce COD loadings and save on both water and energy use using pollution prevention measures. The POTW has been recognized nationally for the excellence of their pretreatment program, and we wanted to pursue the question of what distinguishes pretreatment program managers who are effective at promoting pollution prevention, even though in Woonsocket textile production dominates over plating. Through enforcement actions the Woonsocket POTW has encouraged the Seville Dyeing Company to reduce their COD contribution to the plant--in particular, by limiting the number of black dye runs. If the firm demonstrates that most of the COD loadings come from other sources within the plant, the restrictions will be modified. They are saving $150K/yr in water, sewer, and raw material costs as a result of the changes they developed after encouragement from the POTW.

One of the changes Seville has just begun to pursue is to use heat exchangers instead of live steam to warm the river water in the dyeing kettles. With properly maintained heat exchangers, they will use less fuel for the boilers than they currently do, because a substantial amount of superheated steam escapes from the dye kettles as they are currently operated. In addition to that energy savings, Seville's owner expects to see a marked reduction in re-dyes due to quality problems from rust and other contaminants carried from the boiler to the dye solutions in the steam. The cost reduction opportunity in quality control (as opposed to energy savings) has been their primary motivator in speeding up the modification to all of the other kettles, but they only discovered the opportunity when they saw re-dyes virtually eliminated in the first kettle changed to save energy.

Cranston Water Control Facility
Cranston, RI

The Industrial Pretreatment Program for the City of Cranston, RI is managed by Tutela Engineeing Associates with 100% industrial cost recovery. The secondary wastewater treatment facility, sized for 23 MGD, serves a population of 70,000 and discharges about 12 MGD to the Pawtuxet River. There are 88 significant industrial users (SIUs) and about 250 non-significant industries in the pretreatment program.

The cost recovery program, described to us by Al Tutela, provides incentives to firms to reduce water use and avoid upsets: one fee is proportional to the flow-based sewer use fee collected by the city, with a surcharge for SIUs based on the highest concentration measured during the billing year for each of nine pollutants (Cd, Cr, Cu, Pb, Ni, Ag, Zn, total CN, and TTO). Concentrations below the Sewer Use Ordinance limit (markedly below the discharge permit limit) are counted as zero for billing purposes, providing an economic incentive to reduce or eliminate releases of these materials. The program does not distinguish among loadings reduced through pollution prevention or conventional pretreatment.

Upper Blackstone Water Pollution Abatement District (UBWPAD)
Auburn, MA

The UBWPAD serves the City of Worcester and the Town of Auburn. A 35 MGD plant near the headwaters of the Blackstone River, its flow constitutes about 70% of the 100-year drought dry weather flow. We met with Paul Richard, the UBWPAD Pretreatment Coordinator who participated with the Massachusetts Department of Environmental Protection (DEP) and Office of Technical Assistance (OTA) in multimedia inspections for the Blackstone Project; Tim Deegan, the current UBWPAD Pretreatment Coordinator; and Debra LaVergne, Laboratory Manager.

Massachusetts does not have CWA delegation from EPA; EPA Region I regulates the POTW. The POTW's current NPDES permit does not include discharge limits for metals; however, the proposed one would. UBWPAD uses the EPA categorical limits (40 CFR 413 and 40 CFR 433) as local limits. Apparently the governing board and the communities won't support local limits stricter than the NPDES permit requires--because they are in compliance with their NPDES permit, they don't see a problem. They are concerned that they may need to institute local limits if the new permit comes into effect as proposed, despite vociferous opposition from the business community. A reverse osmosis system their consultant has specified to control metals would cost several million dollars to install and operate.

We discovered that the POTW doesn't perceive itself to have the authority that EPA does. On the basis of a conflict with a categorical source, they had concluded that they could not enforce limits at the end of the treated process (before the waste stream was combined with sanitary wastes and other diluting streams). The firm in question, which occupies several city blocks, owns the sewer pipes in the vicinity of their plant.

The Pretreatment Coordinator asserted that by coordinating with a state multimedia inspection team and a technical assistance program, he became more effective in promoting pollution prevention. One factor of this effectiveness may have been his own increasing familiarity with and promotion of pollution prevention options.

Warwick Sewer Authority
Warwick, RI

The Warwick Sewer Authority in Warwick, RI, treats about 3.5 MGD before discharge to the Pawtuxet River, which has a flow of about 50 MGD. The Cranston and West Warwick authorities also discharge to the Pawtuxet. Their NPDES permit is up for renewal, and the proposed numbers are significantly less than the previous permit: silver - one microgram/liter; lead - three micrograms/liter; and copper - ten micrograms/liter. The numbers were based on a water quality study from the University of Rhode Island. Warwick will do bioassays with Daphnia Pulex and flathead minnows to establish what concentrations would have toxic effects. Three-fourths of the Pawtuxet flow is from treatment plants.

Warwick has had local limits since February of 1986 which are much stricter than the categorical limits. Their ordinance authorizes them to measure as EPA does, after the process stream has been treated but before combination with diluting waters like sanitary wastes. We met with Howard Hadfield, the Warwick Pretreatment Coordinator and President of the Rhode Island Pretreatment Forum. Mr. Hadfield maintains that the stricter local limits make the firms more efficient because they have had to use better management practices to come into compliance--that categorical standards are "way behind the times." Pollution prevention is also the new thrust because some firms use too much water--the sewer use charges will be going up again soon, in part to drive water use reduction. The state Pollution Prevention Council is studying alternatives, and the state technical assistance program is effective in spreading the word. The jewelry industry has not suffered as much as other platers during the economic downturn--they still have money to invest in process changes.

Howard raised the "zero discharge" question that directly affects pollution prevention choices made by platers in Rhode Island: if a manufacturer reduces water and chemical use enough to allow reuse of the water in the process and some evaporation rather than discharge under NPDES or to a POTW, do they then lose the RCRA exemption for water treatment and require a Part B permit? A few RI shops have been shut down over air complaints--it bears further study under what conditions "zero discharge" systems are desirable and how logically as well as statutorily that they should be regulated.

One Warwick plater invested heavily to develop a closed-loop system using ion exchange. The RI DEM Air & Hazardous Materials Division shut them down with a cease & desist order because they did not have a RCRA Part B permit to run the unit. Rather than taking on the legal battle, the plant president chose to spend additional money and resume discharge to the sewer.

In each quarterly newsletter the pretreatment program focuses on a particular company in the community. The program gets calls from other companies wanting to be recognized for their environmental achievements--the distribution to other significant users and to legislators and DEM is seen as valuable press.

Appendix B: Selected PPIC Case Studies

1 Name & Location of Company

Bass Plating Company
Old Windsor Road
Bloomfield, CT

2 Relevance to Incentives Study

Example of small plating firm that chose to implement pollution prevention. Participation in ConnTAP's matching grant program may have helped overcome both informational and financial barriers. Pollution prevention options implemented were low-cost, low-tech, but with high O & M savings and short pay-back period (less than 6 months).

3 Case Study Summary

3.1 Process and Waste Information: The company specializes in zinc, cadmium, nickel-cadmium, and tin plating and passivating. Metal hydroxide sludge is generated from the three plating lines which all contain cadmium. The company conducted a waste minimization assessment at the facility.

Many of the low-cost, good operating practice and waste minimization options identified were implemented. These included increasing drip times, elevating plating bath temperatures, improving drip containment and redesigning plating racks.

3.2 Scale of Operation: The company employs 35 people.

3.3 Stage of Development: The options identified above have been implemented. Other options have been identified which may be implemented in the future.

4 Economics

4.1 Investment Costs: The cost was reported as $12,000.

4.2 Operational & Maintenance Costs: Savings in operating expenses were reported as $96,100 per year.

4.3 Payback Time: Payback period is 5.8 months.

5 Cleaner Production Benefits: 120 tons of metal hydroxide sludge were expected to be generated in 1989, representing a 15% decrease in sludge generation in 1988.

6 Obstacles, Problems, and/or Known Constraints: None reported.

7 Contacts and Citation

7.1 Citation: ConnTAP Matching Challenge Grants - 1988-89, Connecticut Hazardous Waste Management Service, pp. 4-5. "Summary Report, Cadmium Waste Management Program, Bass Plating Company," Bass Plating Company, June 1989.

7.2 Industry/Program Contact and Address: Rocco Mastrobattista, Project Manager, Bass Plating Company, Old Windsor Road, Bloomfield, CT 06002, (203) 243-2557.

8 Clean Technology Category: The technology involves implementation of good operating practice and waste minimization options such as increasing drip times, elevating plating bath temperatures, improving drip containment and redesigning plating racks.

1 Name & Location of Company

Pratt & Whitney Aircraft
North Haven, CT

2 Relevance to Incentives Study

Example of large captive shop associated with major metal parts manufacturer. Ultimate goal is zero discharge, but facility is proceeding in phased implementation steps. New plating lines "already on the drawing boards" were re-examined in light of facility-wide pollution prevention program. Designs were revised to incorporate whole range of plating source reduction and recycling/reuse options.

3 Case Study Summary

3.1 Process and Waste Information: This facility produces major metal-finished rotating parts such as discs, hubs, and shafts. In 1987, they were discharging approximately 1,000,000 GPD of treated wastewater, 400,000 of which was generated by metal-finishing operations. Implementation of a "zero discharge" program involved 6 phases.

In Phase One good operating practices were defined. These include defining minimum water quality standards; using countercurrent rinses to reduce water usage; using continuous process purification versus batch purification to maintain consistent process quality (i.e., dummy plating and carbon and particulate filtration); using on-line process monitors to control solution additions; optimizing process solutions to control dragout; optimizing preplate rinsing to control dragin of contaminants; installing automatic level controls on all heated processes; training operators to understand proper rinsing and work transfer techniques to reduce dragout and dragin; and treating small concentrated batches as opposed to high volume dilute wastestreams.

Phase Two is to implement Phase One.

Phase Three is designed to verify closed-loop technology on a single process. This was conducted on an existing nickel plating process encompassing a Woods nickel strike and four sulfamate nickel plating tanks.

Phase Four incorporates good operating practices and closed-loop technologies in the design of planned and appropriated new plating lines. New plating lines, encompassing (1) nickel and chromium plating, (2) cadmium, chromium, and nickel stripping, and (3) titanium descaling were already on the drawing boards. Initial plans were revised to incorporate countercurrent rinses; ion exchange; atmospheric evaporation; deionized water in all critical rinses and softened water in all noncritical rinses and noncritical evaporation makeup.

Phase Five was to install the plating lines.

Phase Six involved renovating remaining existing processes, including cadmium cyanide plating and chromating.

3.2 Scale of Operation: The facility encompasses 1,000,000 square feet. It was discharging 1,000,000 GPD of treated wastewater, 400,000 GPD of which was generated from metal finishing operations.

3.3 Stage of Development: Phases I - III fully implemented

4 Economics

4.1 Investment Costs: N/A

4.2 Operational & Maintenance Costs: N/A

4.3 Payback Time: Anticipated payback time is less than two years.

5 Cleaner Production Benefits: The metal finishing contribution to the total wastestream volume has been reduced from 40% to 5%. Raw material costs have been reduced by approximately 90%. Transportation and disposal costs and associated liabilities have also been reduced by the same order of magnitude due to the decreased sludge production and decreased shipments of concentrated solution wastes to a treatment facility. Product quality has also improved and operator acceptance has been very good despite initial skepticism.

6 Obstacles, Problems, and/or Known Constraints: None mentioned

7 Contacts and Citation

7.1 Citation: American Electroplaters and Surface Finishers Society, Inc., and the Environmental Protection Agency; "12th AESF/EPA Conference on Environmental Control for the Surface Finishing Industry; January, 1991; pp. 75-89.

1 Name & Location of Company

precious metal (Ag) plating
California

2 Relevance to Incentives Study

Two examples from a plating company which, despite waste minimization audits and on-site technical assistance, decided *not* to adopt recommended pollution prevention measures. One was a fairly low cost option (drag-out minimization) that was implemented for a while, then abandoned when violations in silver limits returned to original (pre-process modification) levels. The other involved a capital outlay of $500K for the proposed in-line reverse osmosis (RO) system that would have resulted in an annual savings to the company of some $825K in maintenance costs (for the current reclamation system), however the company chose not to pursue it. Instead they devoted over $1 million to upgrade their conventional wastewater treatment plant.

3 Case Study Summary

3.1 Process and Waste Information: In the <u>first example</u>, the plant's wastewater treatment was frequently violating the discharge standard for silver. The major sources of the silver were rinses following silver-cyanide plating in the reel-to-reel lines. The plant evaluated whether or not to modify the treatment system or introduce waste minimization in the production line. A strategy to reduce silver drag-out was initiated, including: efficient air-knives installed at the rinse tanks, more efficient electrolytic recovery cells installed on the dead rinses following the silver plating baths, and flow restrictors installed on all rinses.

In the <u>second example</u>, to replace off-site silver reclamation, on-site silver reclamation was proposed to reclaim silver from the silver dead rinses. This in-line reuse system consisted of 6 reverse osmosis units. The installation would involve conversion of the dead rinse and DI-Water rinse stations to a two-stage counter flow rinse, conductivity control of DI Water supply, and recirculation pumps for rinsing to reduce the flow rate.

3.2 Scale of Operation: Information not provided.

3.3 Stage of Development: Recommendations not implemented

3.4 Material/Energy Balances and Substitutions <u>(Example 1)</u>:

Material Category	Quantity Before	Quantity After
silver drag-out reduction rinse-wastewater:	240,000 gpd	155,000 gpd
silver concentration in influent:	5 mg/l	0.5 mg/l
silver concentrations in effluent:	N/A	< 0.15 mg/l

4 Economics

4.1 Investment Costs: In the <u>first example</u>, the capital investment for silver drag-out reduction was $12,000.

The capital cost to install the reverse osmosis units in the <u>second example</u> was estimated at $525,000.

4.2 Operational & Maintenance Costs: N/A

4.3 Payback Time: Without expanding the capacity of the plant, the payback period for installing waste minimization in the production line in the <u>first example</u> was projected to be less than one month.

The marginal payback period for the in-line reuse system for the <u>second example</u> (as compared to the existing off-site reclamation) was projected as 5 months.

5 Cleaner Production Benefits: For the <u>first example</u>, the operating savings of silver drag-out reduction versus treatment is $470,000 per year. For the first six months after implementation of the reduction process, all discharge standards were being met.

In the <u>second example</u>, the net savings of the in-line reuse system versus the off-site reclamation were estimated at $825,000. According to laboratory tests, more than 90% recovery is feasible with the reverse osmosis units.

6 Obstacles, Problems, and/or Known Constraints: There were fiscal and organizational limits to implementation of waste minimization for these processes. The silver drag-out reduction program required considerable attention from production Q/A personnel. Despite initial improvements from waste discharge standards, by the end of a year, silver violations had returned to their former level. This was due to significant changes in production and inadequate new treatment plant and the company decided not to continue with the waste minimization efforts.

Due to the large capital cost needed for the in-line reuse system in the second example, the facility also decided not to adopt the in-line silver reclamation system.

7 Contacts and Citation

7.1 Source: American Electroplaters and Surface Finishers Society, Inc., and the Environmental Protection Agency; "12th AESF/EPA Conference on Environmental Control for the Surface Finishing Industry"; January, 1991; pp. 59-69.

7.2 Industry/Program Contact and Address: John Rosenblum, Rosenblum Environmental Engineering, 3502 Thorn Road, Sebastopol, CA 95472. Mazen J. Naser, Plating and Waste Management Consulting, 96 Lycett Circle, Daly City, CA 94015.

8 Clean Technology Category: The clean technologies evaluated in this case study consisted of the modification of air-knives, electrolytic recovery cells and flow restrictors to reduce silver drag-out and the installation of reverse osmosis units as in-line reuse systems.

1 Name & Location of Company

Seaboard Metal Finishing Co., Inc.
50 Fresh Meadow Road
West Haven, CT 06516

2 Relevance to Incentives Study

An example of a firm which received technical assistance without a compelling regulatory need, and has not acted on the suggestions. Pollution prevention options were low-cost, low-tech, and would have decreased facilities RCRA F006 waste generation by 16 tons/year and would have reduced copper, hex. chrome, cyanide and nickel wastewaters by 75%.

3 Case Study Summary

3.1 **Process and Waste Information: The facility has six process plating lines, including copper, automatic nickel, barrel copper/nickel, bulk chrome, hard chrome and rack nickel/chrome plating. The resulting F006 sludge requires off-site disposal.**

A waste minimization study of the six electroplating lines was conducted. A mass balance was determined by analyzing the discharges for metals and determining an average discharge rate. A waste inventory was peformed and critical sources of waste were identified. Waste minimization alternatives were analyzed for technical feasibility and cost effectiveness. The proposed alternatives included recycling rinsewaters, automating plating lines, installing evaporation technology and additional rinse tanks with reduction of countercurrent flow.

3.2 Scale of Operation: The facility employs 45 plant personnel.

3.3 Stage of Development: The proposed alternatives had not been implemented at the time the case study was written.

4 Economics

4.1 Investment Costs: The cost is estimated at $13,500 for several new rinse tanks and evaporation unit.

4.2 Operational & Maintenance Costs: Annual savings of more than $15,000 are anticipated.

4.3 Payback Time: The payback period is estimated at 1.2 years.

5 Cleaner Production Benefits: If the alternatives were implemented, a reduction of 75% would be achieved for copper, hexavalent chromium, cyanide, and nickel wastewater. About 16 tons of F006 sludge, now requiring off-site disposal, would be eliminated.

6 Obstacles, Problems, and/or Known Constraints: None mentioned.

7 Contacts and Citation

7.1 Citation: ConnTAP Matching Challenge Grants - 1988-89, Connecticut Hazardous Waste Management Service, pp. 8-9. "Waste Minimization Study." YWC, Inc., April 1989.

7.2 Industry/Program Contact and Address: John Conroy, Project Manager, Seaboard Metal Finishing Co., Inc., 50 Fresh Meadow Road, West Haven, CT 06516 (203) 933-1603.

8 Clean Technology Category: A waste minimization study, including performing a mass balance and waste inventory, identified alternatives for future implementation.

1 Name & Location of Company

Stanley Fastening Systems
Route 2
East Greenwich, RI 02818

2 Relevance to Incentives Study

Example of medium-size metalworking firm that eliminated use of TCA by installing aqueous parts washing systems. Motivation to eliminate TCA was both economic and regulatory (plant was exceeding discharge limit).

3 Case Study Summary

3.1 Process and Waste Information: This facility manufactures nails, staples, and the tools to drive these fasteners. The fastening tools are made of aluminum, magnesium and carbon steel. To produce these parts, grinding, milling, drilling, lathe working, heat treatment and metal finishing operations are employed. Prior to many of these operations, parts are cleaned in a cold application using 1,1,1-trichloroethane (TCA). TCA was being discharged in the wastewater at levels twice as high as the allowable limit. Absorbents used around the machine tools also showed levels of TCA that prevented disposal in the regular trash. The company decided to eliminate the use of TCA.

A task force identified reasons for excessive use of TCA: too much availability of cleaners, unnecessary dumping of TCA, lack of operator awareness, and unnessary parts cleaning.Initially, the firm reduced the number of cleaning stations from 37 to 27. Costs associated with dumping of cleaners were make the responsibility of each department. Operators were surveyed to identify TCA use and determine alternatives.

The selected pollution prevention measure was to installed 13 aqueous washing systems and 2 mineral spirits cleaning systems. They expect to have a total of 15 aqueous systems, which are centralized within departments to replace 37 former TCA locations.

3.2 Scale of Operation: Approximately 6500 gallons per year of TCA were originally used. No other measure of the scale of operations was provided.

3.3 Stage of Development: In the implementation stages-all equipment is not yet fully installed

4 Economics

4.1 Investment Costs: The anticipated capital expenditures during 1990-1991 on this project are $80,000. This includes costs for aqueous cleaning systems, waste water collection equipment, and equipment installation.

4.2 Operational & Maintenance Costs: $15,000 in utility costs are required for heating and pumping aqueous fluids.

4.3 Payback Time: With an approximate annual savings of $56,500 and $80,000 in capital costs, the pay back period is approximately 1.4 years.

5 Cleaner Production Benefits: A net savings of $7,000 is expected from reduced disposal costs, since the disposal costs in 1988 were $9,000 and they expect that the cost for disposal of separated oils will be $2,000. In addition, the annual cost saving associated with the disposal of absorbents no longer contaminated with TCA is $34,000.

A net savings from replacing virgin TCA and aqueous cleaners will be $7,000. This was calculated from the difference in the 1988 cost of virgin TCA ($27,000) and the 1991 costs for aqueous cleaning solution ($20,000).Overall, the potential savings from eliminating TCA is approximately $56,500 per year (including the extra utility costs discussed below).

6 Obstacles, Problems, and/or Known Constraints: There is an extra electrical cost associated with heating and pumping aqueous cleaning fluids equal to $15,000 per year. TCA cold cleaning had no utility cost.

7 Contacts and Citation

7.1 Citation: American Electroplaters and Surface Finishers Society, Inc., and the Environmental Protection Agency; "12th AESF/EPA Conference on Environmental Control for the Surface Finishing Industry"; January, 1991; pp. 165-181.

7.2 Industry/Program Contact and Address: Kevin P. Vidmar, Div. Manager, Environmental Affairs, Stanley Fastening Systems, Route 2, East Greenwich, RI 02818.

8 Clean Technology Category: The clean technology involved initially reducing 1,1,1-trichlorethane use and finally eliminating its use by installing aqueous cleaning systems.

Appendix C: Telephone Contacts List

Institution	Location	Contact	Comments
Acteron Metal Finishers	Redwood City, CA	Pat Burt	Chairman, NAMF Waste Minimization Committee. Gave industry perspective and further technical contacts.
Atlantic States Legal Fund	Syracuse, NY	Alan Hayes	Attorney handling CWA citizen suit cases; pollution prevention in enforcement settlement.
Barron Consulting	Lafayette, CA	Tom Barron	Authored "Evaluation of Waste Audit Study Program" for CA DHS Alt. Tech. Div.; evaluated audit program impacts on 6 industries.
California DHS Alternative Technology Division	Sacramento, CA	Kathryn Barwick	Gave DHS perspective of state, regional, and local POTW pollution prevention initiatives.
California DHS Alternative Technology Division	Sacramento, CA	Arvind Shah	Contact person for CA Waste Reduction Act of 1989 (SB-14); discussed CA waste audit guidance documents.
California Local Government Commission	Sacramento, CA	Tony Eulo	Has been involved with pollution prevention in CA for several years; gave local government perspective.
California Regional Water Quality Control Board	Oakland, CA	Teng-chung Wu	Chief, Surface Water Div.; pioneered incorporation of pollution prevention requirements into POTW NPDES permits.
California Regional Water Quality Control Board	Oakland, CA	Dale Hopkins	Pretreatment Coordinator for RWQCB.
EPA, Region 1	Boston, MA	Joe Canzano	Perspective on using pollution prevention requirements in enforcement context

EPA, Region 9	San Francisco, CA	Laurie Kermish	Attorney in Office of Regional Counsel; metal plater enforcement case with pollution prevention planning requirement in Consent Order
Integrated Technogies	Bethany, CT	Peter Gallerani	Former owner of VT metal finishing shop; consultant and promoter of pollution prevention with nation-wide experience.
Mass. DEM Office of Technical Assistance	Boston, MA	Barbara Kelly	Director of OTA; gave non-regulatory technical assistance perspective.
Mass. DEM Office of Technical Assistance	Boston, MA	Tim Greiner	Contact on Blackstone Project; perspective on zero discharge systems in Mass. (permit); gave leads on facilities for site visits.
Narragansett Bay Commission	Providence, RI	Tom Uva	Pretreatment Program Manager; talked about EPA audits of pretreatment programs; also leads on zero dischargers and jewelry platers.
Palo Alto Water Pollution Control Plant	Palo Alto, CA	Phil Bobel	POTW perspective; progressive pollution prevention program targeted to photofinishers; formerly with EPA and CA DHS.
Rhode Island DEM, Water Resources Division	Providence, RI	Gina Friedman	State Pretreatment Coordinator; perspective on delegated states; gave contacts for site visits and follow-up; zero discharge and vendor issues
Rhode Island DEM, Air & Hazardous Waste Division	Providence, RI	Bev Migliori	Regulatory perspective on RI interpretation of possible RCRA violations associated with zero discharge systems

Rosenblum Environmental Engineering	Sebastopol, CA	John Rosenblum	Consultant in pollution prevention with expertise in energy and water conservation; performed many waste audits for SF Bay metal finishers.
Sunnyvale Water Pollution Control Plant	Sunnyvale, CA	Helen Farnham	General Manager of POTW that won 1991 EPA Pretreatment Award; pollution prevention requirements in NPDES permit; POTW targets metal finishers and electroplaters for PP.
Sunnyvale Water Pollution Control Plant	Sunnyvale, CA	Pamela Morrison	Pretreatment Manager; gave details on POTW's sampling and QA/QC protocols; 10 years at Sunnyvale POTW.
Sunnyvale Water Pollution Control Plant	Sunnyvale, CA	Chris DeGroot	Pretreatment Inspector; former process engineer in a printed circuit board plant; gave both technical and regulatory perspective.