City of Winnipeg
Water and Waste Department

Combined Sewer Overflow Management Study

PHASE 3 Technical Memorandum No. 3

PHASE 3 WORKSHOP

July 1998
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Internal Document by:

WARDROP Engineering Inc. and TetrES CONSULTANTS INC.

In Association With:

Gore & Storrie Limited and EMA Services Inc.

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The Study Team acknowledges, with sincere appreciation, the contribution of many individuals and agencies consulted in the course of Phase 3 of the CSO Management Study. The Study Team especially acknowledges the assistance of the City of Winnipeg Project Management Committee and the Advisory Committee.

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In Association with CH2M Gore & Storrie Limited and EMA Services Limited

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The study team extends particular thanks to Mr. P. Moffa and Ms. N. Wheatley, in their role as special external advisors. Mr. Moffa participated in the Phase 3 Workshop. Ms. Wheatley had intended to participate but was forced to change her plans at the last minute. They both provided an important and informed outside perspective to the Winnipeg circumstances. Their advice was valuable both in their critical review of the work done up to the time of the Workshops and their assistance in developing the direction of future activities.

PREAMBLE

This Technical Memorandum (TM) is one of a series of TMs intended for internal discussion. It is not intended as a report representing the policy or direction of the City of Winnipeg.

The other two TMs produced in Phase 3 are:

TM #1	Control Alternatives
TM #2	Public Communication

Each of the Phase 3 TMs draws on information developed in the prior Phase 1 and Phase 2 TMs.

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1. INTRODUCTION

The CSO Management study was structured into four (4) distinct phases to define the general approach and identify specific objectives to be realized at the end of each phase, as shown in Figure 1-1. Each study phase was progressive in that it comprised specific tasks and working sessions designed to shape and focus the products for that phase and to help confirm the direction for subsequent phases. A series of technical memoranda (TMs) were prepared prior to each workshop summarizing the results of that phase. These were distributed to key members of the study team and all City of Winnipeg Project Management members for review and comment.

Milestone workshops are held at the end of each phase. These workshops are a structured forum specifically intended for critical peer review, assessing the validity and soundness of current study phase results. The direction and advice received at these workshops are used to help strengthen the then current results and to provide insight into activities that may be required in the subsequent phases to achieve identified study products.

1.1 PURPOSE

The revised workplan for the CSO Management Study provided for the conducting of a Phase 3 Workshop. The objectives of the Phase 3 workshop were to:

- review fundamental objectives of the CSO study;
- review potential Phase 3 CSO control plans
  - assumptions, requirements, technical issues, practicability, performance, costing, gaps, etc.
  - obtain group input, e.g., critical review, new ideas, additional analyses;
- identify additional/alternative/revised control plans;
- identify outstanding concerns:
  - operations
  - regulatory/public
  - technical

General Approach

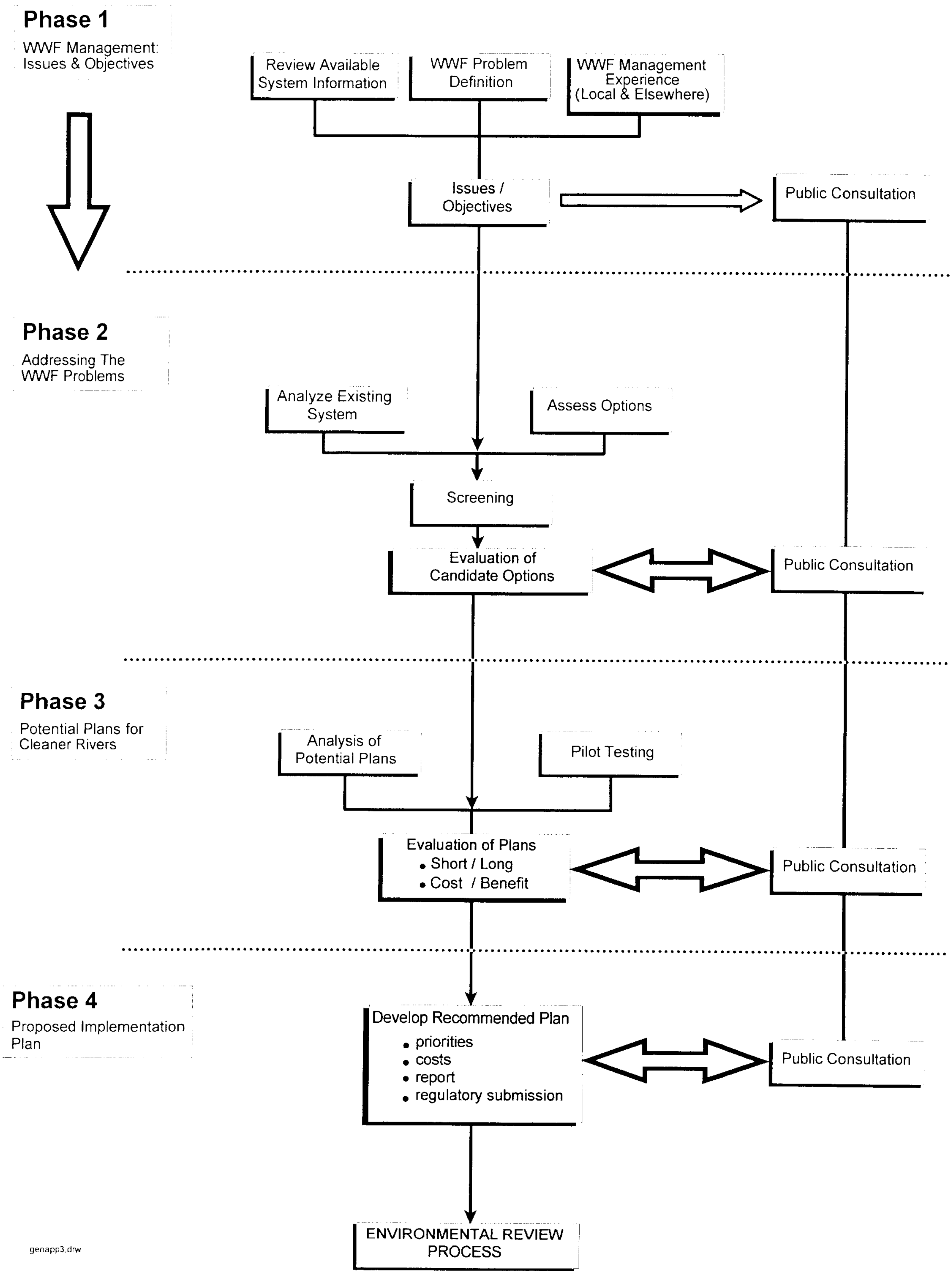

Figure 1-1

- develop follow-up actions.

1.2 WORKSHOP PARTICIPANTS

The participants in the Phase 3 workshop were as follows.

1.2.1 City of Winnipeg, Project Management Committee

- Ed Sharp, P.Eng., Senior Project Manager
- Bill Borlase, P.Eng., Manager of Regional Operations
- Paul Lagasse, P.Eng., Wastewater Engineer
- Mike Shkolny, P.Eng., Acting Manager of Engineering
- Tom Pearson, P.Eng., Manager of Local Water and Sewer
- Al Zaleski B.Sc., Research Chemist
- Terry Josephson, P.Eng., Wastewater Systems Planning Engineer (Env. Studies)

1.2.2 CSO Advisory Committee (observer only)

- Charles Conyette, P.Eng., Special Projects Engineer

1.2.3 Consulting Study Team

- George Rempel, P.Eng., Project Manager (President, TetrES Consultants) and Chair of the Workshop

Wardrop Engineering Inc.

- Bob Gladding, P.Eng., Senior Engineer

- Bill Dowhopoluk, Principal, Civil and Transportation Engineering

TetrES Consultants Inc.

- Nick Szoke, P. Eng., Senior Engineer
- David Morgan, P.Eng., Senior Engineer
- Roger Rempel, P.Eng., Intermediate Engineer

Gore & Storrie

- M. Parente, P.Eng., Senior Project Manager

1.2.4 Technical Specialists

- Peter E. Moffa, P.E., Principal, Moffa and Associates Consulting Engineering, Syracuse, New York
- Charles Rowney, P.Eng., Ph.D., Vice president, Director of Planning/Analyses, CDM
- Donald Weatherbe, P.Eng., President, Donald G. Weatherbe Associates Inc.
- George Zukovs, P.Eng., President, XCG Inc.

1.3 FORMAT OF WORKSHOP AND REPORT

The Phase 3 Workshop was the third in a series of workshops conducted at the end of each study phase. The purpose of this workshop was to provide the study team, the City's project management committee and the technical specialists, with the opportunity to review and discuss progress to-date on all activities and tasks associates with Phase 3 of the CSO study and previous phases if relevant.

The workshop was organized as a one day event and took place on May 7, 1998 at the Winnipeg Canoe Club located at 50 Dunkirk Drive. Mr. G. Rempel, Project Manager for the consulting team, chaired the workshop. The agenda for the one day workshop is included as

Table 1-1. Careful consideration was given to the content and length of time required for the workshop to maximize the effectiveness of the attendees and to achieve identified objectives of the workshop. The workshop was organized so as to promote an open forum for unconstrained discussion on all study related aspects as they arose during the scheduled presentations.

The following sections of this report follow the order of the workshop agenda and include only those discussions (e.g., advice, expert opinion, direction, recommended actions, and so on), which arose as part of the presentations.

The agenda was structured into four key sections:

1. workshop objectives and background information;
2. technical review of CSO control alternatives (including summary of group input and direction received);
3. overview of control plans and potential financial impacts on customers; and
4. a wrap-up of the session.

The main focus of this report is the documentation of group input as it related to the technical assessment of CSO control technologies and their applicability to the Winnipeg situation.

The overheads presented at Workshop No. 3 are appended to this document (Appendix A). Each overhead has been numbered and references in the text refer to those numbers.

TABLE 1-1

AGENDA

MAY 7, 1998
WINNIPEG CSO WORKSHOP
Winnipeg Canoe Club – 50 Dunkirk Drive

8:00 BACKGROUND TO STUDY (E.J. Sharp)
- Clean Environment Commission (CEC) direction
- Concept of performance "targets"
- "Trade-offs" for decision-making
- Study products for City/CEC
- Present status

8:30 INTRODUCTION TO WORKSHOP (G. Rempel)
- Study Objectives
- Objectives of Workshop
- Agenda
- Critical review of potential plans (key questions):
  - Are potential plans technically acceptable, operationally do-able, relatively cost-effective, environmentally and socially reasonable, consistent with good practice?
  - Are we confident that these plans can be implemented if selected?
  - What key questions (technical, operations, environmental, social) remain?
  - Should these questions be addressed and, if so, how?

8:40 POTENTIAL PLANS (G. Rempel/D. Morgan)
- Performance evaluation concepts
- Approach to definition of requirements (storage/treatment modelling)
- Representative year/long term record
- Additional CSO control (plans range from optimizing existing infrastructure to separation)

9:20 IMPLICATIONS OF CSO CONTROL ON EXISTING SYSTEM (R. Gladding)
- Existing system (Main Interceptor)
- Wastewater treatment (NEWPCC)

*Note: A **brief** presentation on each of the main categories of control plans will be made at the start of the following agenda items. The control plans will then be reviewed considering the factors listed below for In-Line Storage. The intent is to subject each main category of control plan to a similar critical review.*

9:50 IN-LINE STORAGE (fixed weirs, gates, dams) (N. Szoke)

- PRESENTATION (20 min)
  - technology
  - system requirements
  - assumptions
  - potential plan(s)
  - technical issues
  - practicability
  - performance evaluation
  - costing
- DISCUSSION
  - *critical review*)
  - *new ideas*) *input from Group*
  - *additional analyses*)

10:50 OFF-LINE DISTRIBUTED STORAGE (near surface basins, local tunnels) (R. Gladding)

- PRESENTATION (15 min)
- DISCUSSION

11:20 HIGH RATE SATELLITE TREATMENT (VSS, RTBs) (D. Morgan)

- PRESENTATION (15 min)
- DISCUSSION

12:00 LUNCH

1:00 REGIONAL TUNNEL (R. Gladding)

- PRESENTATION (15 min)
- DISCUSSION

1:30 SEPARATION (new road drainage sewers) (N. Szoke)

- PRESENTATION (10 min)
- DISCUSSION

1:50 FLOATABLES CONTROL (N. Szoke)

- PRESENTATION (10 min)
- DISCUSSION

2:10 OVERVIEW OF CONTROL PLANS (Performance/Cost) (G. Rempel)

- Number and volume of overflows
- % capture
- Compliance
- Possible evaluation criteria

2:40 OVERVIEW OF FINANCIAL IMPACTS ON CUSTOMERS (E.J. Sharp)

3:00 BREAK-OUT SESSIONS (with coffee)

- Three groups will address the range of potential plans from the standpoint of issues/concerns relating to:
  - Group 1: Operations
  - Group 2: Regulatory/Public
  - Group 3: Technical

4:00 GROUPS REPORT BACK (3 reports;10 min. each and 10 min discussion)

5:00 WRAP-UP (G. Rempel/E.J. Sharp)

5:30 ADJOURN

/smc
1080.AGD

2. BACKGROUND INFORMATION

2.1 TECHNICAL MEMORANDA (TMS)

Prior to the workshop, each attendee was provided with a copy of the following TMs, documenting the work done in Phase 3:

- TM#1 Control Alternatives; and
- TM#2 Public Communications.

This current Phase 3 TM#3 "Phase 3 Workshop" incorporates the overheads presented at the Phase 3 Workshop and summarizes the discussion which took place, and the direction received at the Workshop.

2.2 PHASE 3 OVERVIEW

The workshop opened with a review of the study objectives, the objective of the workshop, and an overview of potential plans.

2.2.1 Study Objectives

E. Sharp presented overheads WS3-4 through WS3-17, by way of background to the overall study, its objectives and the proposed projected timeframe. G. Rempel completed the introduction to the workshop through overheads WS3-18 to WS3-22.

2.2.2 Objective of Workshop

G. Rempel set the stage for the Phase 3 presentations (overheads WS3-23 to WS3-28).

2.2.3 Potential Plans

G. Rempel identified the need for performance measures and the proposed measures for CSO control (overheads WS3-29 and WS3-30). He also discussed the Manitoba policy and the fecal coliform objectives (WS3-31 through WS3-33). Rempel concluded with a review of the EPA CSO policy and recent clarifications thereof (overheads WS3-34 through WS3-36). The latter aspect led to some discussion of the EPA policy as follows:

- Moffa/Zukovs noted that there were different positions taken within the EPA itself, and potential difference between enforcement (the regional representatives) and policy (headquarters). The EPA position is based on eventual compliance with the *Clean Water Act* (CWA) and on state water quality standards.

- Moffa noted that a survey is being undertaken of all states with regard to policy. Some states use a "common sense approach" while others, e.g., Michigan, use a “design” approach. In the Michigan case, this comprises capture of the first 10-minutes of a 1:10 year storm.

- Some states are aggressive, e.g., Atlanta has been fined for not meeting CWA requirements.

- The consensus was that the City of Winnipeg should continue developing a range of plans, which reflect different performances for the local situation and develop a site-specific, reasonable and defensible approach.

- Moffa noted that, in general, the states appear to be gravitating towards “doing something about floatables”, because the public associates this as an indicator of water quality.

- G. Rempel presented the recent clarification of EPA policy with regard to the definition of an overflow event. Zukovs noted that there were still some apparently inconsistent applications of this definition.

(It was noted that Manitoba does not have a CSO control policy or wet-weather water-quality objectives for the Red and Assiniboine rivers).

D. Morgan discussed the nature of the potential options for CSO control and their interrelationship with dewatering rates and the existing City of Winnipeg infrastructure. He gave an overview of the basis for modelling and the components of the regional system model (WS3-37 through WS3-47). Morgan explained the selection of 1992 as the representative year for rainfall (WS3-48) and introduced the discussion of the various options considered in Phase 3.

3. EXISTING SYSTEM CONSIDERATIONS

B. Gladding discussed the dewatering rate implications (WS3-50).

3.1 IMPACTS ON INTERCEPTORS

B. Gladding summarized the possible impacts of the three dewatering rates (i.e., 600, 830 and 1060 ML/d) on the main interceptor. During the course of Phase 3, it was recognized that the historic tunneling costs in Winnipeg were significantly lower unit costs for small diameter tunnels, than those shown on the CG&S curve (WS3-52). Accordingly, a lower cost curve, more indicative of local tunneling cost, was developed and applied to estimate the cost of twinning the main interceptor (WS3-52). During the course of the workshop, the use of these revised tunnel unit rates for the interceptor costing was questioned and it was agreed that these would be reviewed as part of the Phase 3 follow-up.

ACTION: Study Team

E. Sharp noted that we should recognize the need for Infiltration and Inflow (I&I) control in the North East (NE) and North West (NW) sanitary sewage service areas. This might include an allowance for improved I&I control in the existing developments (i.e., costs for sump pumps, backup valves and lot grading). Such an allowance will be made in the costs for NEWPCC upgrades.

ACTION: Study Team

Consideration should be given to the impacts of new growth in the NE and NW sewer service areas, in combination with I&I improvements, on the available dewatering rate for stored combined sewage. If the CSO program uses such reserve plant capacity, it should be accounted for as a CSO control program cost, since it may require plant upgrading sooner than otherwise would be the case.

ACTION: Study Team

Such follow-up activities will be developed in cooperation with the City's Technical Advisory Committee.

3.2 PLANT IMPLICATIONS

The expected maximum time needed to dewater storage for the various control options and the associated dewatering rates is provided on overhead WS3-59. For a target of four overflows and a dewatering rate of 825 ML/d, dewatering time would range between 18 to 24 hours. For a zero overflow scenario (based on runoff from the representative year 1992) and the 825 ML/d dewatering rate, dewatering time would range between 32 to 40 hours.

D. Weatherbe noted that the impact of dewatering the storage in the combined sewer districts would be to extend the period which the secondary process would be bypassed after a wet weather flow event. He questioned whether this might be of concern to the regulators.

G. Zukovs noted that primary clarifier performance may not be impaired to the degree assumed, since, although the periods of peak flows will be substantially increased in duration, they are still intermittent conditions. He believed that the assumptions made in the CG&S study (Appendix No. 4) were very conservative and could be explored further in terms of their influence on plant upgrades. The CG&S report noted that "...preferably the primary clarifier performance is determined by full-scale testing. However, full-scale testing was outside the scope of the current study." G. Zukovs concurred with this statement and recommended that such testing be undertaken before any final decisions are made with respect to treatment plant upgrades associated with wet weather flows. B. Gladding noted that, in any event, the assumptions made for the current cursory examination of NEWPCC impacts resulting from extended WWF would be conservative and hence could be considered suitable for the CSO study. The study team will give further thought to this aspect in Phase 4.

ACTION: Study Team

As noted in Section 4.3 of TM#1, there is a substantial difference between the CSO quality as developed for the EMCs and that used in the evaluation of CSO impacts on the NEWPCC. As noted at the Workshop, the sewage strength as selected for the NEWPCC analysis requires further investigation. The in-line storage pilot tests, or substitutes therefor, might be best suited to provide further guidance in this regard.

ACTION: **City/Study Team**

4. CONTROL ALTERNATIVES

4.1 IN-LINE STORAGE

N. Szoke presented a discussion on in-line storage (overheads WS3-61 to WS3-82b) which focussed on the following:

- local conditions;
- method of estimating available in-line storage;
- operational considerations;
- potential pilot-testing programs;
- estimated costs of in-line storage; and
- importance of future basement flood relief and rehabilitation programs.

In-Line Storage Devices

Three types of devices were discussed at the workshop:

- **Automated Gates.** Automated gates can maximize the volume of available in-line storage but could involve an element of basement flooding risk due to gate failure in the closed position. C. Rowney asked if we knew the level of risk of the gate failure. The response was that we do not have any data to quantify the risks. D. Weatherbe suggested that the City might self-insure against this consequence, in which case the cost would be added into the cost of the control option. With such an approach, the gate option might still be doable.

- **Fabridams (Inflatable Rubber Dams)**. Given the potential cost associated with a fixed finger weir, Fabridams (which had been considered earlier as an option for the Clifton CS In-line storage pilot project) would be cost-competitive and inherently fail-safe (i.e., deflate reliably). G. Zukovs noted that a device which "gets out of the way" may work better than a combination of fixed and mechanical-based controls.

- P. Lagasse noted that the City of Winnipeg felt that selling in-line storage would be very difficult if there was any increase, however small, in the risk of basement flooding. D. Weatherbe countered that the option could be self-insured and be sold on the merit of reduced cost for the overall system.

- **Fixed-finger Weir**. This was discussed as a "fail-safe" option. Depending on the downstream hydraulics, the fixed-finger weir could be designed so that the hydraulic gradient upstream of the weir is only affected immediately upstream, i.e., with a free-fall to the river downstream of the weir. In the event that the weir had to be installed upstream of a free-fall to the river, i.e., built within the trunk hydraulic gradient, preliminary calculations indicated that this would impose an additional 6" increment on the hydraulic gradient. The calculation has been appended (Appendix B).

- **Latent Storage**. Latent storage was discussed separately from the full in-line storage options. One very important factor relevant to the use of latent storage is the watertightness of the flap gates. P. Lagasse noted that if they leak without a storm, or without a flood, they will know right away because they will be continuously pumping river water. If they leak during a flood, they will know after 4 hours for the same reason. If latent storage became the option, it would probably be desirable to alarm the relief sewers being used for this purpose, in order to detect leaking flap gates as early as possible.

- **Summary**. G. Zukovs cautioned against the City rejecting any of the in-line storage options hastily. In his opinion, the risks of the multi-gate failure modes is quite small. D. Weatherbe cautioned against allowing the risk to completely discount the use of automated gate control. He proposed that the City continue with the in-line pilot program and consider all available CSO control technologies for this purpose. The option is worth making a major commitment to evaluate its function and safety.

Pilot Testing

Three of the important concerns which would be addressed through pilot testing are: sediment accumulation, quality changes in the stored combined sewage and resulting odours from the stored CS. In addition, the pilot testing would provide the opportunity to assess the impacts on the rivers resulting from the flushing of the CS by the storms in excess of the storage capacity.

It was noted that inlet restriction would be installed before or concurrently with in-line storage. This would have the added benefit of improving basement flood protection beyond the 1:5 year design event. E. Sharp noted that earlier versions of the inlet control devices were difficult to maintain. Experience with new improved devices will be followed-up.

ACTION: City/Study Team

Rehabilitation/Structural Condition

B. Dowhopoluk noted that an important, and costly, aspect of sewer rehabilitation is the cleaning, lighting and inspection required to determine the conditions of the pipes prior to commencing rehabilitation. Experience on the Mission District trunk sewer, for the City of Winnipeg, indicated that about 40% to 60% of the total rehabilitation cost is incurred in the preparation and inspection of the sewers. A further constraint is the time available in which to perform rehabilitation. The time is generally limited to two to three months (1 December to 28 February at best).

B. Dowhopoluk expressed concern about water levels remaining above current levels for a sustained period of time in these old sewer pipes. If sustained long enough, dewatering of the pipe could result in more damage to deteriorated sections.

G. Rempel cautioned that the City should not assume that area-wide rehabilitation is required for use of in-line storage. It is believed that in many cases sewers can be expected to be in good condition. T. Pearson noted that the rehabilitation would have to be done in any case, however, if it is done concurrently with in-line storage, it would have an impact on budget or timing of the two aspects, i.e., it could extend the CSO control timeframe aspect in order to accommodate budget cycles. The need for rehabilitation will be identified as an incidental cost, i.e., necessary prerequisite to in-line storage.

ACTION: City/Study Team

The remaining or potential concerns with in-line storage, as developed in the workshop, are summarized in Tables 4-1A and 4-1B.

4.2 OFF-LINE STORAGE

B. Gladding presented the two aspects of off-line storage, namely:

- near-surface tanks; and
- local storage tunnels.

Near-Surface Tanks. B. Gladding's presentation comprised overheads WS3-83 to WS3-96. M. Parente believed that tanks at the same elevation as the trunk sewers would be more cost-effective than near-surface tanks, i.e., pumping would make near-surface facilities more expensive. B. Gladding believes it is questionable as to whether it would be cheaper. In any event, the use of the current costing would be representative of the cost of tankage for this CSO control option.

Local Storage Tunnels. The flushing option shown on WS3-91 reflects the CG&S concept developed for the City of Toronto tunnels. The flushing is effected through the use of potable water, well water, river water or wastewater. The withdrawal of the stored water is proposed to be by submersible pumps, if these are acceptable to the City.

The remaining or potential concerns with off-line storage, near-surface tanks and local storage tunnels, as developed in the workshop, are summarized in Tables 4-2A and 4-2B respectively.

4.3 HIGH-RATE TREATMENT

D. Morgan presented overheads WS3-97 to WS3-108, comprising the background for the high-rate treatment options. He noted that the retention treatment basin (RTB) was used as a surrogate for high-rate treatment. The units are similar to those used in the state of Michigan, although the design bases differ somewhat.

TABLE 4-1A

CSO CONTROL OTPION – IN-LINE STORAGE
REMAINING OR POTENTIAL CONCERNS

ISSUES	ASPECTS	COMMENTS
Technical	• Basement Flooding Risk – Gate	
	• Weir camber hydraulics and construction in right-of-way	
	• Structural integrity of sewers	
	• Formation of sink holes and/or sewer collapse	
	• Relief sewer hydraulics/level control	
Operations	• Increased sediment accumulation	
	• Automation controls and reliability	
	• Increased WWF to WPCCs	
	• Access to chambers	
	• Flushing and cleaning	
	• Pilot program for operator comfort	
	• H_2S generation/corrosion	
Environmental	• Changes in stored water quality ↑NH_3, ↑BOD, ↓Fecal coliform	
	• Debris in overflows ↑↓?	
	• Odour nuisance	
Socio-Economic	• Traffic disruption to install weirs	
	• Costs overstated or understated ⇒ rate impacts	
	• Cost of inspection alone ($250/m)	
Regulatory/ Public	• Time to implement	
	• No or reduced basement flood protection	
	• Implementation provides opportunity for refinement and proving out options	• Pilot still desirable
	• Other technologies need to be considered, e.g., bendable weir, articulated weir, inflatable dam	
	• Integration with other programs, BFR, rehab, I/I, other	
	• Rehab may be required, must be done before implementing In-Line storage	• Timing (length of)
	• Dewatering rate, storage time	

TABLE 4-1B

CSO CONTROL OPTION – IN-LINE STORAGE-2
REMAINING OR POTENTIAL CONCERNS

ISSUES	ASPECTS	COMMENTS
Technical	• Hydraulics of fixed weir	• Physical model
	• Effectiveness/Implications of inlet control	
	• Better ways of control	• Fabridam?
	• Cost of inlet restrictors	
Operations	• Maintenance of inlet restrictors	
Environmental		
Socio-Economic		
Regulatory/ Public		

TABLE 4-2A

OFF-LINE STORAGE – NEAR SURFACE TANKS REMAINING OR POTENTIAL CONCERNS

ISSUES	ASPECTS	COMMENTS
Technical	• Odour	• Experience shows control OK – Toronto
	• Flushing	
	• Potential for remote monitoring	
Operations	• Level of effort needed	
	- at tanks	
	- at pumping stations	
	• Up to 17 installations	
Environmental	• Tank below grade	
	• Ground restored	
Socio-Economic	• Costs could be reduced by land acquisition; $tanks <$tunnels	
	• Possible?	
	• Multiple Use of Land (surface)	
Regulatory/ Public	• Need a iicense for each tank?	
	• Land acquisition	
Other	• Monitor flushing/odours elsewhere	

TABLE 4-2B

OFF-LINE STORAGE – LOCAL TUNNELS
REMAINING OR POTENTIAL CONCERNS

ISSUES	ASPECTS	COMMENTS
Technical	• Odour • Flushing • Potential for remote monitoring	
Operations	• Flushing operations near surface (as much as practicable) (dewatering pump submersible)	
Environmental	• Little visible impact • Little or no disturbance to public lands	
Socio-Economic	• Minimal impact on public lands • More expensive than near surface tanks (buy land?)	
Regulatory/ Public	• No more likelihood of license than for sewers	
Other	• Monitor flushing/odours elsewhere	

D. Weatherbe noted that the Michigan design was criticized for being a wasteful use of chlorine, i.e., all contents of the RTB, whether stored and returned to the plant or overflowing to the river, were chlorinated.

G. Zukovs noted that the 10-metres/hr treatment rate used as a design basis for the RTBs, is the highest that he is aware of in North America. Contrariwise, he felt that the 2.5 multiplier for peak flow was too conservative. These two factors would seem to have off-setting impacts.

P. Moffa noted that it is possible to achieve effective high-rate disinfection with five minutes contact time. Even without solids removal, and with high-rate mixing and a high dosage, four-log reduction could be achieved with chlorination. P. Moffa felt that the VSS could perform as well as the RTB and, in his opinion, would likely be cheaper than the RTB. (A comparison carried out on the day following the workshop [using the unit cost developed in the CG&S analysis and comparing these to Moffa's experience in the United States], indicated that this might not be the case. In any event, the CG&S costs seem to be borne out by recent Canadian experience and the RTB should still be able to stand as a reasonable surrogate for the costs and performance of high-rate treatment.)

During the review, B. Gladding realized that the costs carried for RTBs had included for an economy of scale, which is appropriate for storage units but not for treatment basins. The RTBs would be constructed on a modular basis and therefore should be costed on the basis of 5,000 m^3 units. This would more closely reflect the geometry required for them to perform as sedimentation basins. The costs will be adjusted accordingly in the final comparison.

ACTION: Study Team

B. Borlase indicated that the City was doing away with manned operations. The multiple locations for more complex facilities could present a problem to this concept.

Table 4-3 summarizes the highlights of the remaining or potential concerns with regard to high-rate treatment, which were raised at the workshop.

TABLE 4-3

CSO CONTROL OPTION – HIGH RATE TREATMENT
REMAINING OR POTENTIAL CONCERNS

ISSUES	ASPECTS	COMMENTS
Technical	• 10 m/hr for 15 minute overflow rate	• Conservative
	• Contact chamber 5 minute	
Operations	• Odour/Flushing	• Man power?
	• What are the issues for City Operations of a 17 location system?	
Environmental	• Does RTB/VSS give same benefit as stored/NEWPCC treatment	
	• Chlorine threat to fisheries	
Socio-Economic	• Land-use less than RTB	
	• Chlorine through the City	
	• Perception of chlorine in neighbourhood	
Regulatory/ Public	• License required for each of 17 sites?	

4.4 REGIONAL TUNNEL

B. Gladding's presentation on regional tunnels comprised overheads WS3-109 through WS3-115.

Most of the major discussions related to the cleaning of such major regional tunnels. M. Parente reported that in Milwaukee, a flushing system was installed but they don't use it. They find that infiltration provides sufficient base flows to keep the tunnel clear. Toronto will probably use a system similar to that shown for the local tunnel flushing and proposes to flush after each event. He noted that all tunnels in Toronto are concrete lined and, as such, they do not expect major infiltration or exfiltration.

G. Zukovs noted that Chicago had built a model to demonstrate tunnel storage interaction with groundwater. The indications were that groundwater quality would not be impacted by the tunnel storage.

The remaining or potential concerns, as brought up during the workshop discussions, are summarized on Table 4-4.

4.5 SEPARATION

N. Szoke presented overheads WS3-116 to WS3-121 inclusive.

Rehabilitation became a part of the discussion of separation as an option. It was noted that the rehabilitation program will have a budget of approximately $9 Million per year starting in 1999. If the old combined sewer system becomes the sanitary system, the rehabilitation might be cheaper than it would be in a combined system, primarily because the full capacity would not be required.

TABLE 4-4

CSO CONTROL OPTION – REGIONAL TUNNELS
REMAINING OR POTENTIAL CONCERNS

ISSUES	ASPECTS	COMMENTS
Technical		
Operations	• Flushing - frequency	• Experience in Milwaukee - is not required
	• Central facility (i.e. 1) but access Difficult	• Toronto expect to flush frequently (after each event)
Environmental	• Groundwater contamination	• Chicago models indicated exfiltration not a problem (won't go far)
		• Toronto tunnels are lined (shale)
Socio-Economic		
Regulatory/ Public		

Partial separation should be considered as an alternative for basement flooding relief. It was suggested that the CSO study should provide some guidance to the BFR program for ways to mitigate CSO impacts.

ACTION: Study Team

The highlights of the discussions on the remaining or potential concerns with the separation option are provided on Table 4-5.

4.6 FLOATABLES CONTROL

R. Rempel presented a summary of floatables capture programs performed in 1996 and 1997. His overheads are included as WS3-122 through WS3-127. Table 4-6 comprises the highlights of the remaining or potential concerns as developed from the workshop discussions.

TABLE 4-5

CSO CONTROL OPTION – SEPARATION
REMAINING OR POTENTIAL CONCERNS

ISSUES	ASPECTS	COMMENTS
Technical	• New LDS	
	• New Wastewater	
	• Reduce I/I	
	• Opportunistic separation. Should be considered when rehabilitating or installing BFR	
Operations	• Rehabilitation of existing trunks	
	• Flap gates and sluice gates	
	• Maintenance on combined sewer after separation (reduced flow)	
Environmental	• Future permitting of LDS discharges	
	• Can cause non-compliance w/fecal coliform objective	
	• Does not capture floatables and other debris from streets	
Socio-Economic	• Very expensive	
	• Long-term program	
	• Disruption (commercial/industrial)	
Regulatory/ Public	• Disruptive	
	• stormwater impacts	

TABLE 4-6

CSO CONTROL OPTION – FLOATABLES REMAINING OR POTENTIAL CONCERNS

ISSUES	ASPECTS	COMMENTS
Technical	• Trash trap – some reaches too narrow	
Operations	• Screens - operating effort - odour	
Environmental		
Socio-Economic		
Regulatory/ Public		

5. OVERVIEW OF CONTROL PLANS

G. Rempel presented overheads WS3-128 through WS3-144, by way of an overview of the results of the CSO control plan investigations.

It was agreed that a key decision with regard to proceeding with Phase 4 of the development of the CSO Management Strategies is whether or not in-line storage is acceptable. G. Zukovs believed that it was technically-feasible and provided a significant reduction in CSO control costs. D. Weatherbe suggested that the City should go forward with the proposal that the initial stage comprise development of latent storage. E. Sharp added that this approach could be followed by raising the diversion weirs so as to maximize the use of the existing storage without significant costs. If a decision is reached to proceed with in-line storage, then no further work would be done on "without in-line storage options" and only refinement would be necessary for developing the costs of the options including in-line storage.

The basement flood relief (BFR) program offers a means of increasing the potential in-line storage so as to reduce the frequency of overflows, in a cost-effective manner, in those districts which currently exceed the average number of overflows.

M. Shkolny also asked whether we have the ability to distill the various plans to the point where we could illustrate the result/benefit which would occur in the rivers as a result of their implementation, i.e., could we plot a fecal coliform profile achieved by each control plan down the river? How could we communicate this? The study team can model the effect of such discrete actions and provide a profile at a given time but it is expected that the development of such information, to show the effects of benefits in a dynamic fashion, will be difficult and time consuming.

ACTION: City/Study Team

G. Rempel noted that the City could go to the CEC with a recommended approach(s), as a reasonable first stage control, and then revisit the scene in some 10 years. D. Weatherbe elaborated by noting that the City should implement the short- and medium-term controls, monitor, and revisit the overall plan in 10 to 15 years, and modify it on the basis of the monitoring results and the then current technology.

The remaining or potential concerns, resulting from the workshop discussions of the control plan overview, are provided on Table 5-1.

TABLE 5-1

CSO CONTROL OPTION – OVERVIEW
REMAINING OR POTENTIAL CONCERNS

ISSUES	ASPECTS	COMMENTS
Technical	• Could increase dewatering rates for small districts (to improve compliance) • Implement latent storage first - if program proceeds - improve latent storage (raise existing weirs) • Add SCADA for monitoring	
Operations		
Environmental		
Socio-Economic	• Replacement cost allowance? • Strong case for integration of BFR/ rehabilitation programs • Benefit for avoided costs for CSO control (vis a vis BFR)	
Regulatory/ Public	• How to illustrate benefits of technology on river quality • Separate plot for compliance 1 with/ 1 without DWF disinfection	

6. FINANCIAL IMPACT TO CUSTOMERS

E. Sharp presented overheads WS3-145 through WS3-164. The main results of the discussions of the remaining and potential concerns are summarized in Table 6-1. All participants agreed that the final costs used to determine financial impacts should include inlet restriction, rehabilitation and O&M. The final results should note that depreciation (i.e., replacement) is not allowed for in these costs.

ACTION: City/Study Team

There was a question as to whether or not industry/commercial customers would support any increase. If they would not, then the whole load would have to shift to residential customers. The distribution of cost burdens between the different classes of customers will need further study.

ACTION: City/Study Team

TABLE 6-1

CSO CONTROL OPTION – FINANCE
REMAINING OR POTENTIAL CONCERNS

ISSUES	ASPECTS	COMMENTS
Technical		
Operations		
Environmental		
Socio-Economic	• Add dollars for rehabilitation	$30 M for in-line?
	- inlet restriction	? M for in-line?
	- replacement	- noted, not included
	• Industrial/Commercial rates are a concern	
	• Numbers to be refined for Questionnaire	
Regulatory/ Public		

7. PHASE 4 CONSIDERATIONS

G. Rempel presented a wrap-up of the workshop, comprising overheads WS3-165 through WS3-170.

Overhead WS3-169 indicates the Phase 4 activities as were originally proposed for the project. A significant portion of the then-Phase 4 activities were moved forward to Phase 3. As a result, the activities remaining will generally fall into the following categories:

- evaluation of plans
  - integration of objectives;
- define strategies, short and long-term priorities;
- detail recommended plan(s)
  - integration of sewer/interceptor rehabilitation programs
  - schedule
  - funding implications
- prepare a report; and
- prepare regulatory strategy.

M. Shkolny indicated that the team must communicate with Council prior to proceeding with development of the Phase 4 Workplan.

ACTION: City/Study Team

The majority of participants agreed that the presentation to Council should use the lowest envelope on the cost versus number of overflow curves on Figure 7-1 (overhead WS3-165). This could show a band of costs such as that shown on Figure 7-2 (over head WS3-166). The presentation would indicate that this curve is based on maximizing the use of the existing facilities. It would note, but not emphasize, that this involves fail-safe in-line storage.

CONSIDERATION: City/Study Team

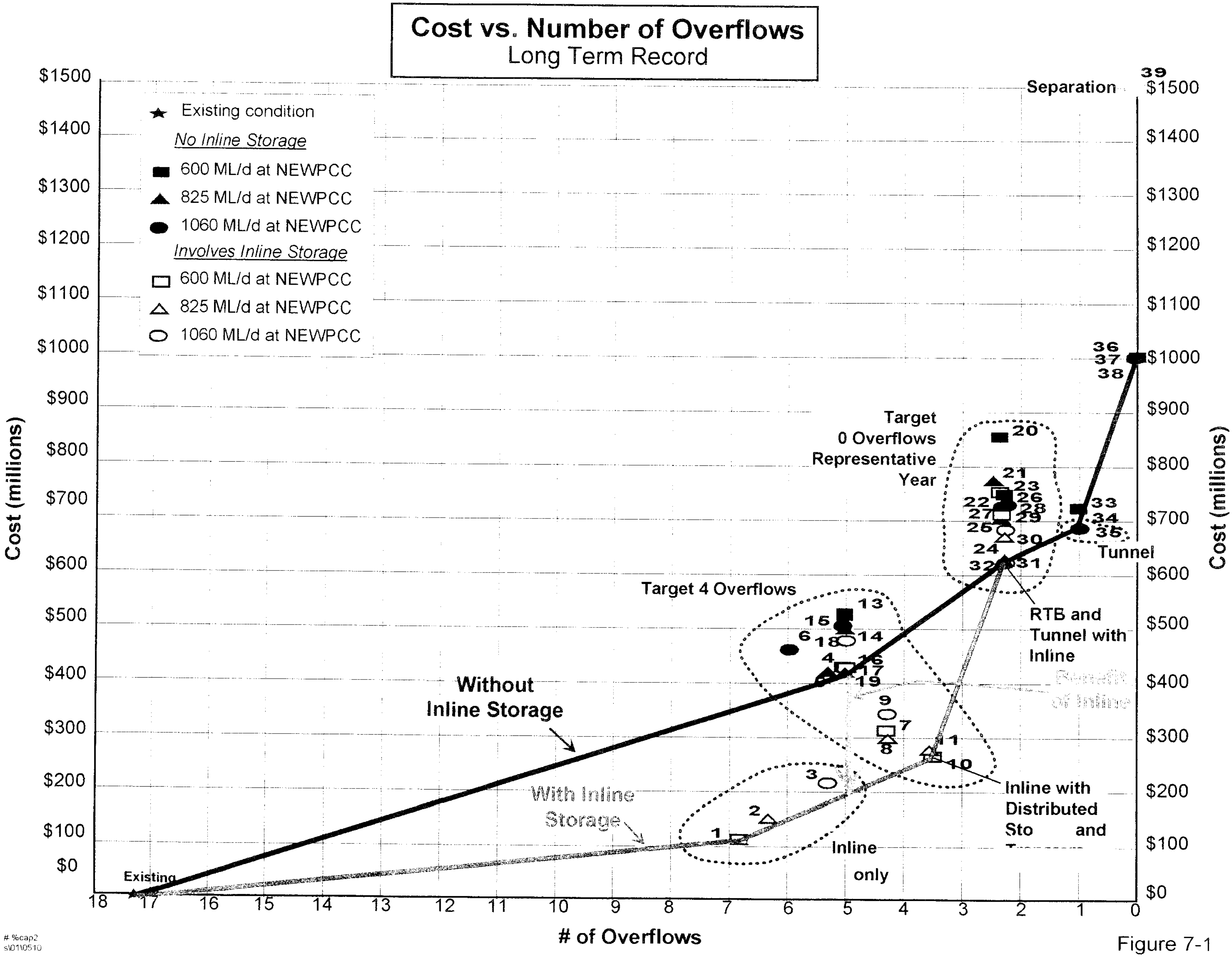

Figure 7-1

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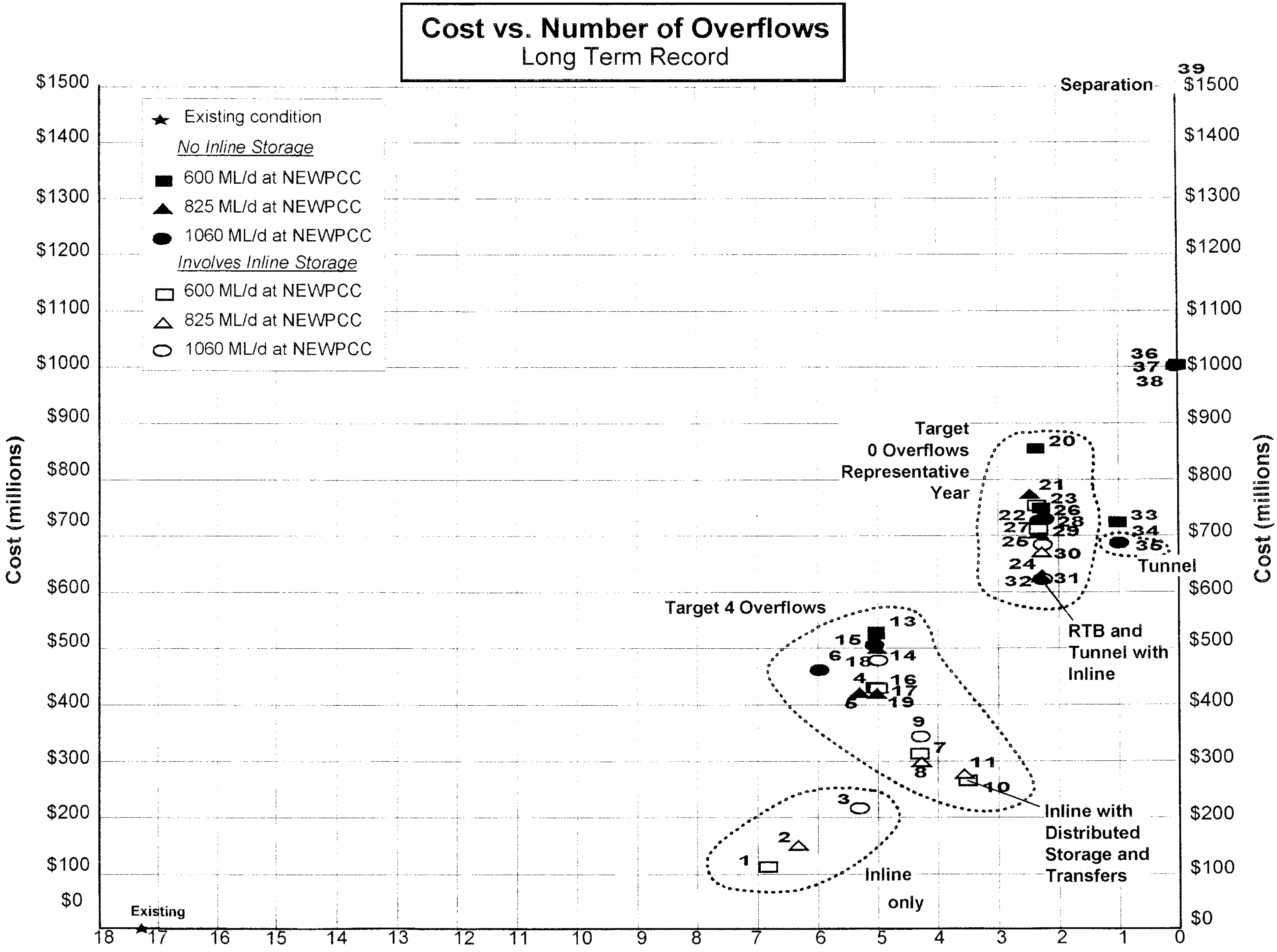

Figure 7-2

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M. Shkolny noted that whatever is taken to Council, efforts should be made to simplify the technical aspects. His suggestion is that one dewatering rate be selected rather than using the three dewatering rates for each of the control alternatives.

The post-Phase 3 workshop activities comprise the following:

- follow-up studies as appropriate;
- workshop report;
- consider public feedback;
- evaluation of plans (working session);
- Phase 4 strategic planning working session; and
- workplan.

Subsequent to the workshop, a post-workshop activity diagram was prepared entitled "Post Workshop – Phase 3 Regrouping". For completeness, this diagram is incorporated in the T.M. as Figure 7-3.

Post Workshop - Phase 3 Regrouping

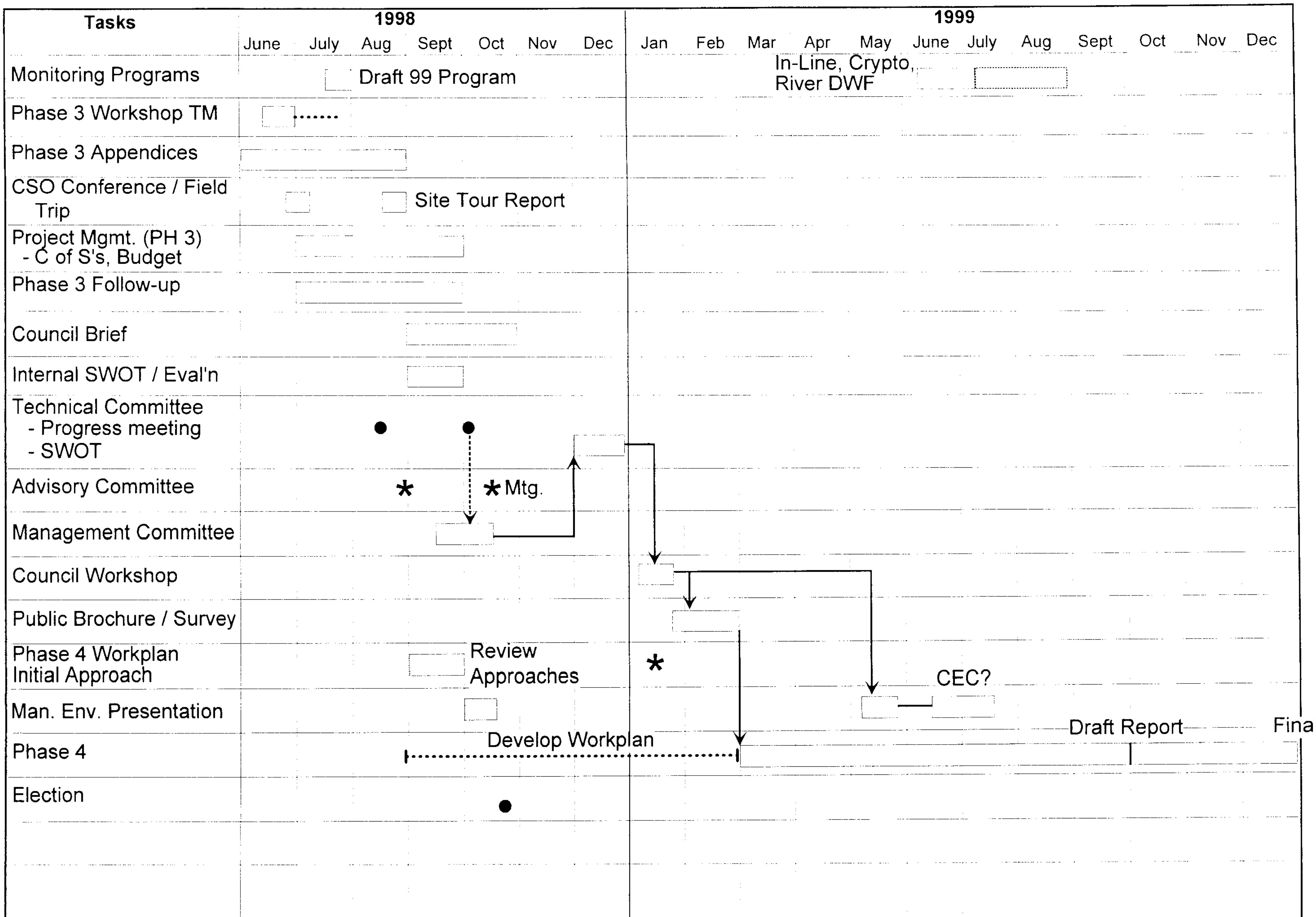


Figure 7-3

2yrcalndr, s\01\0510

1 - INTRODUCTION
E. SHARP

INTRODUCTION

June 1992

- **Clean Environment Commission (CEC) released recommendations concerning the Red and Assiniboine Rivers:**
  - Insufficient site-specific information to advocate CSO regulatory requirements
  - Study of CSO be completed within a 5-year period
  - Report back to Public Hearings

November 1993

- **Minister of Environment accepted the CEC Recommendations.**

February 1994

- **City of Winnipeg commenced the CSO Management Strategy Study.**

WS 3-4

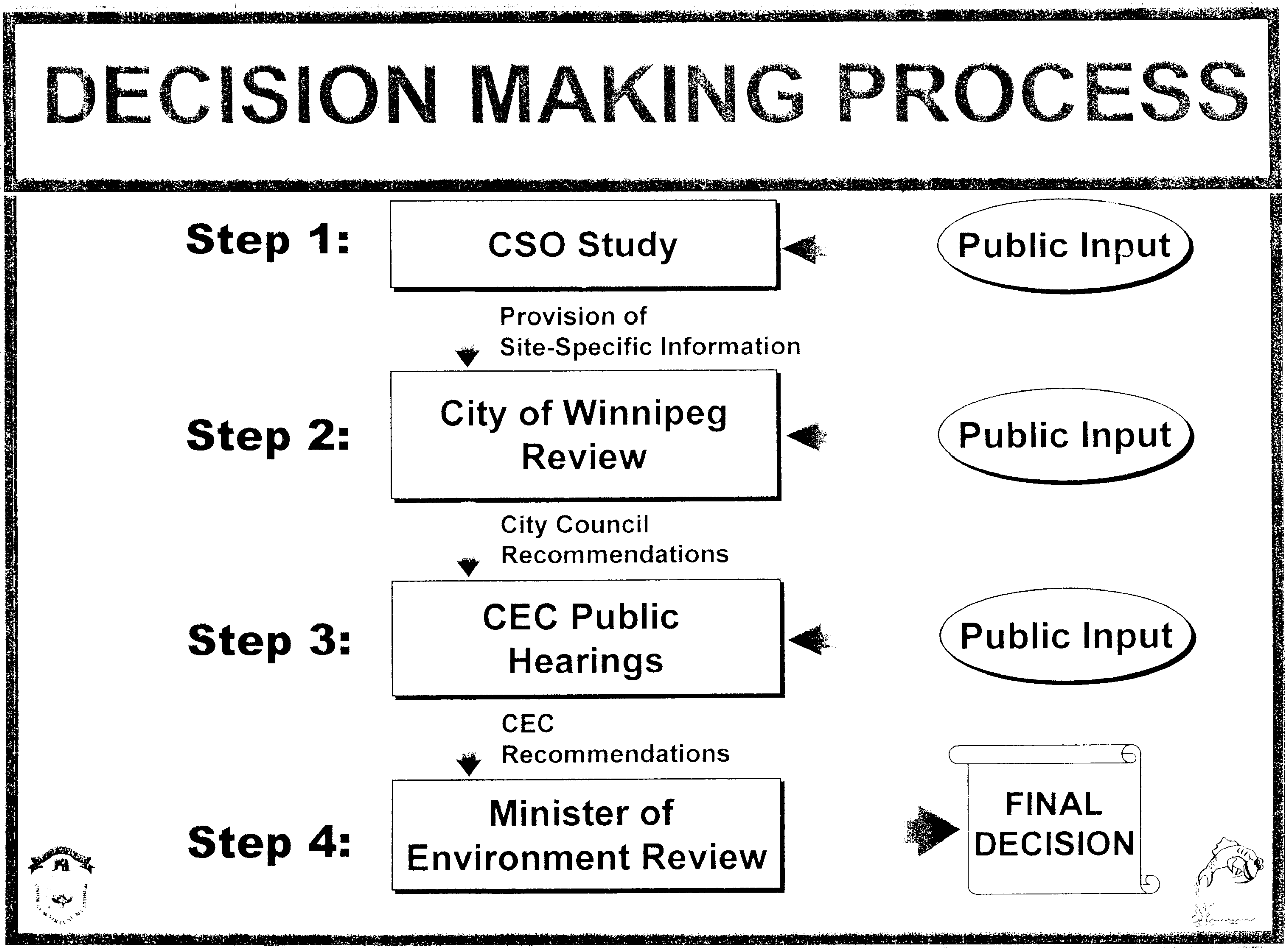
IMPACT OF CEC RECOMMENDATIONS ON W&W DEPARTMENT

	DWF	WWF
DISINFECTION		
Greenhouse Irrigation	Protect	Study (7)
Field Crop Irrigation	Protect	Study (7)
Livestock Watering	Protect	Study (7)
Primary Recreation		
Red River	Protect	Study (7)
Secondary Recreation		
Assiniboine River	Protect	Study (7)
NITRIFICATION (Ammonia Removal)		
Cool Water Aquatic Life and Wildlife	Study (6)	Study(?)

(6) Un-Ionized Ammonia Study

(7) Fecal Coliform Study

WS 3-5


DECISION MAKING PROCESS
Step 1:
CSO Study
Public Input
Provision of Site-Specific Information
Step 2:
City of Winnipeg Review
Public Input
City Council Recommendations
Step 3:
CEC Public Hearings
Public Input
CEC Recommendations
Step 4:
Minister of Environment Review
FINAL DECISION

STEP 1 - CSO STUDY

OBJECTIVE

- To establish a cost-effective, prioritized implementation plan for remedial work based on assessment of costs and benefits of practicable CSO control alternatives.

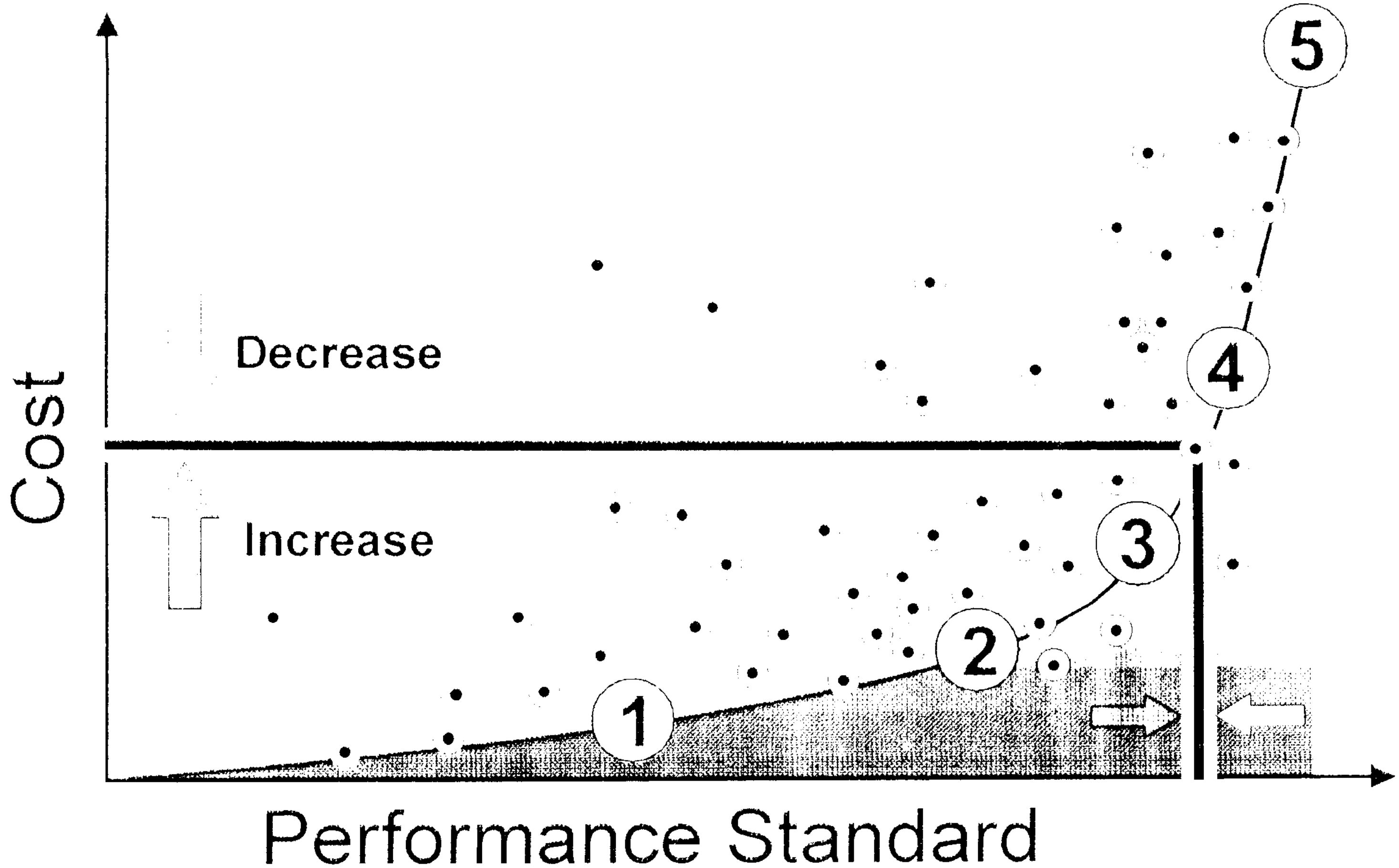
DELIVERABLES

- Provides information for decision makers and the basis for the City's recommendations:
  - Problem definition
    - sources of pollution
    - types of pollutants
    - relative impacts
  - Experience elsewhere
  - Public communication
  - Control alternatives
    - costs and benefits
  - Prioritized implementation plan(s)

STEP 1 CSO STUDY - Cont'd

- **Must consider a complex maze of alternatives**
  - Various performance measures
    - Compliance with objectives
    - Number of overflows
    - Volume of capture
  - Various control options for each Performance Standard
  - Various performance standards for each measure
- **Study will develop control options for selected performance standards based on being**
    - Doable
    - Practicable
    - Cost effective
    - Reasonable

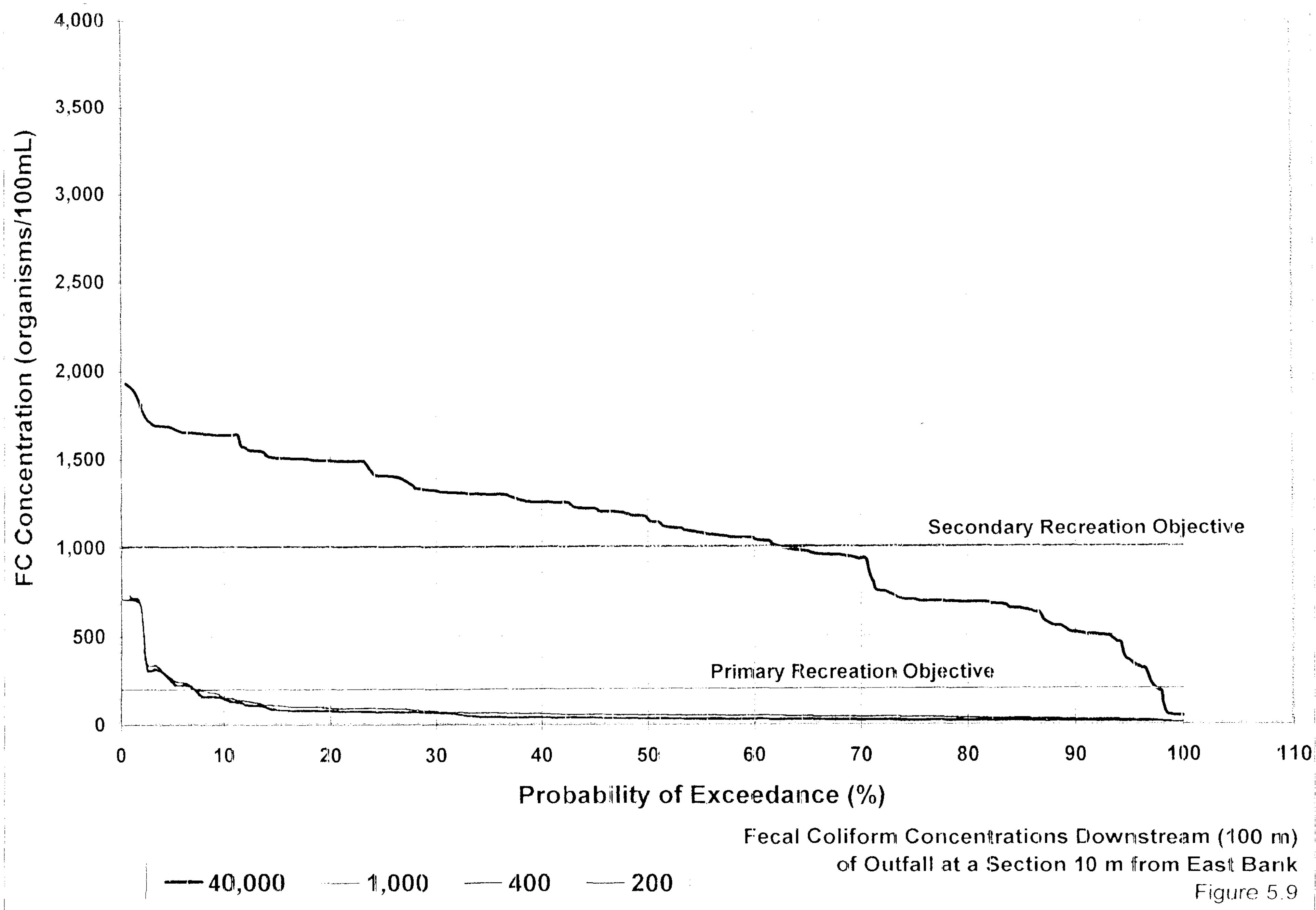
Alternative Levels of Control for a Performance Standard



For example:
- compliance with objectives
- number of overflows
- volume of overflows

A MAJOR "PUBLIC POLICY" ISSUE

- **Involves choices which affect the Public**
- **Costly**
  - $85 to $1000+ million
- **Controversial**
  - Benefits difficult to quantify
  - Broad range of opinions
- **Deals with "*Trade-Offs*"**
- **Example of competing programs**
    - water treatment
    - basement flooding protection
    - infrastructure rehabilitation
    - social services
    - fiscal restraint
- **Mandated by others**
  - Under Provincial authority
  - Public Hearings will provide the only opportunity for the City to significantly influence the program.



Fecal Coliform Concentrations Downstream (100 m) of Outfall at a Section 10 m from East Bank

Figure 5.9

M 5 3-11

WHAT WILL BE DECIDED

- **"Policy" Issues only**
- **Public Hearing Agenda will include:**
  - River uses to protect
    - Recreation
    - Irrigation
    - Livestock
  - Performance Standards to protect uses:
    - Compliance with objectives
    - Number of overflows
    - Volume of capture
  - Schedule for compliance with Performance Standard(s)

FINAL IMPLEMENTATION PROCESS

- Implementation Plan
  - will be developed to conform to
    - Performance Standards
    - schedule requirements
  - plan development to include
    - selection of site specific control technologies
    - optimization of system wide control alternatives
    - project prioritization

- Licencing
  - development application
  - development approval process

- Implementation
  - construction

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WPCC

ENVIRONMENTAL LICENCING

Public Hearing Process

NEWPCC	SEWPCC	WEWPCC
Ammonia	Ammonia	Ammonia
Other	Other	Other

Proposed Alteration Licences

NEWPCC	SEWPCC	WEWPCC
Odour	Odour	
	Bacteria (dwf)	

Optional Alteration Licences

NEWPCC	SEWPCC	WEWPCC
BOD	BOD	BOD
SS	SS	SS
Bacteria (dwf)		Bacteria (dwf)
Noise	Noise	Noise
		Odour
Sludge		

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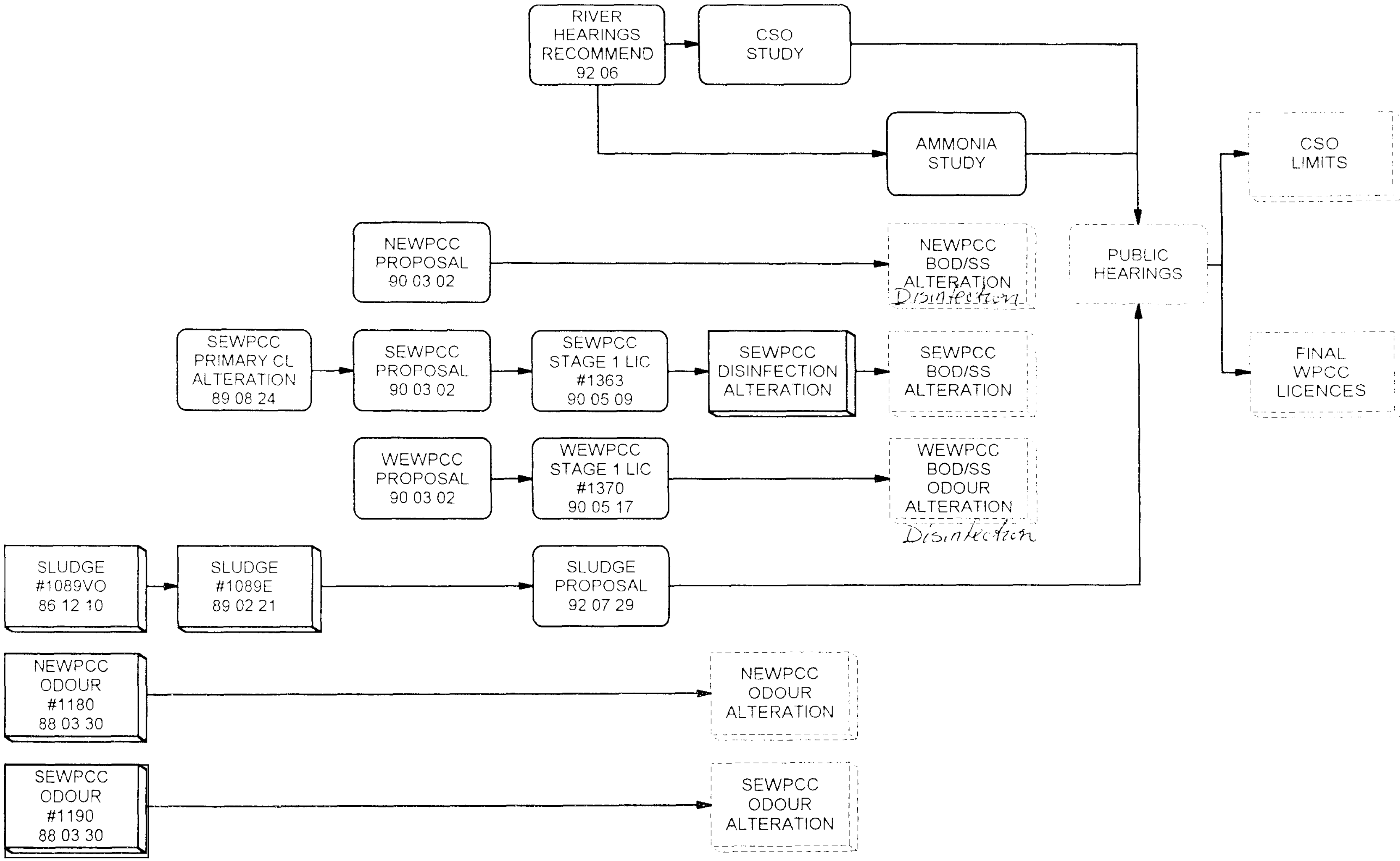
WS 3-14



MANITOBA ENVIRONMENT ACT LICENCING STEPS

WS 3-15

CSO PROJECT

EXTENSION

- Formal extension for CSO and Ammonia Studies received from Manitoba Environment - October 2, 1997
  - permits both issues to be dealt with at one Hearing
  - Manitoba Environment to provide notification to CEC

- CSO Study Extension to December 31, 1999
  - will facilitate review in advance of Ammonia Study results
  - (provided for incorporation of Pilot Study results)

- Ammonia Study Extension to July 1, 2000
  - based on two monitoring seasons
  - provides time for;
    - data collection
    - analysis
    - report preparation and finalization
    - internal approvals
  - will provide valuable information on fishery resource

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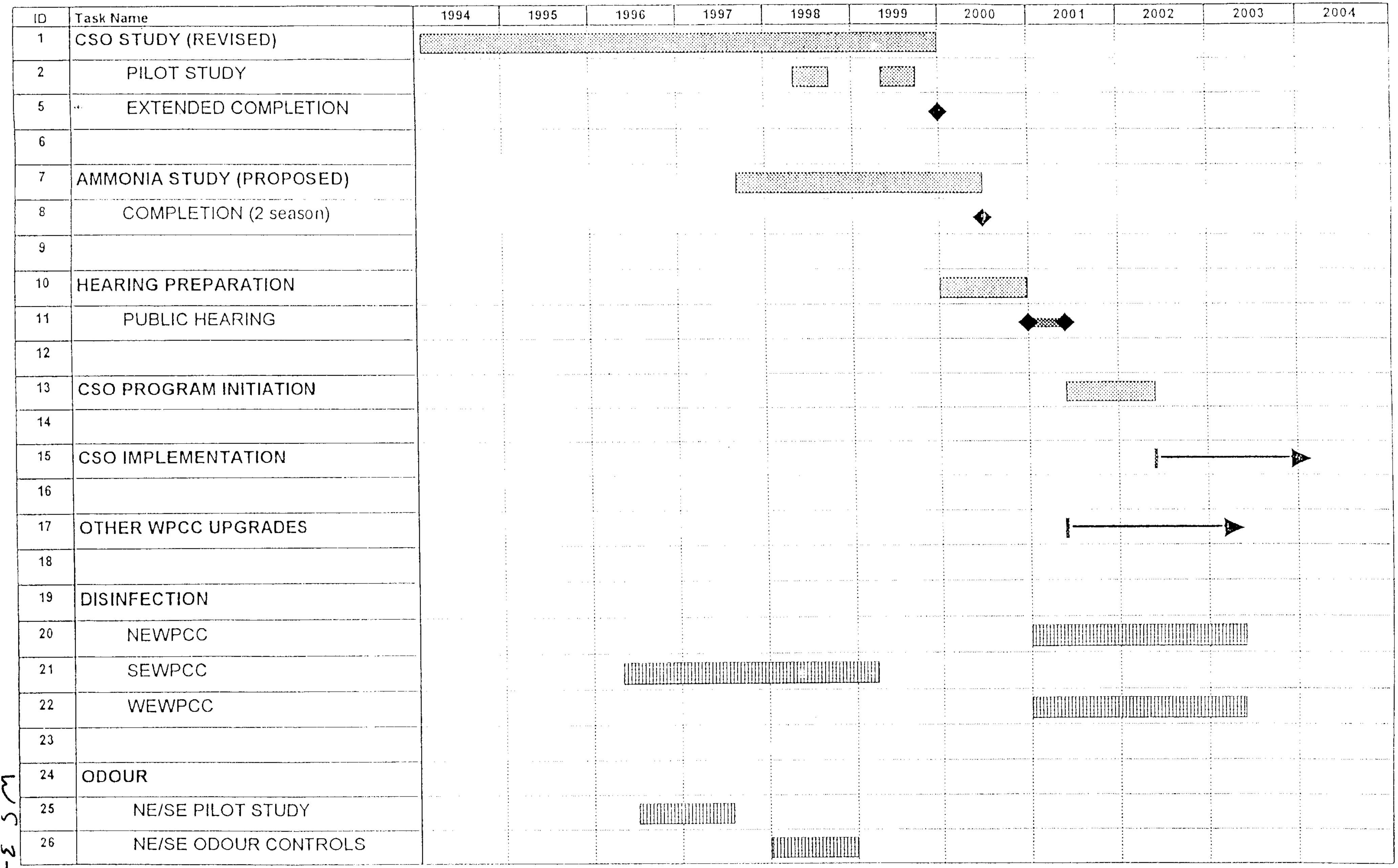
WS 3-16

ENVIRONMENT ACT LICENCING
PROJECT SCHEDULE
July 1997



WS 3-17

APPENDIX A
WORKSHOP OVERHEADS

AGENDA

MAY 7, 1998
WINNIPEG CSO WORKSHOP
Winnipeg Canoe Club – 50 Dunkirk Drive

8:00 BACKGROUND TO STUDY (E.J. Sharp)
- Clean Environment Commission (CEC) direction
- Concept of performance "targets"
- "Trade-offs" for decision-making
- Study products for City/CEC
- Present status

8:30 INTRODUCTION TO WORKSHOP (G. Rempel)
- Study Objectives
- Objectives of Workshop
- Agenda
- Critical review of potential plans (key questions):
  - Are potential plans technically acceptable, operationally do-able, relatively cost-effective, environmentally and socially reasonable, consistent with good practice?
  - Are we confident that these plans can be implemented if selected?
  - What key questions (technical, operations, environmental, social) remain?
  - Should these questions be addressed and, if so, how?

8:40 POTENTIAL PLANS (G. Rempel/D. Morgan)
- Performance evaluation concepts
- Approach to definition of requirements (storage/treatment modelling)
- Representative year/long term record
- Additional CSO control (plans range from optimizing existing infrastructure to separation)

9:20 IMPLICATIONS OF CSO CONTROL ON EXISTING SYSTEM (R. Gladding)
- Existing system (Main Interceptor)
- Wastewater treatment (NEWPCC)

*Note: A **brief** presentation on each of the main categories of control plans will be made at the start of the following agenda items. The control plans will then be reviewed considering the factors listed below for In-Line Storage. The intent is to subject each main category of control plan to a similar critical review.*

9:50 IN-LINE STORAGE (fixed weirs, gates, dams) (N. Szoke)

- PRESENTATION (20 min)
  - technology
  - system requirements
  - assumptions
  - potential plan(s)
  - technical issues
  - practicability
  - performance evaluation
  - costing

- DISCUSSION
  - *critical review*)
  - *new ideas*) *input from Group*
  - *additional analyses*)

10:50 OFF-LINE DISTRIBUTED STORAGE (near surface basins, local tunnels) (R. Gladding)

- PRESENTATION (15 min)
- DISCUSSION

11:20 HIGH RATE SATELLITE TREATMENT (VSS, RTBs) (D. Morgan)

- PRESENTATION (15 min)
- DISCUSSION

12:00 LUNCH

1:00 REGIONAL TUNNEL (R. Gladding)

- PRESENTATION (15 min)
- DISCUSSION

1:30 SEPARATION (new road drainage sewers) (N. Szoke)

- PRESENTATION (10 min)
- DISCUSSION

1:50 FLOATABLES CONTROL (N. Szoke)

- PRESENTATION (10 min)
- DISCUSSION

2:10 OVERVIEW OF CONTROL PLANS (Performance/Cost) (G. Rempel)

- Number and volume of overflows
- % capture
- Compliance
- Possible evaluation criteria

2:40 OVERVIEW OF FINANCIAL IMPACTS ON CUSTOMERS (E.J. Sharp)

3:00 BREAK-OUT SESSIONS (with coffee)

- Three groups will address the range of potential plans from the standpoint of issues/concerns relating to:
  - Group 1: Operations
  - Group 2: Regulatory/Public
  - Group 3: Technical

4:00 GROUPS REPORT BACK (3 reports;10 min. each and 10 min discussion)

5:00 WRAP-UP (G. Rempel/E.J. Sharp)

5:30 ADJOURN

/smc
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2 - <u>INTRODUCTION</u>

G. REMPEL

INTRODUCTION TO WORKSHOP

INTRODUCTION TO WORKSHOP (G. Rempel)

- Study Objectives

- Objectives of Workshop

- Agenda

- Critical review of potential plans (key questions):

  - Are potential plans technically acceptable, operationally do-able, relatively cost-effective, environmentally and socially reasonable, consistent with good practice?

  - Are we confident that these plans can be implemented if selected?

  - What key questions (technical, operations, environmental, social) remain?

  - Should these questions be addressed and, if so, how?

OVERALL STUDY OBJECTIVE

- The establishment of "a cost-effective prioritized implementation plan for remedial work based on assessment of costs and benefits of practicable alternatives" (Terms of Reference)

- Objective has been rationalized:

  - plan(s), not plan, to allow value judgements on public policy matters and to reflect the CEC mandate

Recommendation 7 (Fecal Coliform Study)

Site specific studies should be undertaken to determine water quality impacts of the combined sewer system on the rivers with the study including but not limited to:

- a physical inventory of the combined sewer system and the reaches of the rivers affected
- a project schedule in order to ensure that a sufficient number of flow events are monitored to understand the impacts of the combined sewer overflow on water quality in the river particularly during low river flows
- an understanding of routing through the sewer system during dry and wet weather flow events
- flow monitoring of the sewers and the rivers
- rainfall monitoring network
- water quality monitoring during overflow events at the overflows and in the receiving stream
- the establishment of parameters concerning storm frequency and the duration that fecal coliform levels must be met.

The data should be used to establish the cause of water quality violations in the river and subsequently result in the formulation of remedial measures to reduce the impact.

Members of the scientific community in Manitoba should be invited to collaborate in the study design and an advisory or steering committee should be established during implementation of the study. Recommendations should be available before July, 1997 regarding changes to the design and operation of the combined sewer overflows in The City of Winnipeg. Hearings should be held within six months of the completion of the study to determine the implementation schedule for fecal coliform objectives.

In the interim, following rainfall events of sufficient volume to cause combined sewer overflows to the rivers, the rivers in the prescribed area should be posted with health related cautionary notices regarding the safety of primary recreation.

RELEVANT SUB-SETS OF OVERALL OBJECTIVE

- Study the costs and benefits of alternative practicable control plans which would provide different levels of CSO Control, ranging from that performance resulting from optimizing the existing infrastructure to plans that would involve separation of the existing combined sewer system

- Identify the key "trade-offs" associated with the alternative plans

- Obtain technical peer review and public/regulatory responses to the different plans (the latter in accordance with City expectations with respect to public participation on major public works projects)

- Document the wholeness of the information for review by City and Provincial policymakers and the public

General Approach

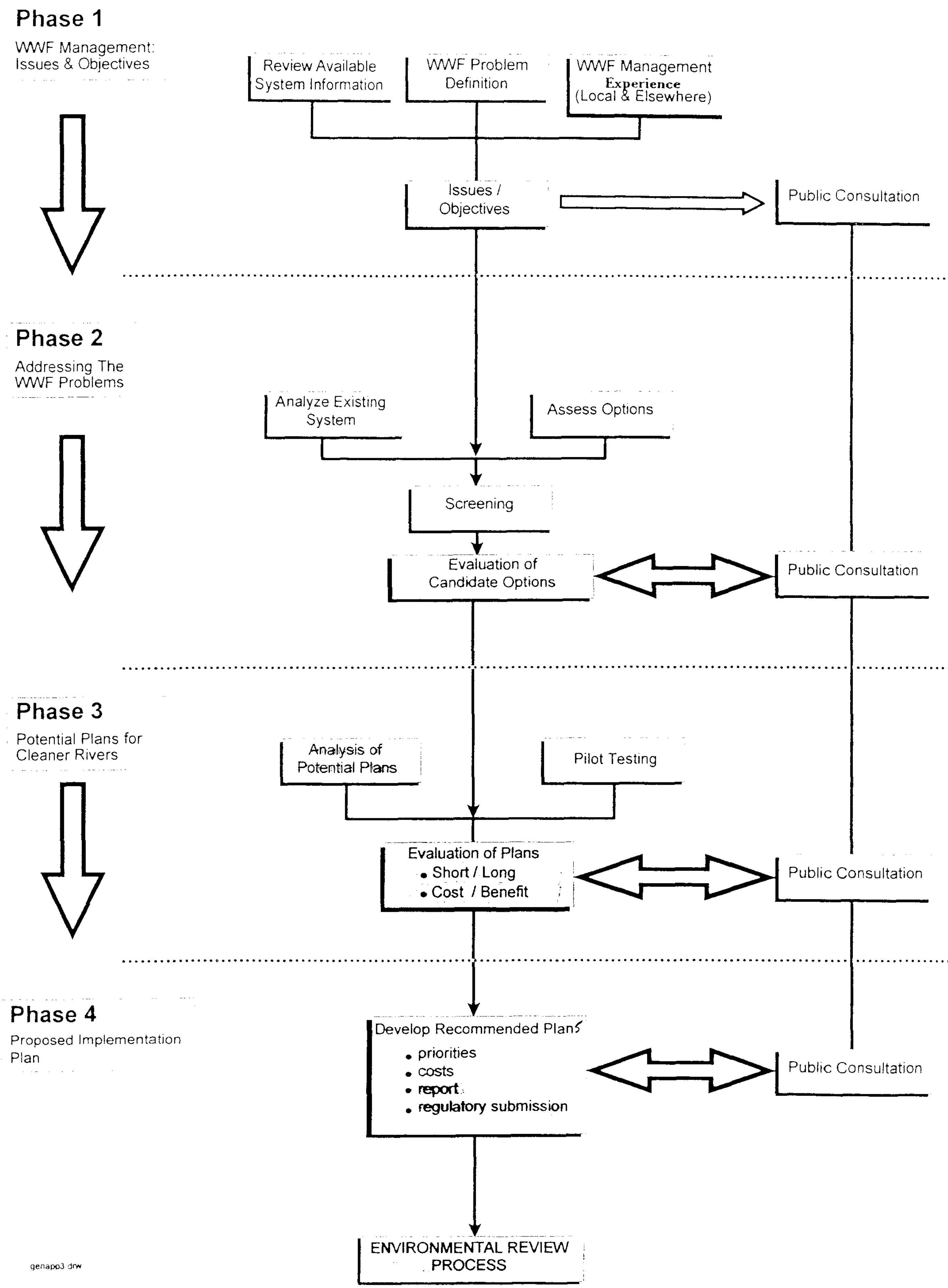

Figure 1-1

WS 3-22

OBJECTIVE OF PHASE 3 CSO WORKSHOP

- Review fundamental objectives of the CSO study
- Review potential Phase 3 CSO control plans
  - (assumptions, requirements, technical issues, practicability, performance, costing, gaps, etc.)
  - obtain Group Input, e.g., critical review, new ideas, additional analysis
- Identify additional/alternative/revised control plans
- Identify outstanding concerns:

- operations
- regulatory/public
- technical

- Wrap-up (follow-up actions)

This is intended to be interactive group consensus-building workshop

CSO PHASE 3 WORKSHOP

BEFORE WORKSHOP

- Two Technical Memoranda were distributed in advance
  - Control Alternatives
  - Public Consultation

- Assume all participants are familiar with contents of TMs before Workshop
  - there will be limited presentation of the material at the Workshop, mainly an overview of the control plans and basic assumptions

AGENDA

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Winnipeg Canoe Club – 50 Dunkirk Drive

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  - Are we confident that these plans can be implemented if selected?
  - What key questions (technical, operations, environmental, social) remain?
  - Should these questions be addressed and, if so, how?

8:40 POTENTIAL PLANS (G. Rempel/D. Morgan).

- Performance evaluation concepts
- Approach to definition of requirements (storage/treatment modelling)
- Representative year/long term record
- Additional CSO control (plans range from optimizing existing infrastructure to separation)

9:20 IMPLICATIONS OF CSO CONTROL ON EXISTING SYSTEM (R. Gladding)

- Existing system (Main Interceptor)
- Wastewater treatment (NEWPCC)

*Note: A **brief** presentation on each of the main categories of control plans will be made at the start of the following agenda items. The control plans will then be reviewed considering the factors listed below for In-Line Storage. The intent is to subject each main category of control plan to a similar critical review.*

WS 3-25

9:50 IN-LINE STORAGE (fixed weirs, gates, dams) (N. Szoke)

- PRESENTATION (?0 min)
  - technology
  - system requirements
  - assumptions
  - potential plan(s)
  - technical issues
  - practicability
  - performance evaluation
  - costing

- DISCUSSION
  - *critical review*)
  - *new ideas*) *input from Group*
  - *additional analyses*)

10:50 OFF-LINE DISTRIBUTED STORAGE (near surface basins, local tunnels) (R. Gladding)

- PRESENTATION (15 min)
- DISCUSSION

11:20 HIGH RATE SATELLITE TREATMENT (VSS, RTBs) (D. Morgan)

- PRESENTATION (15 min)
- DISCUSSION

12:00 LUNCH

1:00 REGIONAL TUNNEL (R. Gladding)

- PRESENTATION (15 min)
- DISCUSSION

1:30 SEPARATION (new road drainage sewers) (N. Szoke)

- PRESENTATION (10 min)
- DISCUSSION

1:50 FLOATABLES CONTROL (~~N. Szoke~~) (Roger Rennel)

- PRESENTATION (10 min)
- DISCUSSION

2:10 OVERVIEW OF CONTROL PLANS (Performance/Cost) (G. Rempel)
- Number and volume of overflows
- % capture
- Compliance
- Possible evaluation criteria

2:40 OVERVIEW OF FINANCIAL IMPACTS ON CUSTOMERS (E.J. Sharp)

3:00 BREAK-OUT SESSIONS (with coffee)
- Three groups will address the range of potential plans from the standpoint of issues/concerns relating to:
  - Group 1: Operations
  - Group 2: Regulatory/Public
  - Group 3: Technical

4:00 GROUPS REPORT BACK (3 reports;10 min. each and 10 min discussion)

5:00 WRAP-UP (G Rempel/E.J. Sharp)

5:30 ADJOURN

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WS 3-27

WHAT WE WILL PRESENT

- Existing System Capabilities
- In-line Storage
- Off-line Storage
- High-Rate Treatment
- Regional Tunnel
- Separation
- Floatables Controls

3 - POTENTIAL PLANS
G. REMPEL/D. MORGAN

WHY DO WE NEED CSO CONTROL GOALS AND PERFORMANCE MEASURES?

- CSO control raises complex issues
  - cost (usually very significant)
  - benefits (usually very difficult to measure)
  - policy issues (usually require value judgements)

- Need to compare alternative control plans to facilitate input from a range of stakeholders

PROPOSED MEASURES OF CSO CONTROL

		PEFORMANCE MEASURE
1.0		"End-of-Pipe" Measures
	1.1	Number of CSOs
	1.2	Volume of CSOs
	1.3	Secondary Bypasses at NEWPCC
2.0		Receiving Stream Measures
	2.1	Duration of Compliance with Primary Recreation Fecal Coliform Guidelines
	2.2	Duration of Compliance with Secondary Recreation Fecal Coliform Guidelines
	2.3	Human Health Risk
	2.4	Pollutant Loading
	2.5	Aesthetics
	2.6	Protection of Sensitive Reaches of Red and Assiniboine Rivers
	2.7	Protection of Aquatic Life in Red and Assiniboine Rivers

COMPLIANCE WITH GUIDELINES

- Manitoba does not have CSO guidelines

- DWF guidelines
  - 200 fc/100 mL (primary recreation)
  - 1,000 fc/100 mL (secondary recreation)

- WWF guidelines
  - Subject to CEC Hearing on CSOs
  - WWF classification [illegible] until site specific research done (Rec #7) to provide adequate information to informed decision making (Rec #7)

MANITOBA-POLICY

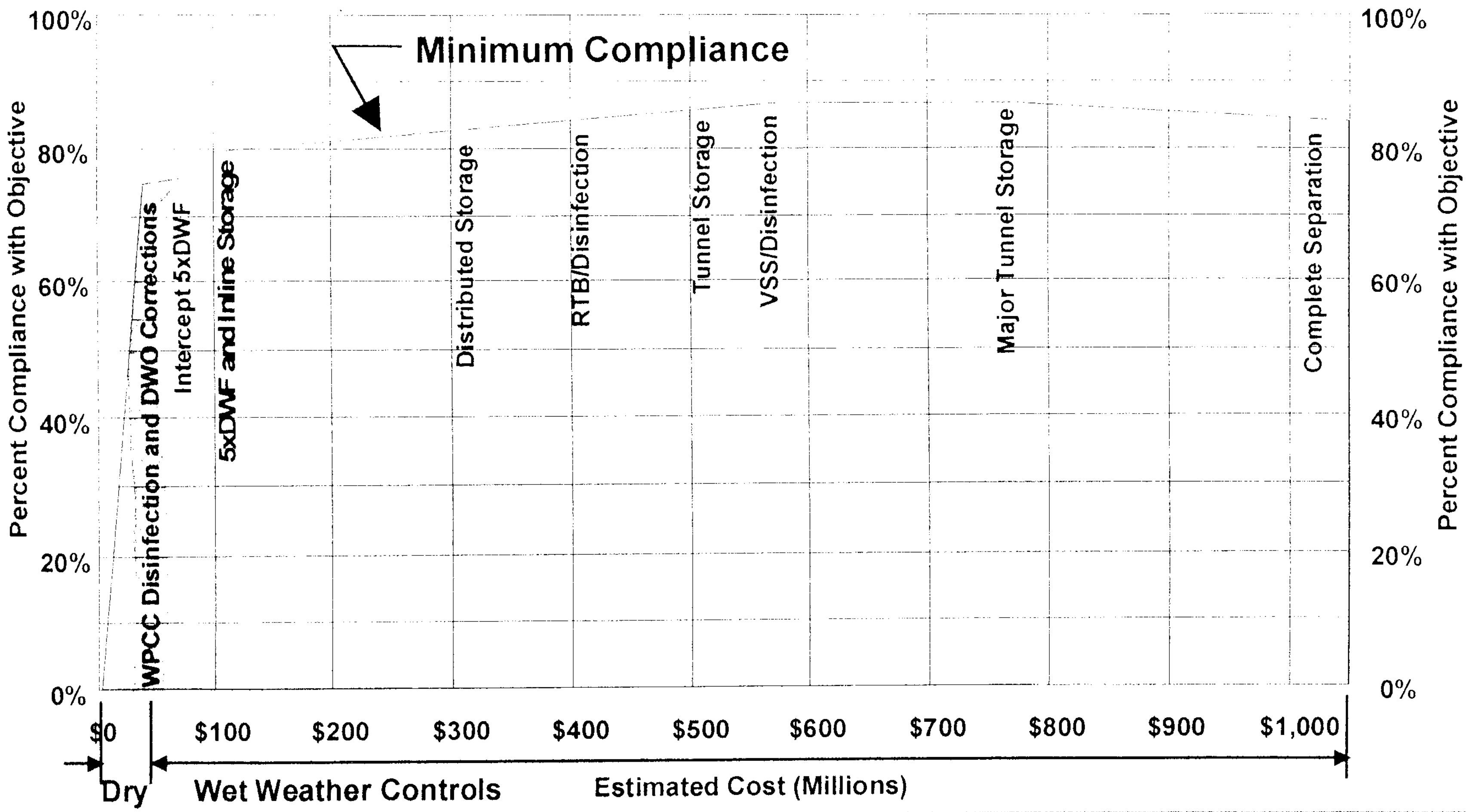
- Manitoba Policy
  - no special permitting policies relating to CSOs or storm sewers at this time
  - the CEC has declared classification of the rivers during wet weather conditions (re: appropriate uses and their associated numerical objectives) to be under review
    - the CSO Study will contribute to this review

- Manitoba Surface Water Quality Objectives (MSWQO)

USE	FECAL COLIFORM/100ml
Primary Recreation	200
Secondary Recreation	1,000
Greenhouse Irrigation	1,000 (200 if workers in contact with water)

TetrES Consultants Inc.

Compliance with Fecal Coliforms Objective
of 200 organisms/100mL for Different Control Scenarios



(From Plan)

WS 3-5

EPA CSO POLICY (Cont'd)

EPA CSO Policy provides the municipalities with two approaches for showing that its selected CSO controls will achieve water quality standards

- "*Presumption Approach*" - in this approach, the municipality can provide a particular level of control that is presumed to meet water quality standards unless there is data to show otherwise. These specified levels of control are:

  - no more than four overflow events per year which do not receive minimum treatment (clarification, solids removal, disinfection if necessary); or

  - the elimination or capture for treatment of no less than 85% by volume of the combined sewage collected in the combined sewer system on a system-wide annual average basis; or

  - the elimination or removal of no less than the mass of pollutants, identified as causing water quality impairment, for the volumes that would be eliminated or captured for treatment under the previous point

- "*Demonstration Approach*" - in this approach, the municipality can provide information and data showing that the selected CSO controls meet water quality standards

This is the real objective.

CSS - COMBINED SEWER SYSTEM

Source: US EPA 832-B-95-002
Combined Sewer Overflows
Guidance for Long-Term Control Plan

Criterion i

The CSO Control Policy defines an overflow event under Criteria i as "*...one or more overflows from a CSS as the result of a precipitation event that does not receive the minimum treatment specified...*" (II.C.4.a.i.). In a CSS with three outfalls, therefore, if one, two, or three of the outfalls discharge untreated or inadequately treated combined sewage during a rain event, then a single overflow event has occurred. Furthermore, in terms of defining an overflow event, a "CSS" is not necessarily the entire set of combined sewers within a municipal or regional boundary. In some cases, a municipality or regional sewer authority might be considered to have more than one CSS if the systems are not hydraulically related. In such a case, the calculation of four overflow events per year would apply for each system individually and not to the entire set of combined sewers within the municipality or regional jurisdiction (this concept would apply to Criteria ii and iii, as well). In addition, the prohibition of more than four overflow events per year (with up to two more if the NPDES permitting authority approves) applies to overflows *not receiving the minimum treatment of primary clarification, solids and floatables disposal, and disinfection, if necessary*. Outfalls may overflow more frequently if they receive the minimum specified treatment

CSS = COMBINED SEWER SYSTEM

Criterion ii

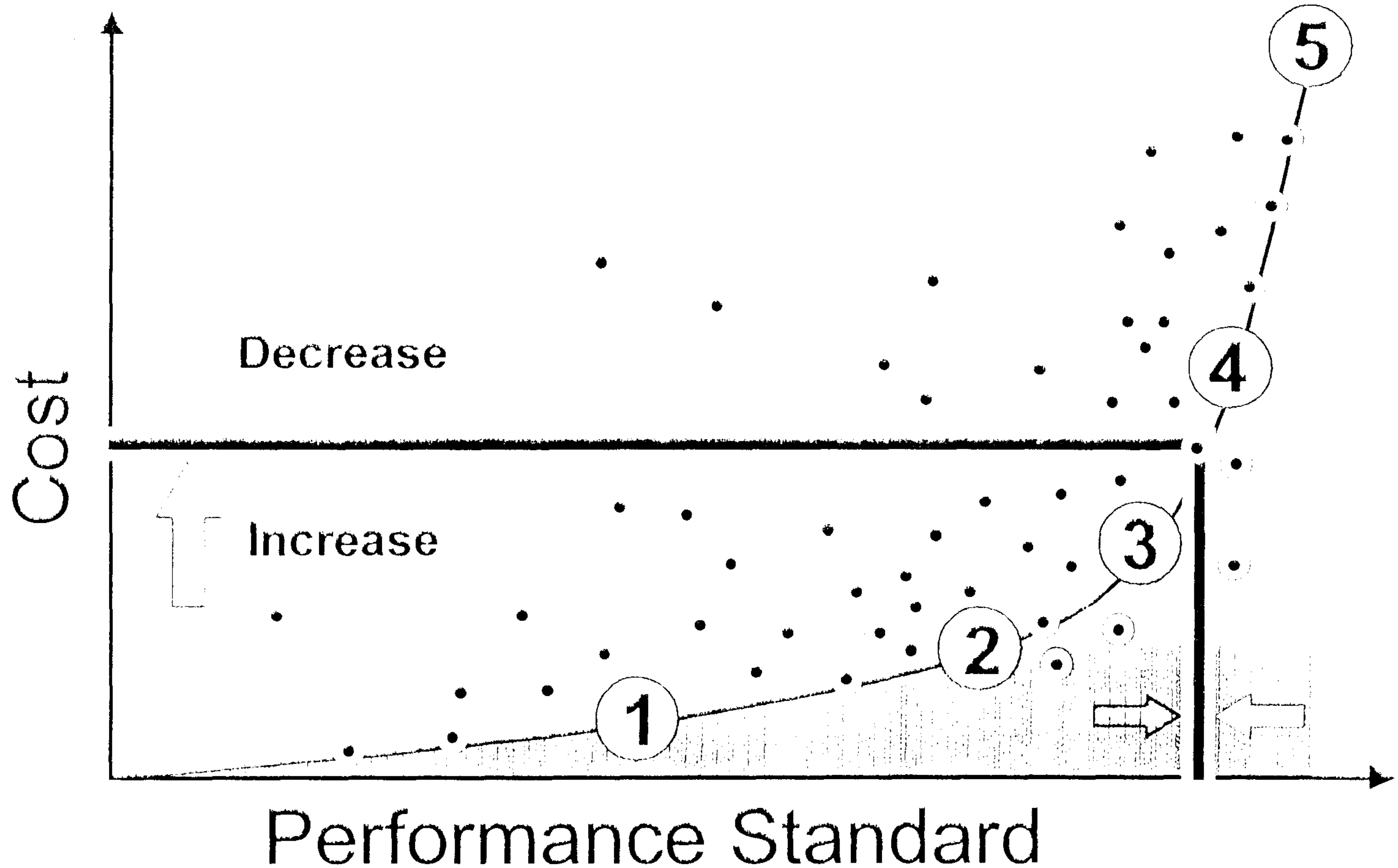
- Under Criterion ii, the "*85 percent by volume of the combined sewage*" refers to 85 percent of the total volume of flow collected in the CSS during precipitation events on a system-wide, annual average basis (not 85 percent of the volume being discharged). In other words, no more than 15 percent of the total flow collected in the CSS during storm events should be discharged without receiving the minimum specified treatment. The total volume of flow collected during wet weather on a system-wide annual average basis would be most readily computed using a model of the CSS, such as SWMM. Similarly, the total volume of flow discharged without receiving the minimum treatment can also be computed using an annual simulation with a CSS model, such as SWMM. Comparing these two volumes under existing conditions will indicate the extent of additional controls necessary to meet the criterion for 85 percent elimination or capture. Sizing facilities to meet a performance criterion based on annual average performance, however, will probably require iterative evaluations of annual simulations. Depending on the size and complexity of the system being modelled, as well as the speed of the hardware used for the simulation, this process can require a great deal of computer time and follow-up analysis

- Analysis performed in conjunction with EPA's 1992 CSO Control Policy dialogue has shown that criteria i and ii are approximately equal

4 of/4 average

WS 3-36

Alternative Levels of Control for a Performance Standard



For example:
- compliance with objectives
- number of overflows
- volume of overflows

WS 3-37

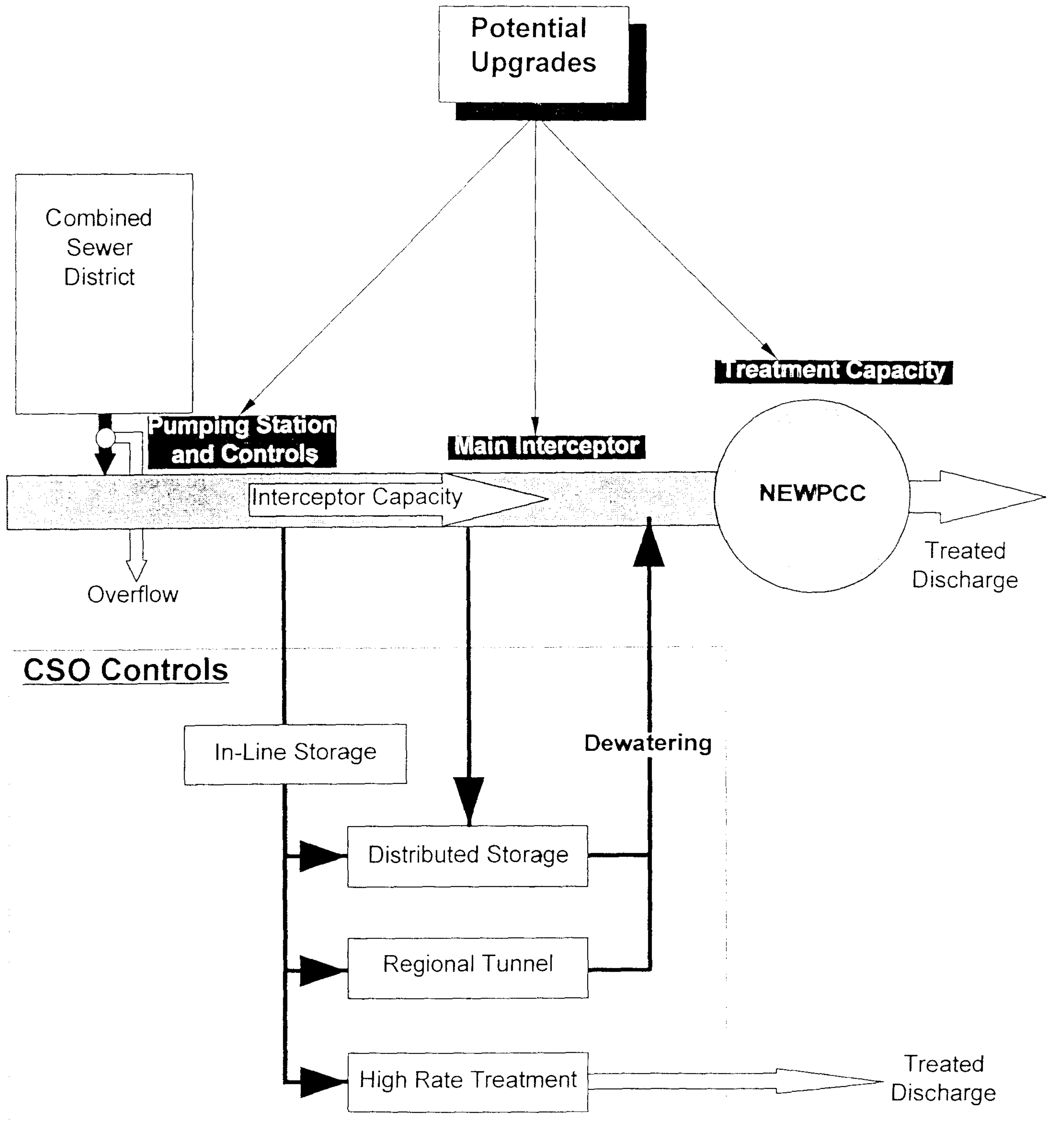


Figure 4-1

Potential Options for CSO Control

WS 3-38

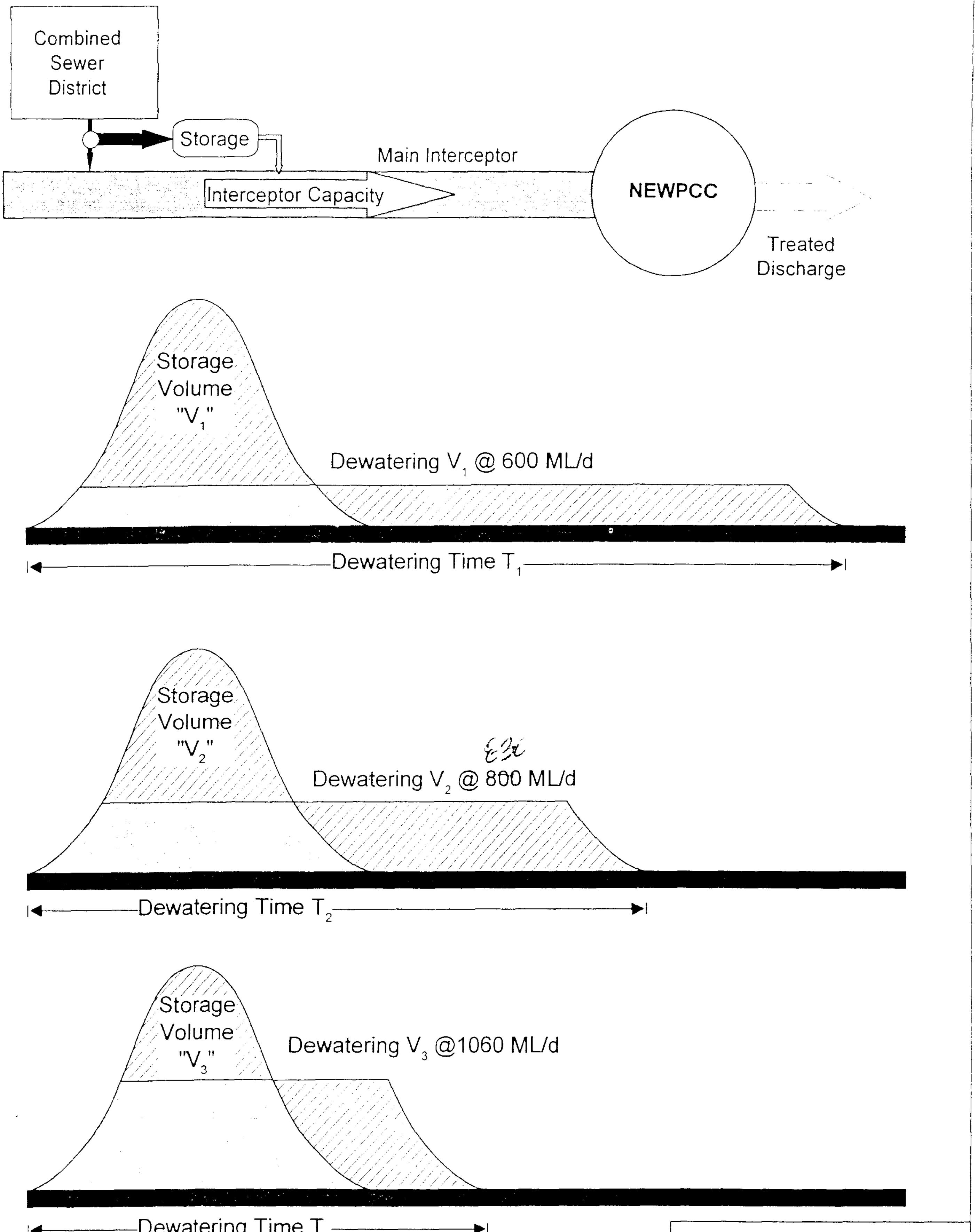


Figure 4-2:

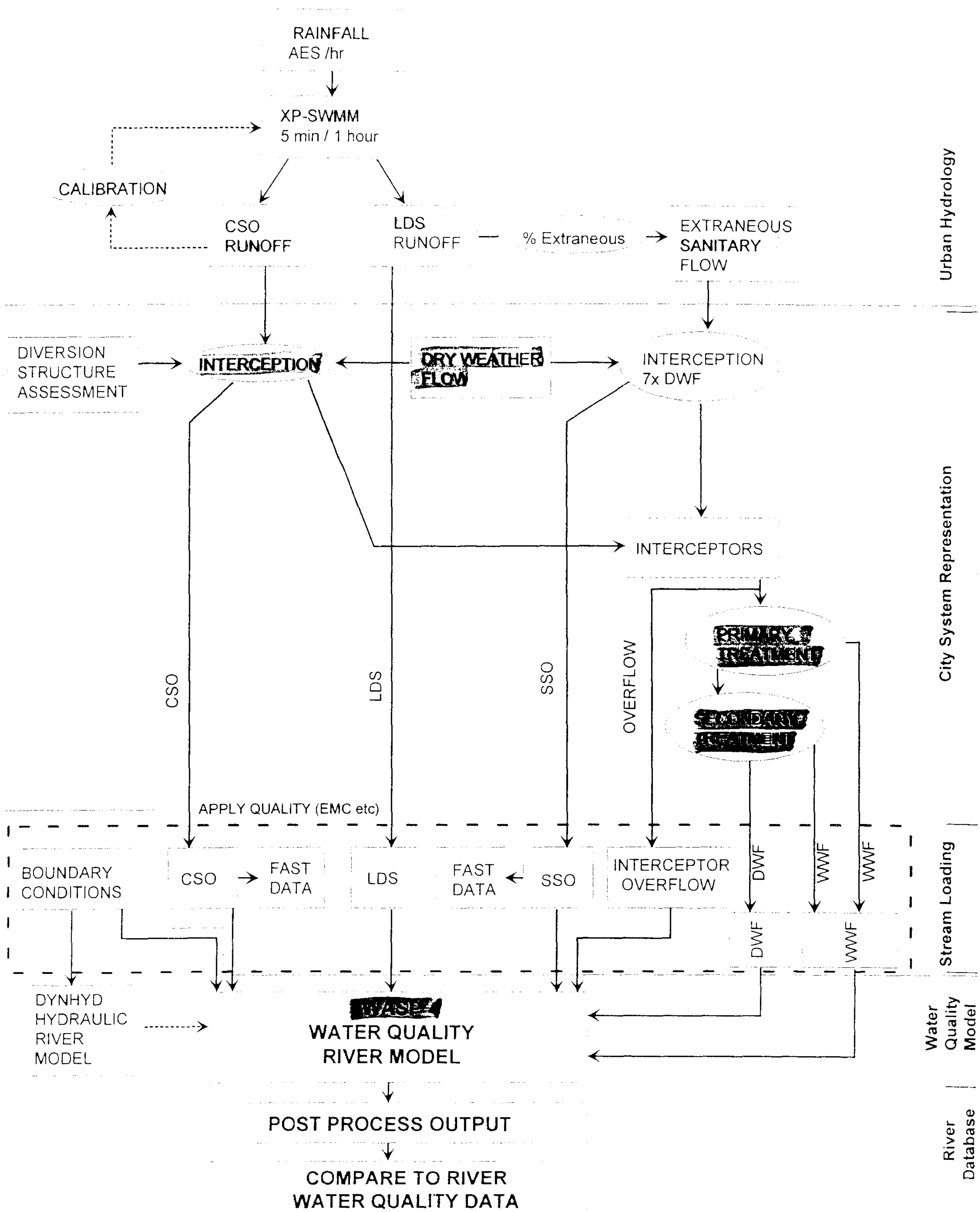
Potential Interception at Various Dewatering Rates

Plan development/ assessment

- Overall Modeling Assessment
  - runoff, systems (CS, LDS), river
- Phase 3
  - Focus on CS districts and NEWPCC
  - base interception rates on ***WWF*** & DWF
  - Design Storage/Treatment with Model to meet performance targets
    - (4 & 0 Overflows *Representative Year*)
  - Assess Candidate performance on ***Long term Rainfall Record***

WS3-40

Regional System Model Components



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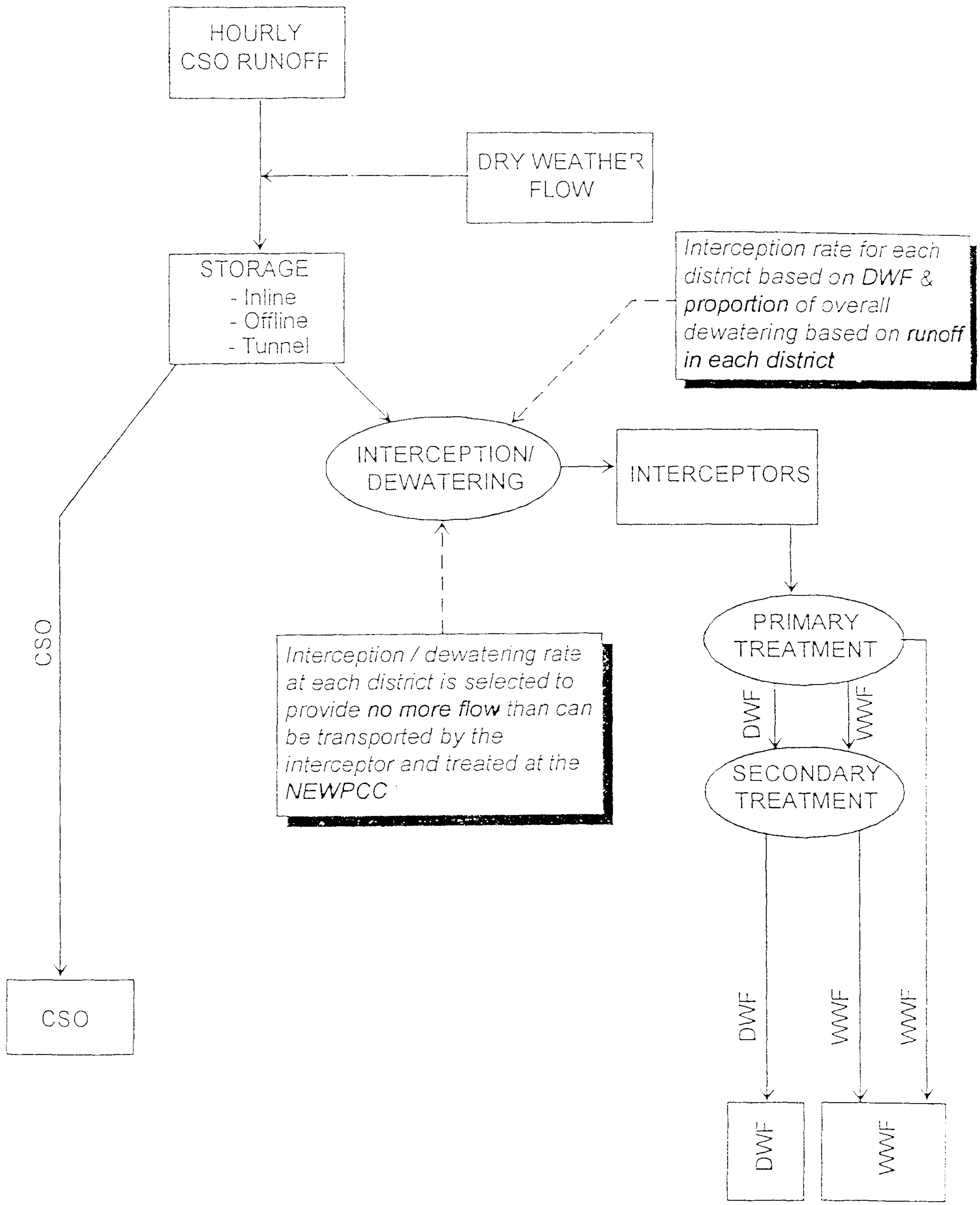
WS 3-41



Regional System Model
Components used in
Candidate Option Assessment
Figure 3-2

WS3-42

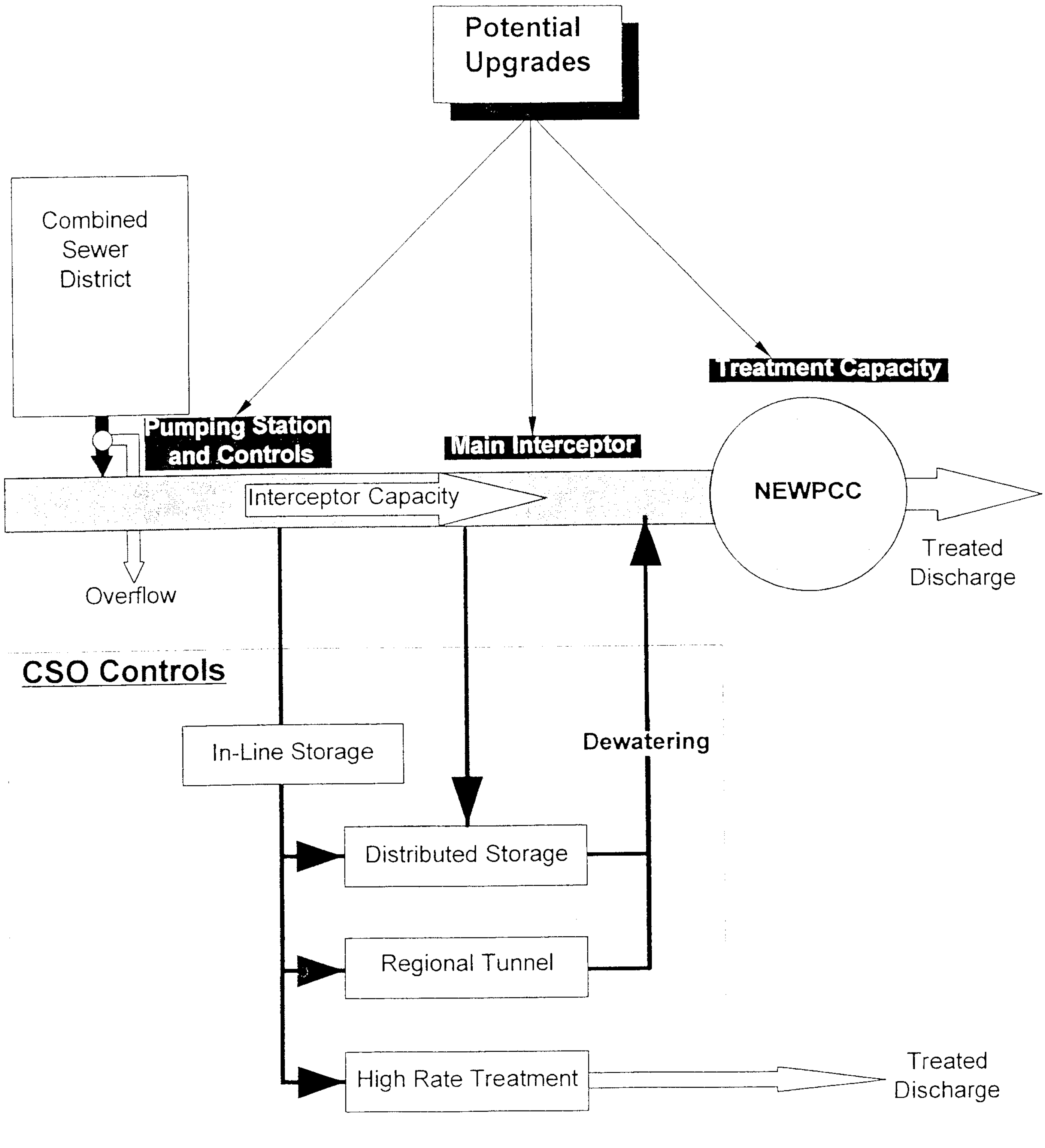
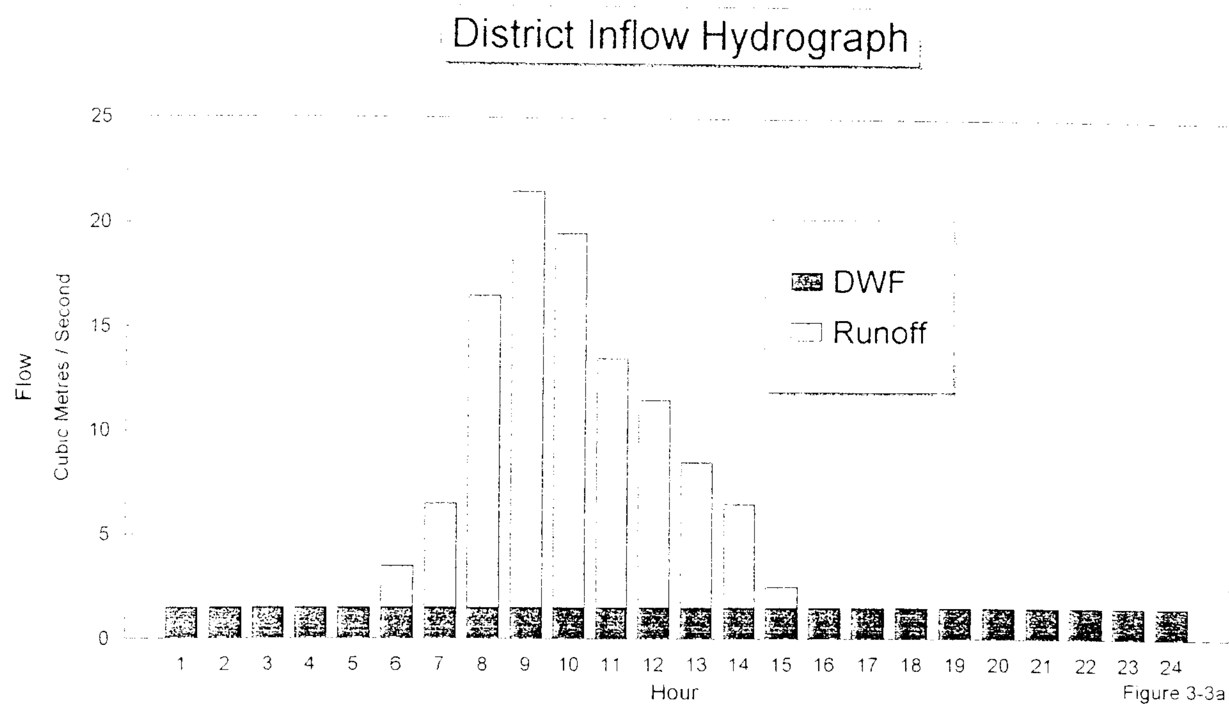
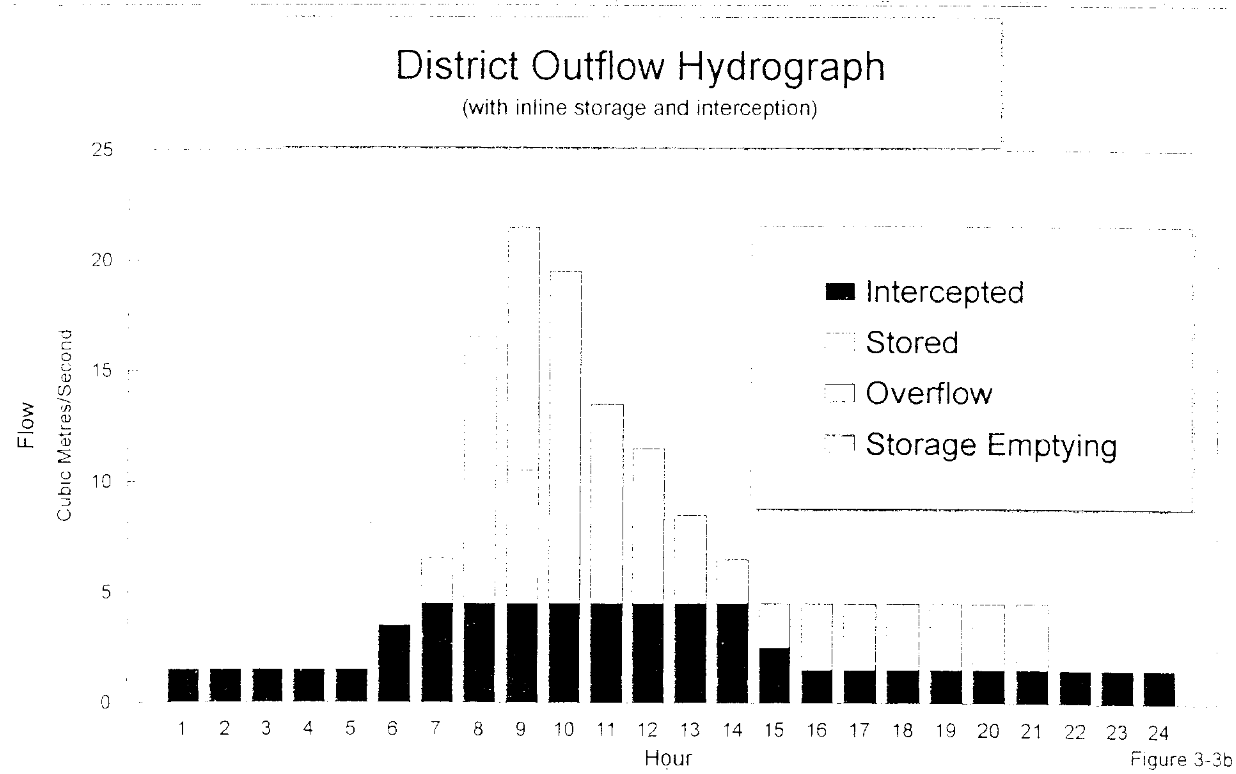


Figure 4-1

Potential Options for CSO Control

WS3-43





MODELLING OF CSO CONTROL
(INLINE STORAGE AND INTERCEPTION)
Figure 3-3

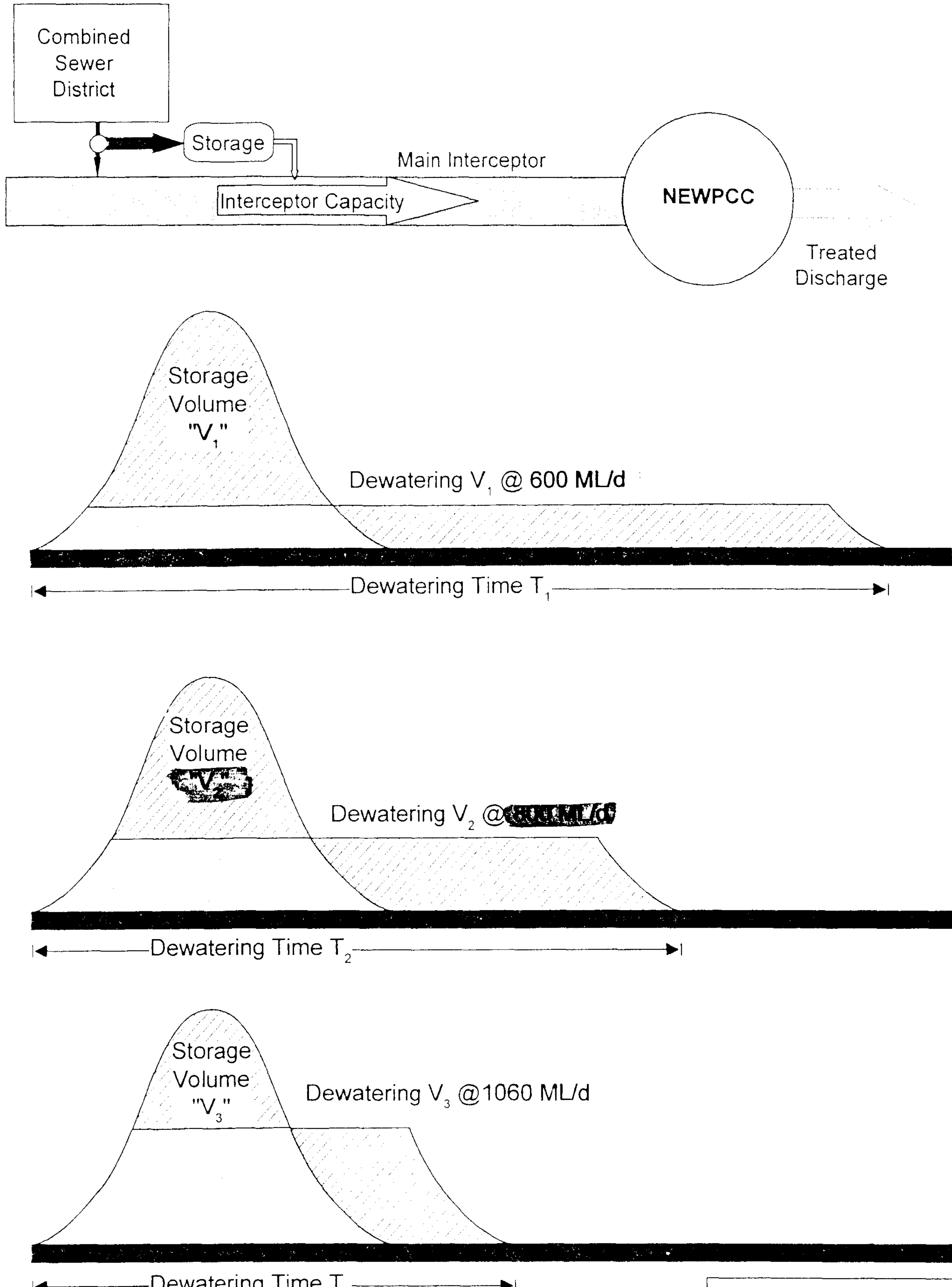
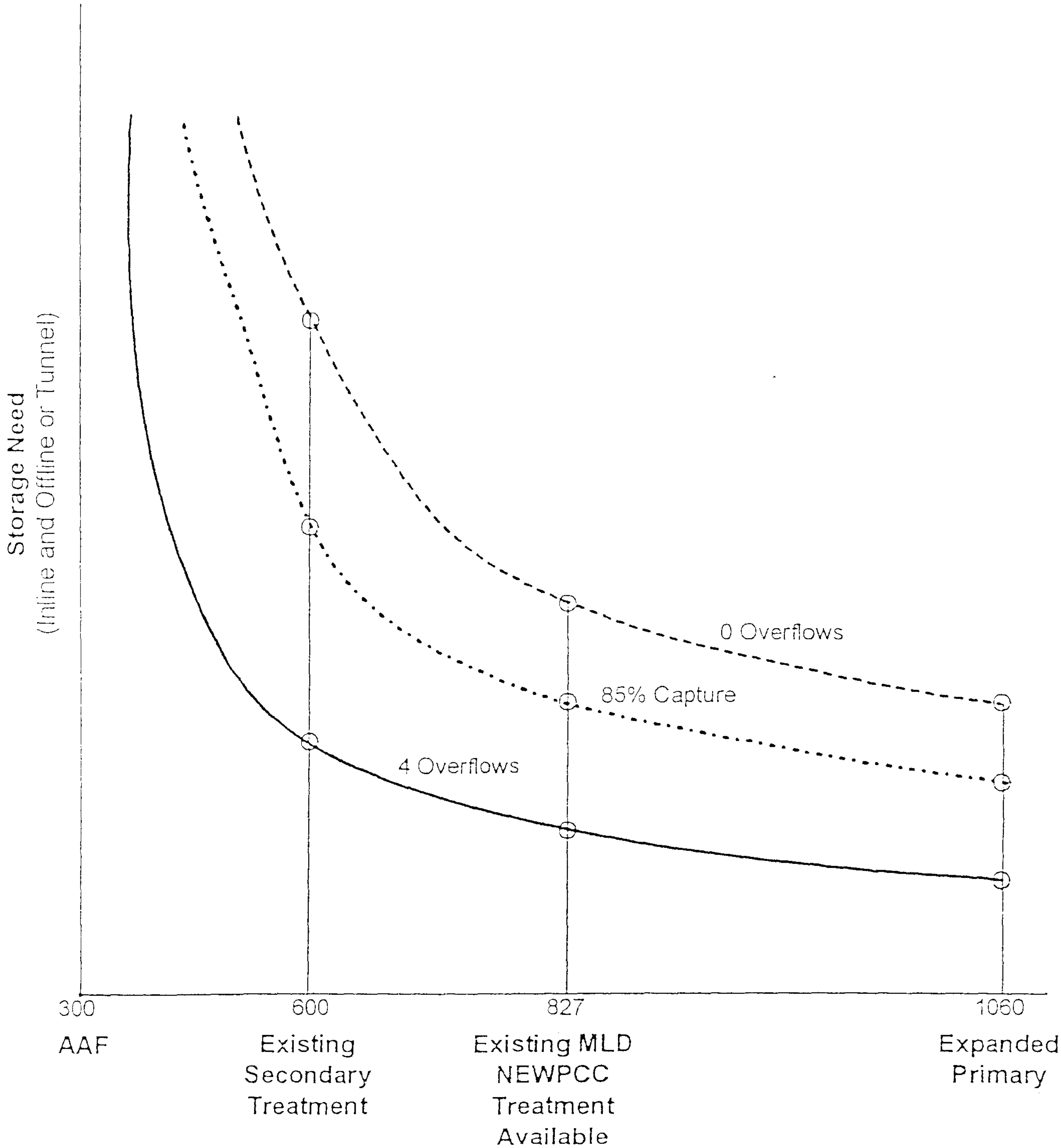


Figure 4-2:

Potential Interception at Various Dewatering Rates

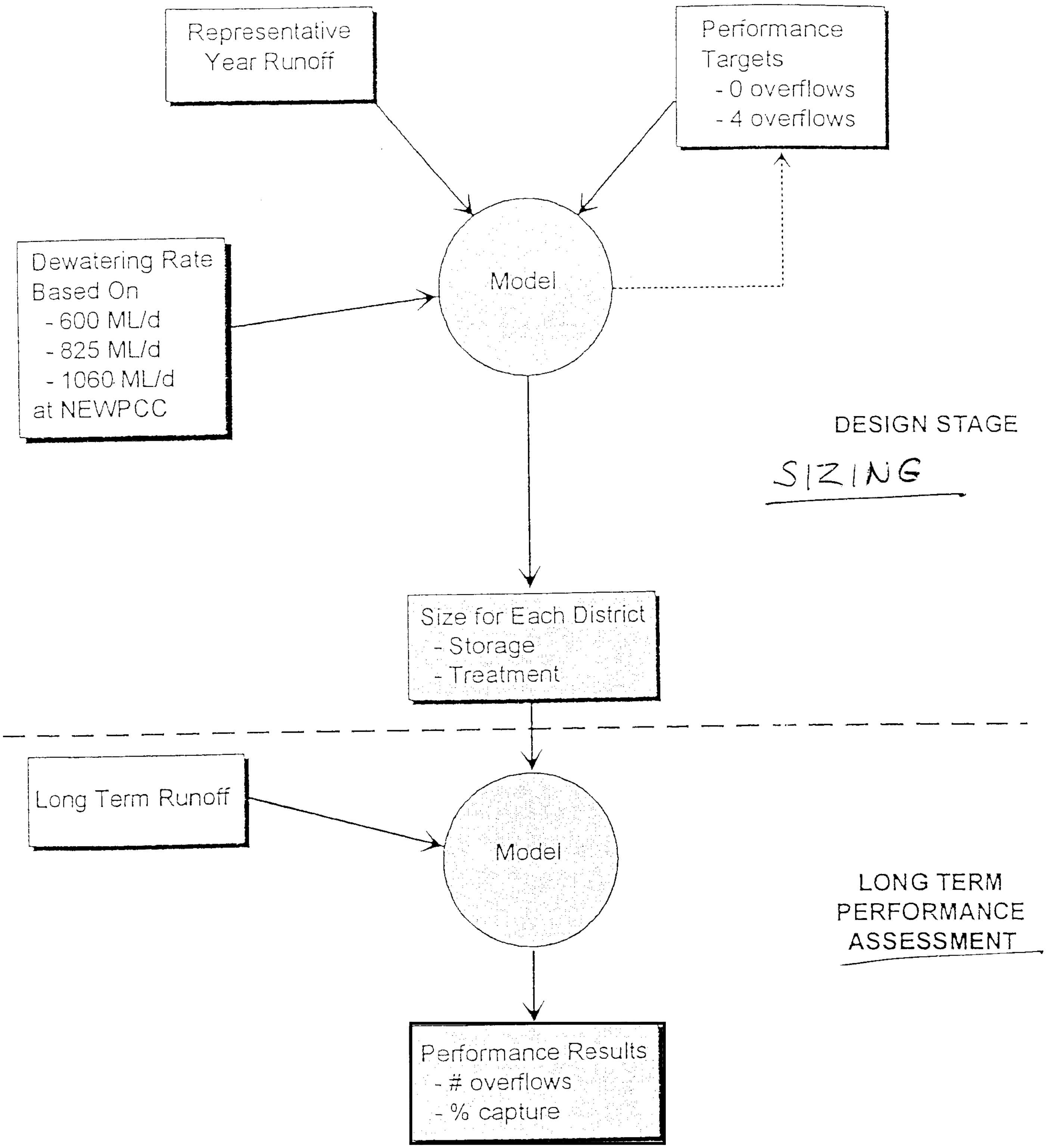
WS 3-45



TetrES
CONSULTANTS INC.

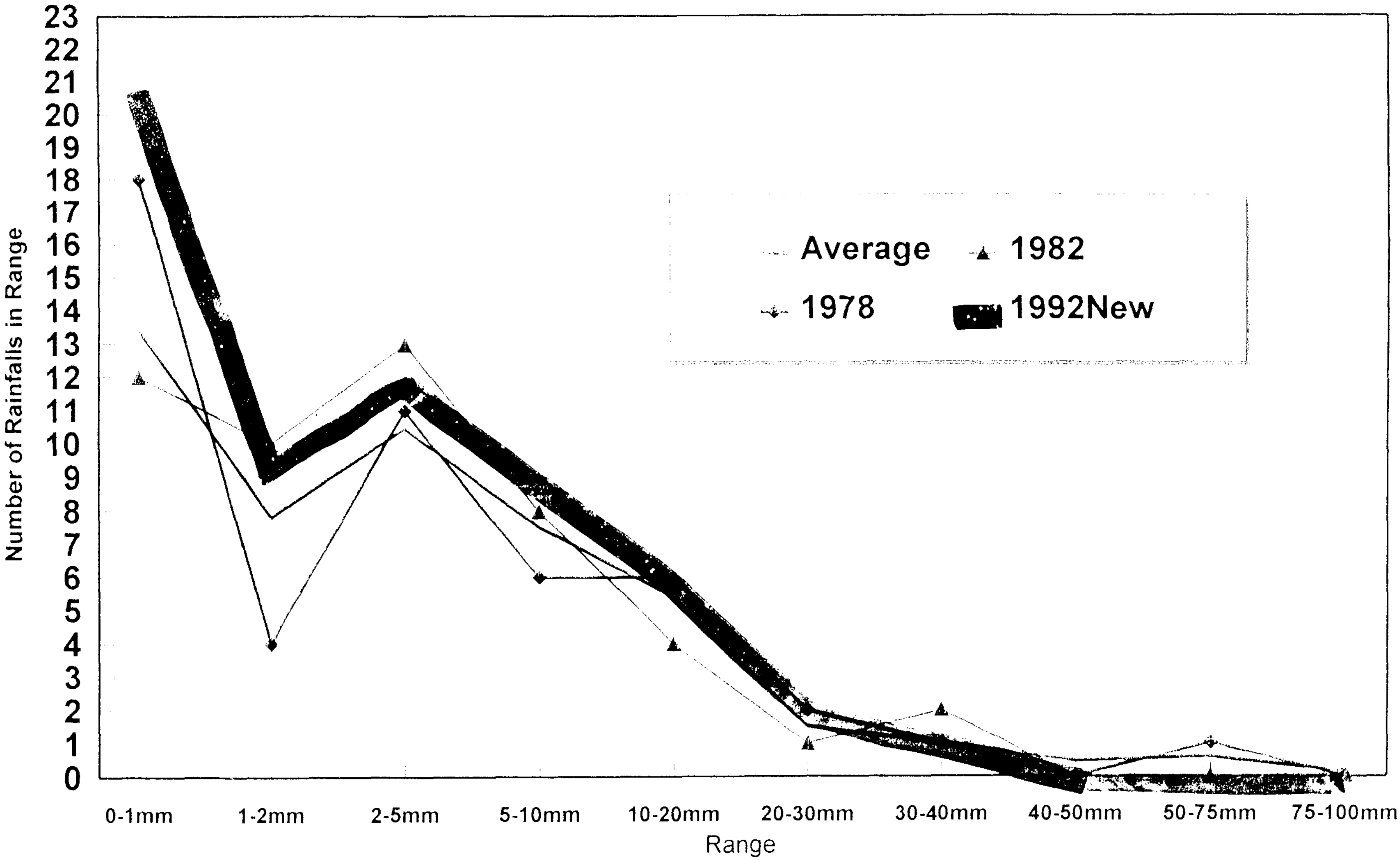
STORAGE / TREATMENT relationship
to meet various performance benchmarks
Figure 3-4

WS 3-46



Method of Sizing and Evaluating Storage / Treament
Figure 3-5

WS 3-47



Rainfall Years with Best Fits

Figure 3-6

RAINNUM.WK4

WS 3-48

A		**Existing Situation**
	1	Existing
B		**Optimizing Existing Infrastructure**
	1	Inline Storage
C		**Target of 4 Overflows**
	1	Distributed Offline Storage
	2	Distributed Inline/Offline Storage
	3	Distributed Inline/Offline Storage with Transfers
	4	Tunnel Transport/Storage
	5	Inline withTunnel Transport/Storage
	6	Hirate Treatment RTB
D		**Target of 0 Overflows - Representative Year**
	1	Distributed Storage
	2	Distributed Inline/Offline Storage
	3	Tunnel Transport/Storage
	4	Inline PlusTunnel Transport/Storage
	5	Hirate Treatment RTB
E		**Target of 1 Overflows - Long Term**
	1	Tunnel Transport/Storage
F		**Target of 0 Overflows - Long Term**
	1	Tunnel Transport/Storage
G		**Separation**
	1	

TRADEOFF.WK4

WSS 3-49

4 - IMPLICATIONS OF CSO CONTROL ON EXISTING SYSTEM

R. GLADDING

DEWATERING RATE IMPLICATIONS

- 600ML/d comprises the design capacity of the NEWPCC secondaries. This would have no impact on the main interceptor and modest impact on the plant.

- 830 ML/d comprises the design capacity of the NEWPCC primaries. This would have a modest impact on the main interceptor and a larger impact on the plant.

- 1060 ML/d comprises an incremental increase in dewatering rate. This has the largest impact on the main interceptor and on the plant.

WS-3-50

IMPACTS ON INTERCEPTORS

- 600ML/d - None

- 830 ML/d - West leg needs reinforcing as a result of Tuxedo/Doncaster/Ash flows plus relief at Omand's Creek and Jessie/River/Marion transfer.

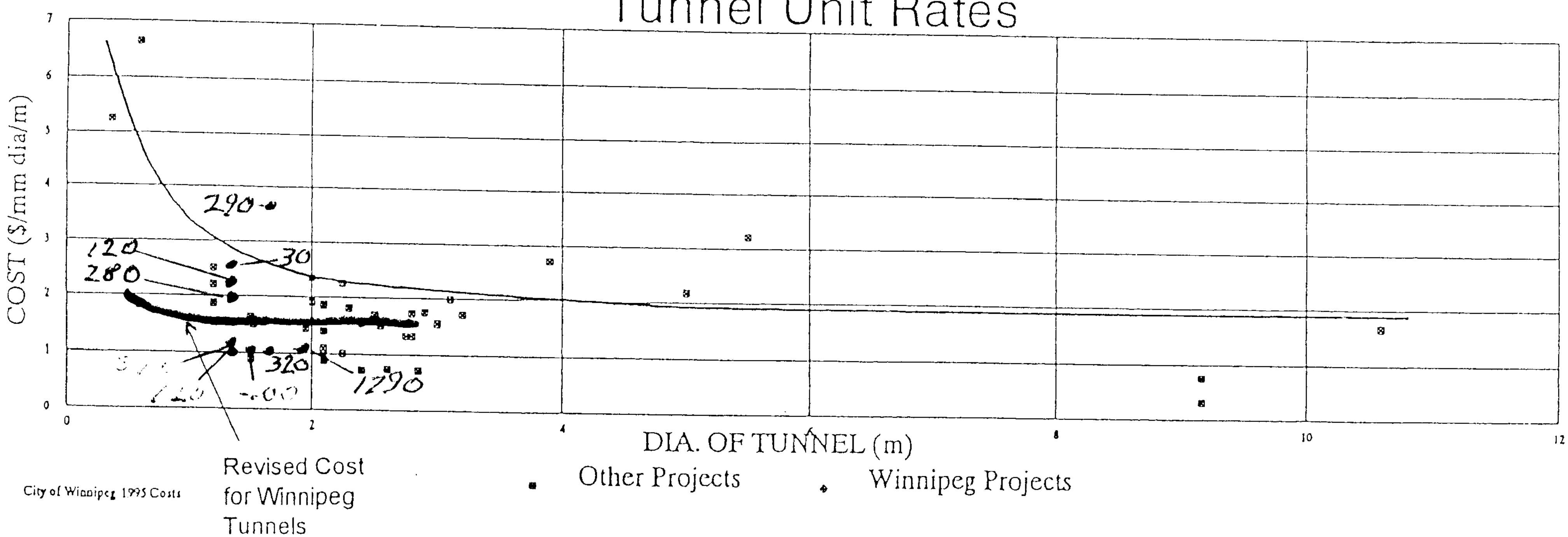
  Cost = $15M

- 1060 ML/d - West leg needs reinforcing from Main Street to Riverbend; main branch, from NEWPCC to west leg plus Jessie/River/Marion transfer.

  Cost = $46M

WS3-51

Tunnel Unit Rates



$X = VALUE OF WINNIPEG CONTRACTS ($K)
1990 → 1995

Figure 4-7

WS3-52

UPGRADING FOR 825 MLD (9.55 CMS)

CSO-275A.dwg

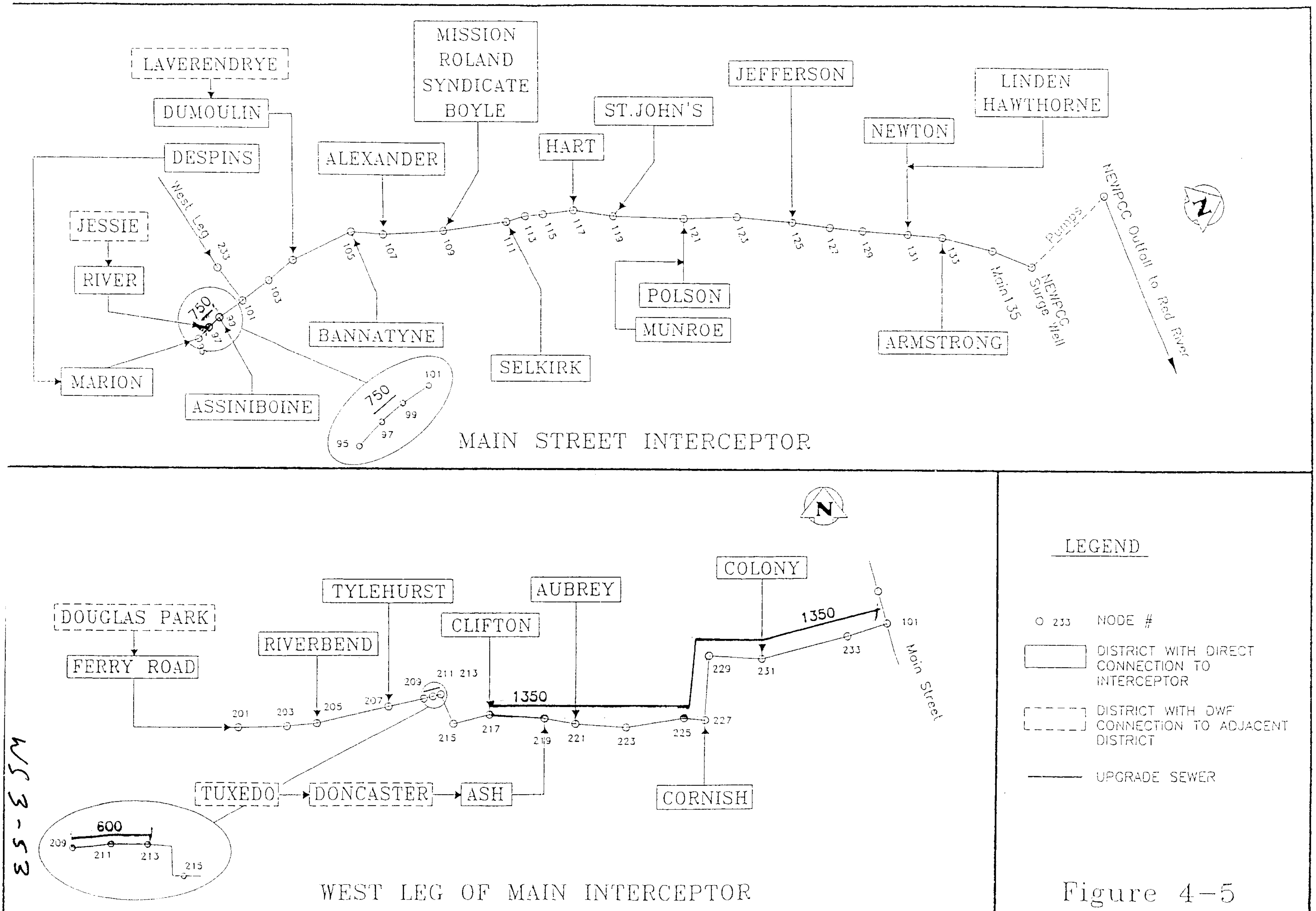


Figure 4-5

UPGRADING FOR 1060 MLD (12.27 CMS)

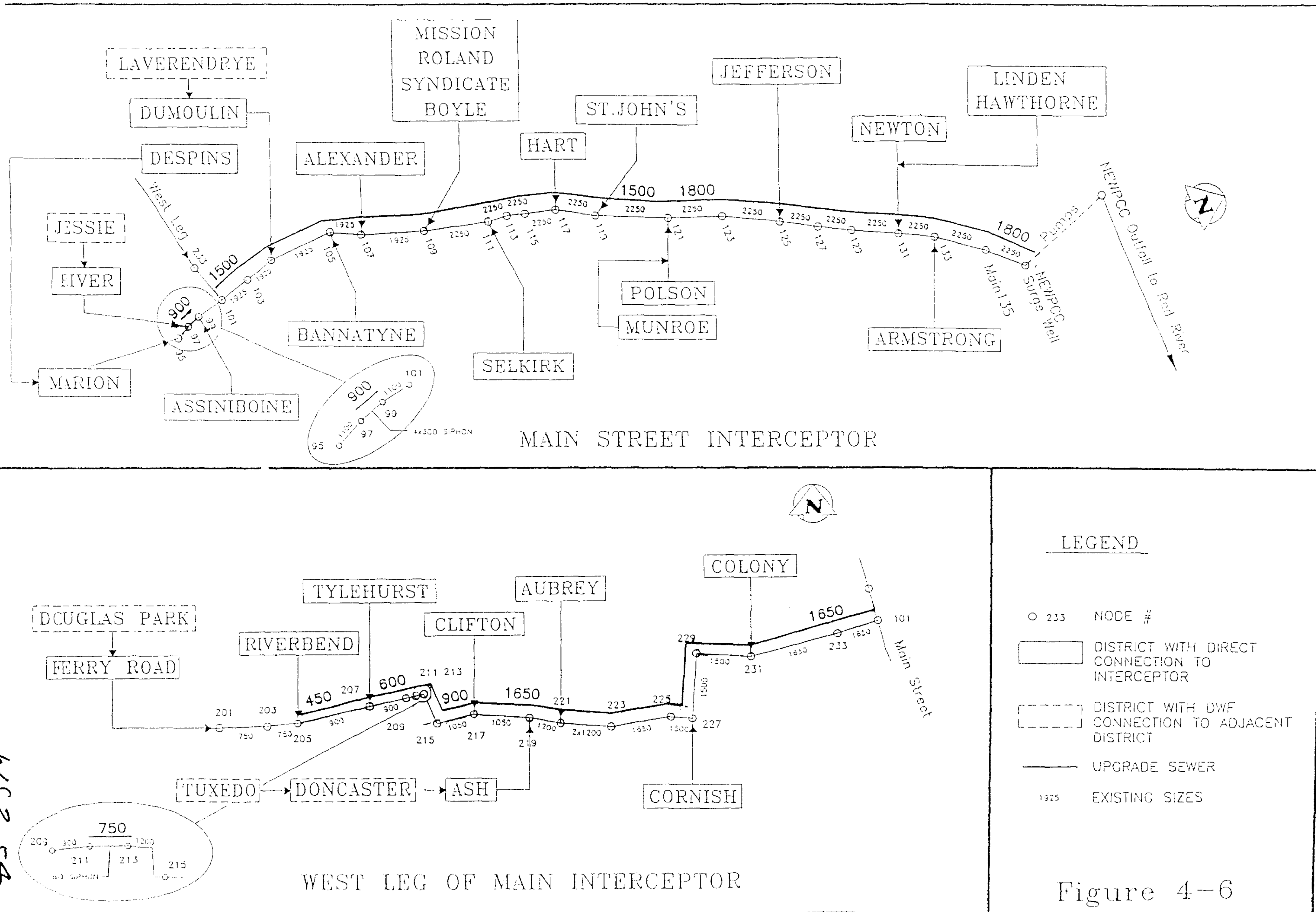


Figure 4–6

PLANT IMPLICATIONS

- 600ML/d - All stored CSO flows would be given secondary treatment and (eventually) disinfection.
- 830 ML/d - Flows in excess of 600ML/d would be given primary treatment. Disinfection would have to be added to mitigate the impacts of the fecal coliforms in the River.
- 1060 ML/d - Similar to 830 ML/d.

IMPACTS ON NEWPCC

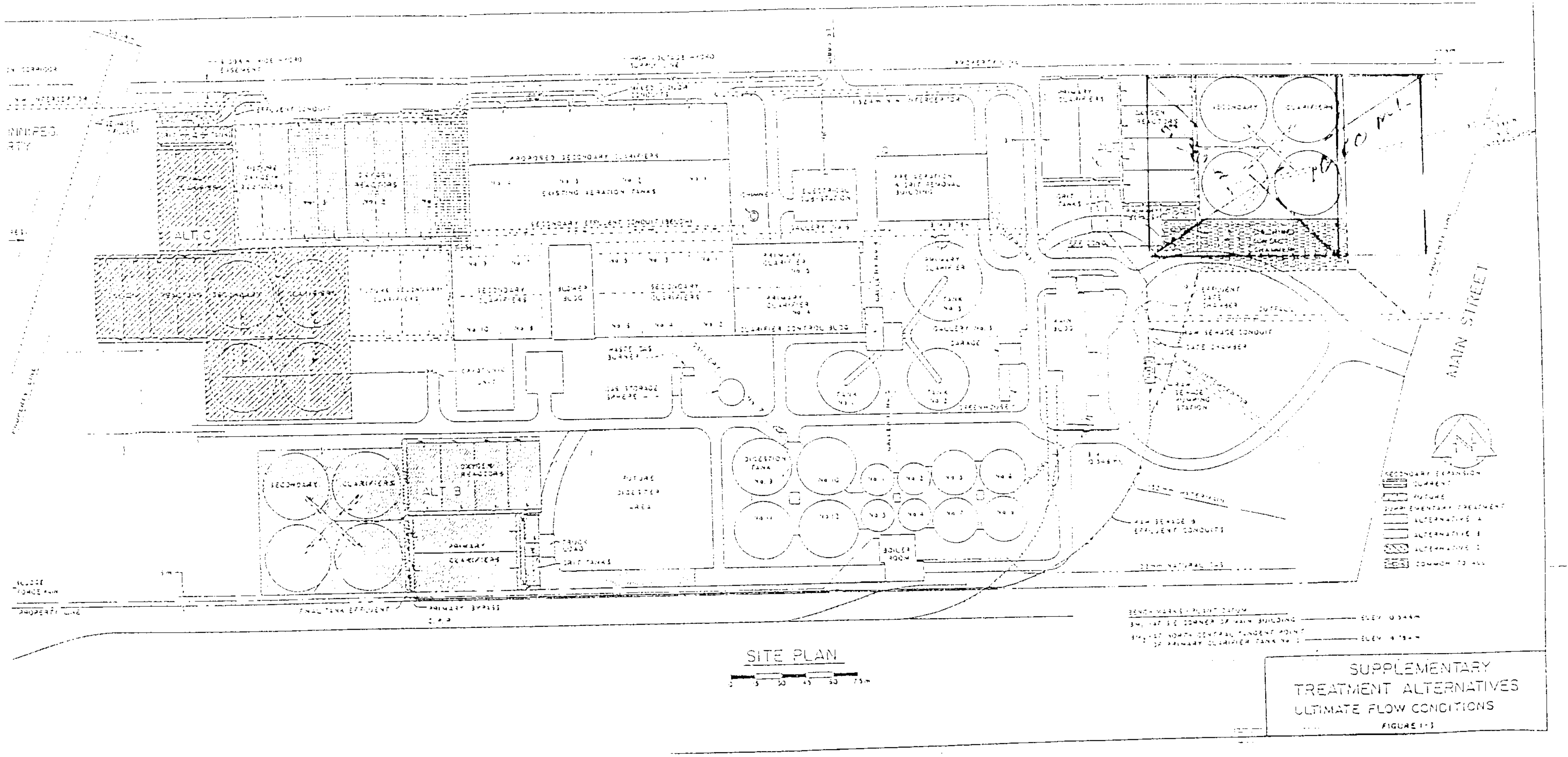
- Increased flows = > solids load to the secondaries (i.e., reduced primary performance). Sustained flow reduces secondary effluent quality

- 600ML/d - Most cost effective answer is to expand secondary clarifier and digester capacity.
  Cost = $15M

- 830 ML/d - Answer is to expand primary clarifier and digester capacity. Also must add disinfection.
  Cost = $36M

- 1060 ML/d - Answer is to expand primary clarifier and digester capacity. Because this exceeds the current NEWPCC capacity , must add pumping, headworks and outfall relief. Also must add disinfection.
  Cost = $70M

WS 3-57



SUPPLEMENTARY TREATMENT ALTERNATIVES
ULTIMATE FLOW CONDITIONS
FIGURE I-3

WS 3-58

Maximum Hours to Dewater Storage

	Plan Number	Dewatering Rate at NEWPCC ML/d	Required Offline Storage Volume m³	Maximum hours to Dewater Storage
Existing Situation				
Existing	0	825		
Optimizing Existing Infrastructure				
Inline Storage	1	600		25
	2	825		15
	3	1060		11
Target of 4 Overflows				
Distributed Offline Storage	4	600	300,000	46
	5	825	215,000	24
	6	1060	185,000	16
Distributed Inline/Offline Storage	7	600	102,000	32
	8	825	66,000	18
	9	1060	38,000	12
Distributed Inline/Offline Storage with Transfers	10	600	80,000	31
	11	825	54,000	18
	12	1060		
Tunnel Transport/Storage	13	600	300,000	46
	14	825	215,000	24
	15	1060	185,000	16
Inline withTunnel Transport/Storage	16	600	102,000	32
	17	825	66,000	18
	18	1060	38,000	12
Hirate Treatment RTB	19	825	160,000	22
Target of 0 Overflows - Representative Year				
Distributed Storage	20	600	825,000	82
	21	825	600,000	40
	22	1060	530,000	27
Distributed Inline/Offline Storage	23	600	606,000	67
	24	825	393,000	32
	25	1060	230,000	18
Tunnel Transport/Storage	26	600	825,000	82
	27	825	600,000	40
	28	1060	530,000	27
Inline PlusTunnel Transport/Storage	29	600	606,000	67
	30	825	393,000	32
	31	1060	230,000	18
Hirate Treatment RTB	32	825	385,000	32
Target of 1 Overflows - Long Term				
Tunnel Transport/Storage	33	600	1,200,000	108
	34	825	1,000,000	57
	35	1060	825,000	35
Target of 0 Overflows - Long Term				
Tunnel Transport/Storage	36	600	2,438,000	193
	37	825	2,175,000	106
	38	1060	2,000,000	70
Separation				
	39			

TRADEOFF.WK4

WS 3-59

5 - <u>IN-LINE STORAGE</u>

N. SZOKE

In-Line Storage CSO Control Option

Phase 3 Workshop
May 7th, 1998
Winnipeg Canoe Club

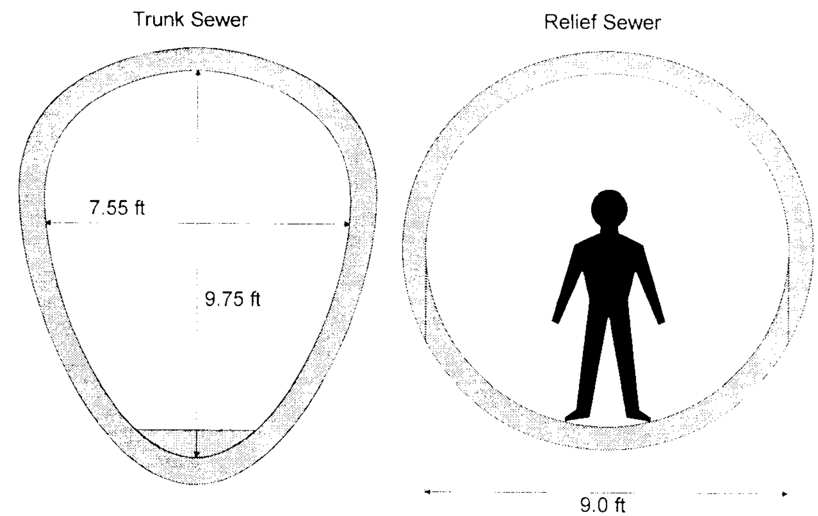
Presentation Overview

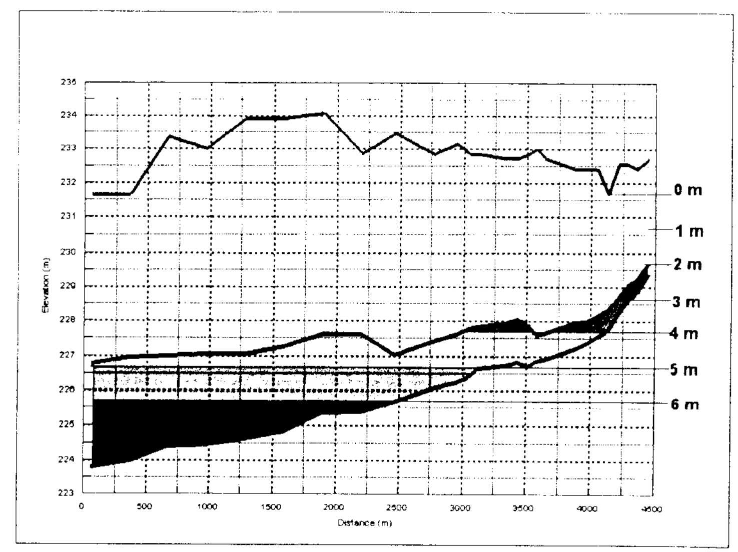
- Phase 3 analysis considered the following key factors to estimate storage potential in existing combined sewer trunks and relief pipe
  - ➠Local Conditions
  - ➠Estimation Method
  - ➠Operational Considerations
  - ➠Pilot Testing Programs
  - ➠Cost Estimates
  - ➠Importance of Future BFR Programs

WS 3-61

Winnipeg Situation

- Flat topography, intense rainfalls, and highly impervious clay soils
- Use large pipes at minimum grade to convey peak flows
  - trunks extend significant distance up into CS districts
  - capacity exists to contain flows for smaller event rainfalls
  - initial phase 2 estimates indicated sufficient storage may be available area-wide to be a valid control option
  - more detailed estimates performed in phase 3 to better quantify benefit



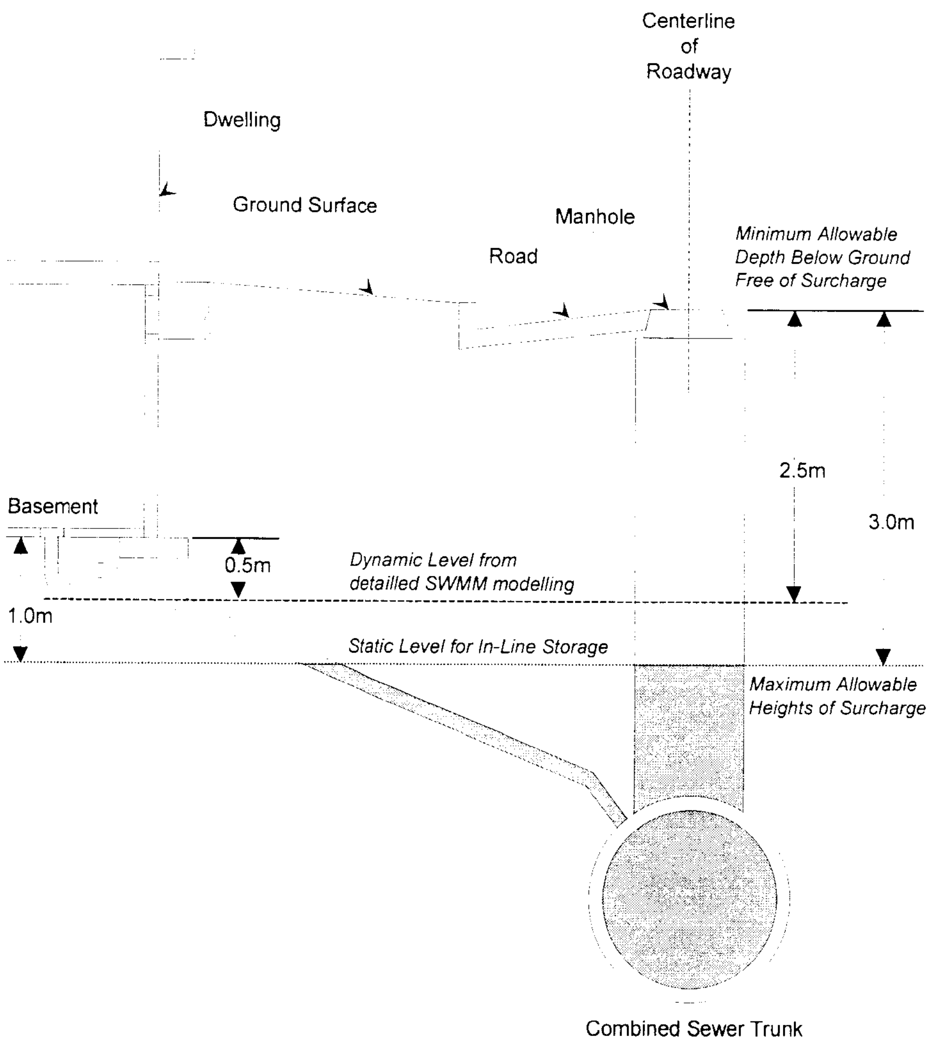


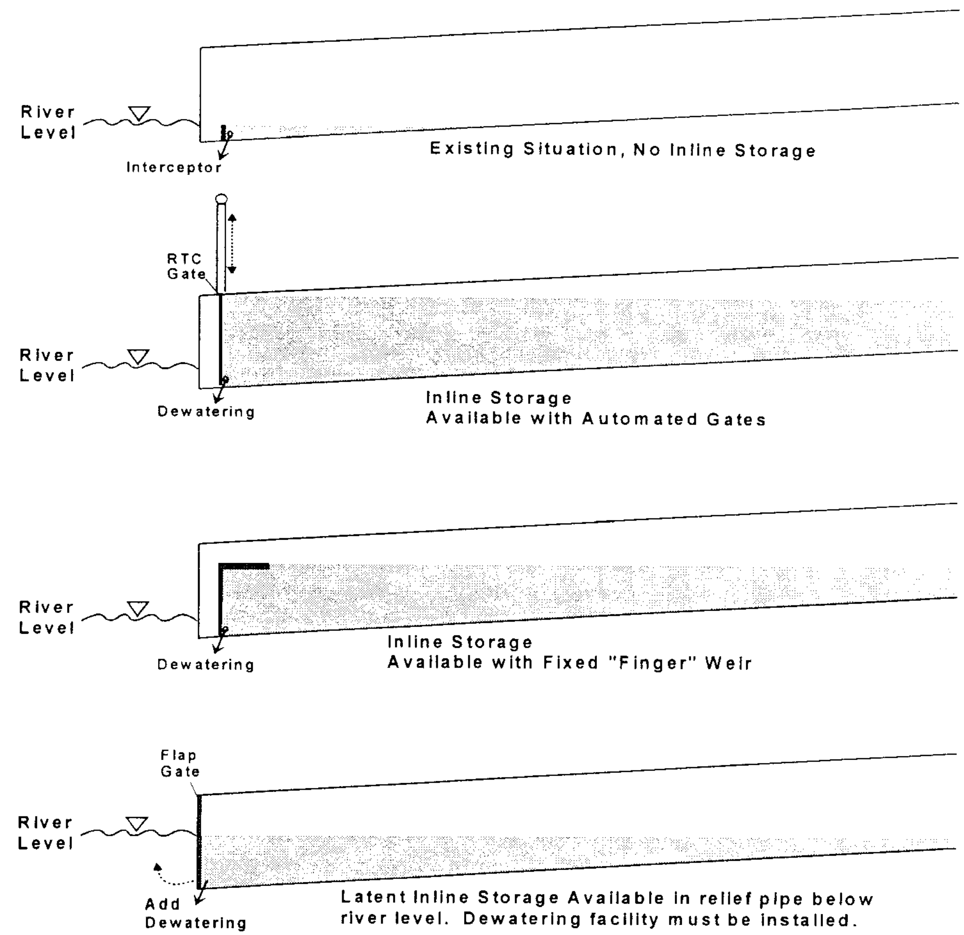
WS3-62

Estimate of Potential Storage

- **Controlling Constraints**
  - Maintain existing level of Basement Flood protection
    - key factor for any in-line storage control technology
    - establishes min. allowable surcharge free depth (3m)
  - Automated Gate Control Option
    - max. water level restricted to pipe obvert at point of control to reduce or eliminate:
      - water hammer, air surges, sink hole formation, structural weakening
    - small risk of failure in closed position
  - Fixed Weir Control Option
    - inherently safe, but must be designed to integrate with HGL for design storm for each CS district
      - height of weir = HGL - depth of flow over weir
  - Latent Storage
    - some existing relief pipes have the potential now to store CSO
    - will required dewatering and flap gates to be water tight

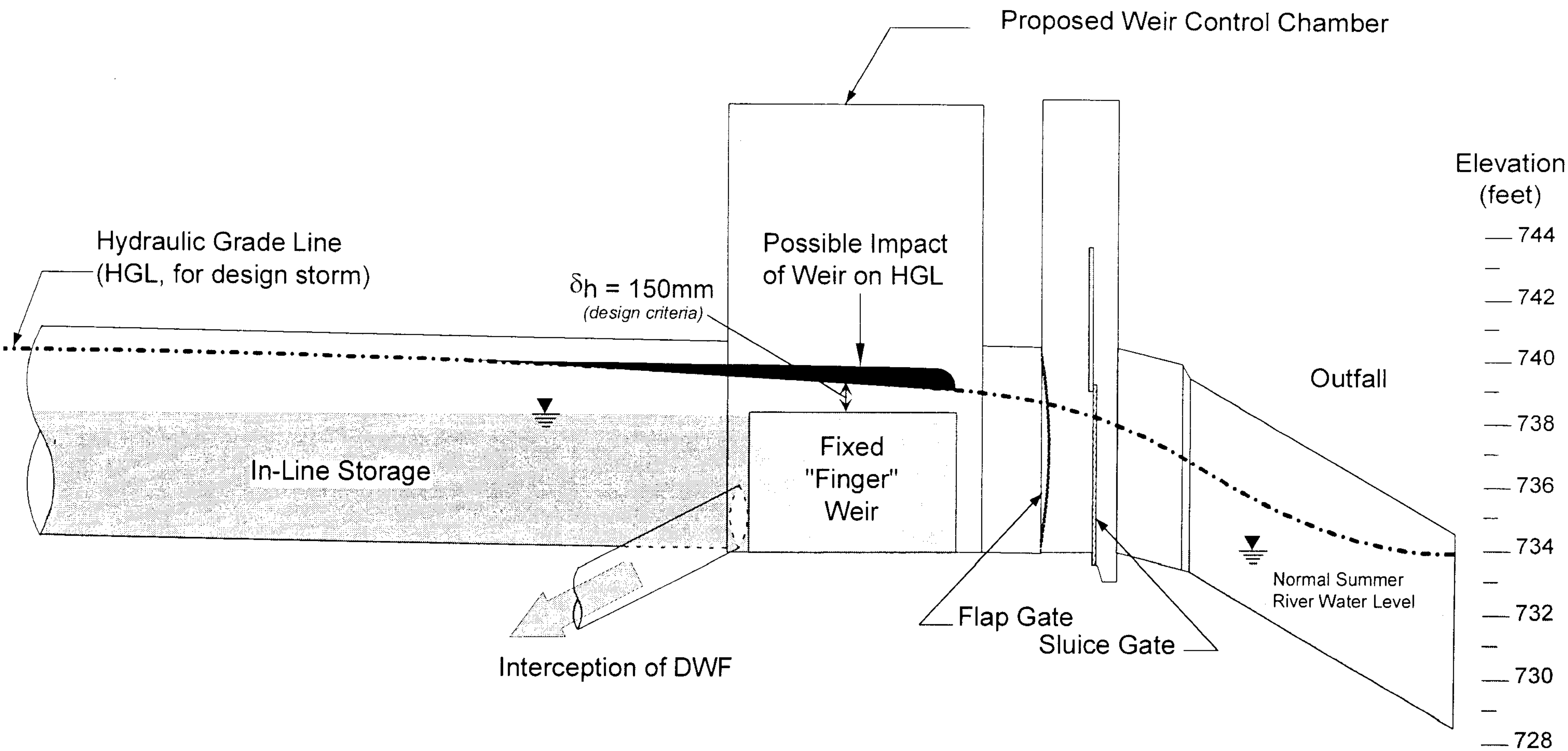
Storage Level Considerations



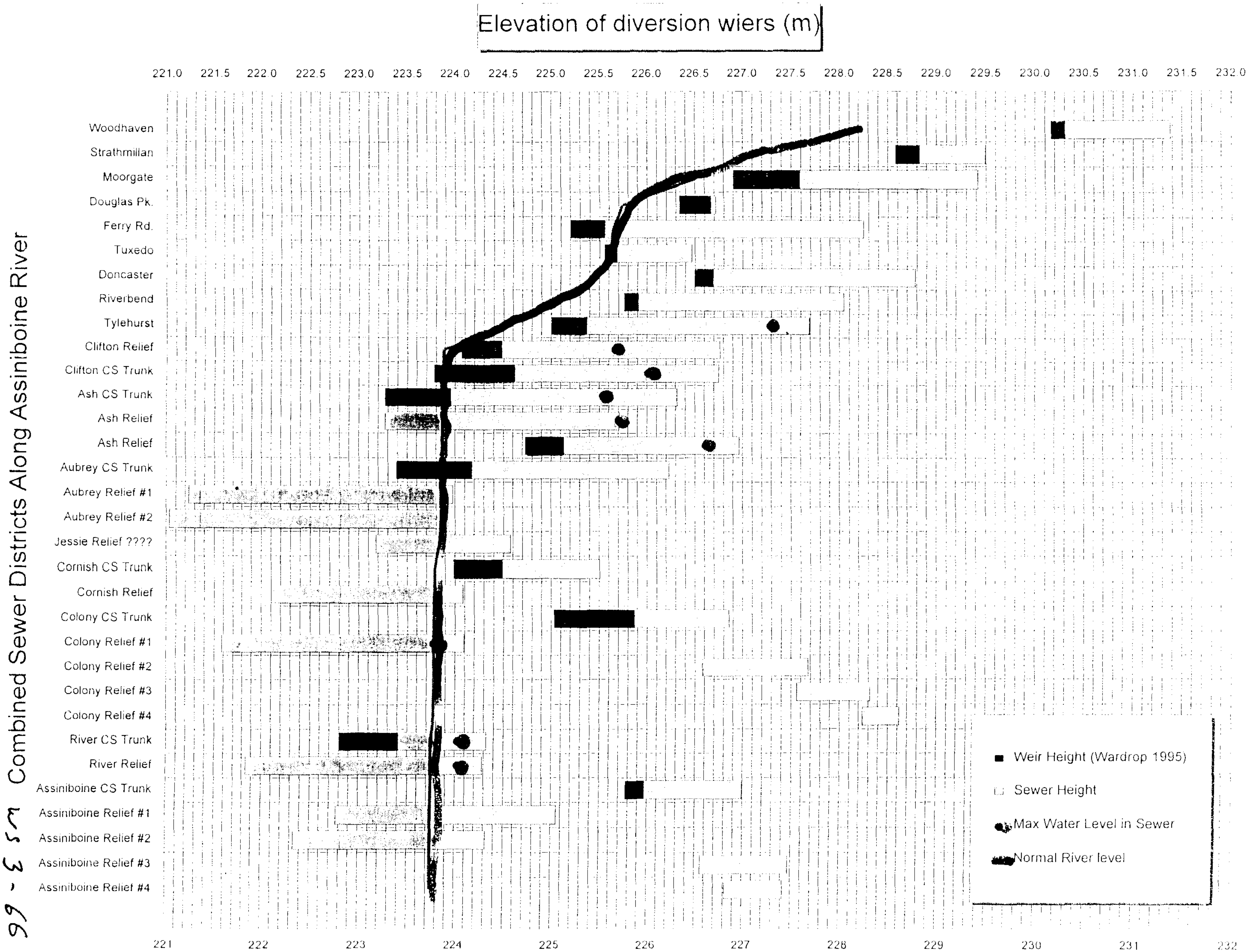


WS 3-64

HGL and Fixed Weir



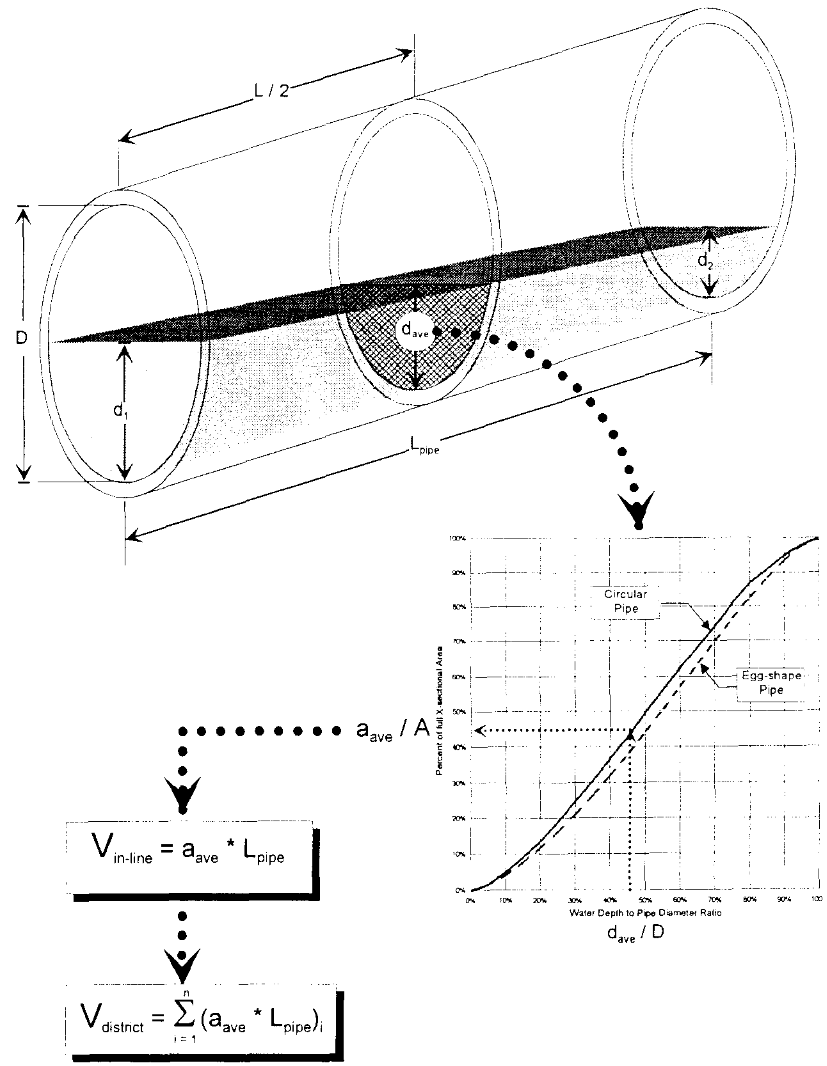
MS 3-65



(CH33-20)
WS 3-66

Estimation Method

- **Key factors considered in volume calculations:**
  - geometric description of the combine sewer network
    - Shape and dimensions (cross-sectional area)
      - Elliptical, height and width
      - Circular, diameter
    - Length (between nodes)
    - Elevation (at nodes)
      - pipe invert
      - ground
    - Sewer network
      - SWMM data files
      - LBIS
  - a) Minimum depth below ground
    - 3.05m for automated gate
    - 3.20m for fixed weir
  - b) Maximum WL = Obvert
  - Lower elevation of a) or b) governs storage level



In-Line Storage Volumes

- **Volume estimates based on:**
  - Existing pipes in the ground
  - Average x-sectional area, as calculate from water depth at mid-pipe length for a specific horizontal control elevation, multiplied by pipe length
  - Automated Gate, lower elevation governs
    - max. level not to exceed obvert, or
    - 3.05m below min. ground
  - Fixed Weir, lower elevation governs
    - HGL - 0.15m, or
    - 3.20m below min ground
  - Latent storage governed by river level
  - Sum of all pipes within each CS districts
  - Sum all CS districts

Table 6-2: Existing Conditions
1c) Potential Storage Available Utilizing an Automated Gate

			1	2	1+2 =3	4	3	19	20	21	22
District Name	Relief Status	Tributary Area (Ha)	Height of Sewer	Invert	Obvert	Min. Ground	Obvert	10 ft below Min Ground	Control Elevation	Depth below min ground	Volume (m³)
Alexander	no	146	5.50	736.990	742.490	758.500	742.49	748.500	742.490	16.0	3,690
Armstrong	no	148	9.00	730.770	739.770	748.500	739.77	738.500	738.500	10.0	5,313
Ash	yes	823	10.00	732.500	742.500	762.139	742.50	752.139	742.500	19.6	33,978
Assiniboine	yes	75	4.00	740.720	744.720	752.570	744.72	742.570	742 570	10.0	6,495
Aubrey	yes	390	9.33	732.890	742.220	760.000	742.22	750.000	742.220	17.8	50,316
Baltimore	yes	211	6.00	732.159	738.159	753.000	738.16	743.000	738.159	14.8	1,026
Bannatyne	yes	206	5.00	736.970	741.970	759.000	741.97	749.000	741.970	17.0	14,015
Boyle	no	25	3.00	734.040	737.040	754.500	737.04	744.500	737.040	17.5	39
Clifton	yes	415	9.75	734.180	743.930	762.000	743.93	752.000	743.930	18.1	6,782
Cockburn/Calrossie	no	243	8.83	732.540	741.370	759.750	741.37	749.750	741.370	18.4	5,576
Colony	yes	227	6.00	738.280	744.280	759.500	744.28	749.500	744.280	15.2	12,464
Cornish	yes	127	5.00	734.850	739.850	756.000	739.85	746.000	739.850	16.2	5,439
Despins/Marion	no	317	4.43	730.774	735.203	746.063	735.20	736.063	735.203	10.9	4,443
Doncaster	no	133	7.50	743.100	750.600	763.770	750.60	753.770	750.600	13.2	5,823
Douglas Pk/Ferry Rd	no	251	10.00	738.840	748.840	758.000	748.84	748.000	748.000	10.0	6,204
Dumoulin/La Verendrye	no	136	11.48	737.690	749.173	754.500	749.17	744.500	744.500	10.0	1,148
Hart	yes	142	9.33	731.370	740.700	749.250	740.70	739.250	739.250	10.0	5,465
Hawthorne	no	219	5.50	734.010	739.510	752.800	739.51	742.800	739.510	13.3	8,397
Jefferson E & W	yes	977	11.83	731.480	743.310	751.500	743.31	741.500	741.500	10.0	21,046
Jessie	yes	338	7.87	731.791	739.665	759.514	739.67	749.514	739.665	19.8	5,372
Linden	yes	149	4.50	733.180	737.680	748.000	737.68	738.000	737.680	10.3	1,455
Mager Drive	yes	260	11.25	734.900	746.150	755.500	746.15	745.500	745.500	10.0	9,427
Metcalfe	no	34	5.33	731.810	737.140	757.500	737.14	747.500	737.140	20.4	967
Mission	no	421	9.75	730.910	740.660	756.000	740.66	746.000	740.660	15.3	8,007
Moorgate	no	157	8.25	744.430	752.680	765.000	752.68	755.000	752.680	12.3	3,592
Munroe	yes	375	10.50	733.600	744.099	752.850	744.10	742.850	742.850	10.0	42,482
Newton	no	56	6.00	734.380	740.380	750.620	740.38	740.620	740.380	10.2	1,847
Polson	yes	238	7.14	730.217	737.352	751.706	737.35	741.706	737.352	14.4	21,854
River	yes	108	5.00	730.970	735.970	753.800	735.97	743.800	735.970	17.8	2,855
Riverbend/Parkside Dr.	no	189	7.50	740.670	748.170	760.000	748.17	750.000	748.170	11.8	6,872
Roland	yes	178	9.50	733.410	742.910	756.500	742.91	746.500	742.910	13.6	26,462
Selkirk	yes	259	6.67	733.900	740.570	750.000	740.57	740.000	740.000	10.0	7,912
St. Johns	yes	335	6.33	732.841	739.173	755.249	739.17	745.249	739.173	16.1	24,975
Strathmillan	no	69	3.00	749.930	752.930	764.500	752.93	754.500	752.930	11.6	96
Syndicate	no	79	3.50	739.940	743.440	751.000	743.44	741.000	741.000	10.0	35
Tuxedo	no	50	3.00	740.000	743.000	759.000	743.00	749.000	743.000	16.0	241
Tylehurst	no	185	8.83	738.180	747.010	762.500	747.01	752.500	747.010	15.5	4,829
Woodhaven	no	42	4.00	755.110	759.110	766.800	759.11	756.800	756.800	10.0	75
		8,733									367,012

Table 6-2: Existing Conditions
1b) Potential Storage Available Utilizing a Fixed Weir

District Name	Relief Status	Tributary Area (Ha)	1 Height of Sewer	2 Invert	1+2 =3 Obvert	4 Min. Ground	12 Max Water Level from Computer Modelling	13 Estimated Max WL	14 Estimated Max WL -0.5 ft	15 10.5 ft below Min Ground	16=Min(14,15) Control Elevation	17 Depth below min ground	18 Volume (m^3)
Alexander	no	146	5.50	736.990	742.490	758.500		741.665	741.165	748.000	741.165	17.3	2,576
Armstrong	no	148	9.00	730.770	739.770	748.500		738.420	737.920	738.000	737.920	10.6	4,380
Ash	yes	823	10.00	732.500	742.500	762.139	740.00	740.000	739.500	751.639	739.500	22.6	26,085
Assiniboine	yes	75	4.00	740.720	744.720	752.570		744.120	743.620	742.070	742.070	10.5	6,123
Aubrey	yes	390	9.33	732.890	742.220	760.000		740.821	740.321	749.500	740.321	19.7	44,533
Baltimore	yes	211	6.00	732.159	738.159	753.000	736.22	736.220	735.720	742.500	735.720	17.3	301
Bannatyne	yes	206	5.00	736.970	741.970	759.000		741.220	740.720	748.500	740.720	18.3	11,776
Boyle	no	25	3.00	734.040	737.040	754.500		736.590	736.090	744.000	736.090	18.4	14
Clifton	yes	415	9.75	734.180	743.930	762.000	741.50	741.500	741.000	751.500	741.000	21.0	3,870
Cockburn/Calrossie	no	243	8.83	732.540	741.370	759.750		740.046	739.546	749.250	739.546	20.2	3,953
Colony	yes	227	6.00	738.280	744.280	759.500		743.380	742.880	749.000	742.880	16.6	11,012
Cornish	yes	127	5.00	734.850	739.850	756.000		739.100	738.600	745.500	738.600	17.4	4,478
Despins/Marion	no	317	4.43	730.774	735.203	746.063	734.91	734.908	734.408	735.563	734.408	11.7	2,932
Doncaster	no	133	7.50	743.100	750.600	763.770		749.475	748.975	753.270	748.975	14.8	3,541
Douglas Pk/Ferry Rd	no	251	10.00	738.840	748.840	758.000		747.340	746.840	747.500	746.840	11.2	4,935
Dumoulin/La Verendrye	no	136	11.48	737.690	749.173	754.500		747.450	746.950	744.000	744.000	10.5	1,046
Hart	yes	142	9.33	731.370	740.700	749.250	737.80	737.800	737.300	738.750	737.300	12.0	3,203
Hawthorne	no	219	5.50	734.010	739.510	752.800		738.685	738.185	742.300	738.185	14.6	6,553
Jefferson E & W	yes	977	11.83	731.480	743.310	751.500	742.00	742.000	741.500	741.000	741.000	10.5	19,395
Jessie	yes	338	7.87	731.791	739.665	759.514		738.484	737.984	749.014	737.984	21.5	4,496
Linden	yes	149	4.50	733.180	737.680	748.000	737.43	737.434	736.934	737.500	736.934	11.1	1,020
Mager Drive	yes	260	11.25	734.900	746.150	755.500	742.50	742.500	742.000	745.000	742.000	13.5	4,905
Metcalfe	no	34	5.33	731.810	737.140	757.500		736.341	735.841	747.000	735.841	21.7	512
Mission	no	421	9.75	730.910	740.660	756.000		739.198	738.698	745.500	738.698	17.3	4,623
Moorgate	no	157	8.25	744.430	752.680	765.000		751.443	750.943	754.500	750.943	14.1	2,324
Munroe	yes	375	10.50	733.600	744.099	752.850	742.06	742.060	741.560	742.350	741.560	11.3	37,556
Newton	no	56	6.00	734.380	740.380	750.620		739.480	738.980	740.120	738.980	11.6	1,349
Polson	yes	238	7.14	730.217	737.352	751.706	737.35	737.352	736.852	741.206	736.852	14.9	21,397
River	yes	108	5.00	730.970	735.970	753.800	735.00	735.000	734.500	743.300	734.500	19.3	1,404
Riverbend/Parkside Dr.	no	189	7.50	740.670	748.170	760.000		747.045	746.545	749.500	746.545	13.5	4,487
Roland	yes	178	9.50	733.410	742.910	756.500	739.24	739.240	738.740	746.000	738.740	17.8	18,261
Selkirk	yes	259	6.67	733.900	740.570	750.000	738.50	738.500	738.000	739.500	738.000	12.0	4,833
St. Johns	yes	335	6.33	732.841	739.173	755.249	739.17	739.173	738.673	744.749	738.673	16.6	24,716
Strathmillan	no	69	3.00	749.930	752.930	764.500		752.480	751.980	754.000	751.980	12.5	28
Syracuse	no	79	3.50	739.940	743.440	751.000		742.915	742.415	740.500	740.500	10.5	2
Tuxedo	no	50	3.00	740.000	743.000	759.000		742.550	742.050	748.500	742.050	17.0	168
Tylehurst	no	185	8.83	738.180	747.010	762.500	745.70	745.700	745.200	752.000	745.200	17.3	2,419
Woodhaven	no	42	4.00	755.110	759.110	766.800		758.510	758.010	756.300	756.300	10.5	25
		8,733											295,233

WS 3-70 (CH 33-22) avail. the report. hydraulics reviewed.

0.85D on average

Table 6-1: Existing Conditions
1a) Latent Storage Potentially Available Now

District Name	Relief Status	Tributary Area (Ha)	1 Height of Sewer	2 Invert	1+2 =3 Obvert	4 Min. Ground	5 Normal River level	6 Weir Elevation	7=Max(5,6) Existing Control Level	8 10 ft below Min Ground	9=Min(7,8) Control Elevation	10 Depth below min ground	11 Volume (m^3)
Alexander	no	146	5.50	736.990	742.490	758.500	733.906	738.599	738.599	748.500	738.599	19.9	995
Armstrong	no	148	9.00	730.770	739.770	748.500	733.537	731.853	733.537	738.500	733.537	15.0	184
Ash	yes	823	10.00	732.500	742.500	762.139	734.474	734.764	734.764	752.139	734.764	27.4	10,143
Assiniboine	yes	75	4.00	740.720	744.720	752.570	734.058	741.289	741.289	742.570	741.289	11.3	5,522
Aubrey	yes	390	9.33	732.890	742.220	760.000	734.426	735.482	735.482	750.000	735.482	24.5	24,236
Baltimore	yes	211	6.00	732.159	738.159	753.000	734.247	734.259	734.259	743.000	734.259	18.7	81
Bannatyne	yes	206	5.00	736.970	741.970	759.000	733.925	738.009	738.009	749.000	738.009	21.0	17,810
Boyle	no	25	3.00	734.040	737.040	754.500	733.857	734.696	734.696	744.500	734.696	19.8	3
Clifton	yes	415	9.75	734.180	743.930	762.000	734.500	736.936	736.936	752.000	736.936	25.1	677
Cockburn/Calrossie	no	243	8.83	732.540	741.370	759.750	734.365	732.867	734.365	749.750	734.365	25.4	166
Colony	yes	227	6.00	738.280	744.280	759.500	734.173	741.036	741.036	749.500	741.036	18.5	9,484
Cornish	yes	127	5.00	734.850	739.850	756.000	734.204	736.523	736.523	746.000	736.523	19.5	2,833
Despins/Marion	no	317	4.43	730.774	735.203	746.063	734.000	732.513	734.000	736.063	734.000	12.1	2,216
Doncaster	no	133	7.50	743.100	750.600	763.770	739.700	743.756	743.756	753.770	743.756	20.0	8
Douglas Pk/Ferry Rd	no	251	10.00	738.840	748.840	758.000	740.300	740.021	740.300	748.000	740.300	17.7	522
Dumoulin/La Verendrye	no	136	11.48	737.690	749.173	754.500	733.970	738.445	738.445	744.500	738.445	16.1	57
Hart	yes	142	9.33	731.370	740.700	749.250	733.780	732.569	733.780	739.250	733.780	15.5	277
Hawthorne	no	219	5.50	734.010	739.510	752.800	733.500	735.355	735.355	742.800	735.355	17.4	3,193
Jefferson E & W	yes	977	11.83	731.480	743.310	751.500	733.570	732.989	733.570	741.500	733.570	17.9	349
Jessie	yes	338	7.87	731.791	739.665	759.514	734.089	734.121	734.121	749.514	734.121	25.4	1,200
Linden	yes	149	4.50	733.180	737.680	748.000	733.558	734.099	734.099	738.000	734.099	13.9	4
Mager Drive	yes	260	11.25	734.900	746.150	755.500	734.313	738.148	738.148	745.500	738.148	17.4	663
Metcalfe	no	34	5.33	731.810	737.140	757.500	734.180	732.818	734.180	747.500	734.180	23.3	126
Mission	no	421	9.75	730.910	740.660	756.000	733.828	733.994	733.994	746.000	733.994	22.0	301
Moorgate	no	157	8.25	744.430	752.680	765.000	743.000	746.841	746.841	755.000	746.841	18.2	177
Munroe	yes	375	10.50	733.600	744.099	752.850	733.640	735.273	735.273	742.850	735.273	17.6	8,606
Newton	no	56	6.00	734.380	740.380	750.620	733.537	735.364	735.364	740.620	735.364	15.3	24
Polson	yes	238	7.14	730.217	737.352	751.706	733.640	732.480	733.640	741.706	733.640	18.1	16,070
River	yes	108	5.00	730.970	735.970	753.800	734.074	732.971	734.074	743.800	734.074	19.7	1,144
Riverbend/Parkside Dr.	no	189	7.50	740.670	748.170	760.000	738.000	741.162	741.162	750.000	741.162	18.8	93
Roland	yes	178	9.50	733.410	742.910	756.500	733.726	734.800	734.800	746.500	734.800	21.7	6,582
Selkirk	yes	259	6.67	733.900	740.570	750.000	733.703	735.803	735.803	740.000	735.803	14.2	2,579
St. Johns	yes	335	6.33	732.841	739.173	755.249	733.688	734.022	734.022	745.249	734.022	21.2	17,949
Strathmillan	no	69	3.00	749.930	752.930	764.500	744.800	750.889	750.889	754.500	750.889	13.6	0
Syndicate	no	79	3.50	739.940	743.440	751.000	733.865	740.760	740.760	741.000	740.760	10.2	14
Tuxedo	no	50	3.00	740.000	743.000	759.000	740.200	740.200	740.200	749.000	740.200	18.8	61
Tylehurst	no	185	8.83	738.180	747.010	762.500	736.800	739.410	739.410	752.500	739.410	23.1	20
Woodhaven	no	42	4.00	755.110	759.110	766.800	748.700	755.558	755.558	756.800	755.558	11.2	2
		8,733											134,371

Available In-Line Storage

- **Automated Gate Control Option**
  - ➠ Approximately 370,000 m^3 of in-line storage potentially available under existing conditions *(table 5-2)*
    - ❖ *equivalent tank cost: $450 Million*
- **Fixed Weir Control Option**
  - ➠ Approximately 300,000 m^3 of in-line storage potentially available under existing conditions *(table 5-3)*
    - ❖ *equivalent tank cost: $380 Million*
- **Latent Storage in Existing Relief Pipes**
  - ➠ Approximately 120,000 m^3 of in-line storage potentially available under existing conditions *(table 5-4)*
    - ❖ *equivalent tank cost: $210 Million*

WS 3-72

Operational Consideration

- Use of in-line storage has the potential to alter existing system behavior:
  - Basement flood protection, specifically the fail-safeness of control mechanisms
  - Water hammer in response to gate closure or opening
  - Air surges from rapid filling with gate closed
  - Increased formation of sink holes and/or structural weakening from increased sewer surcharging
  - Increased sediment accumulation
  - H_2S generation and corrosion
  - Odor nuisance problems
  - Water quality changes (septicity, NH_3 ...)

WS 3.73

Automated Gate Option

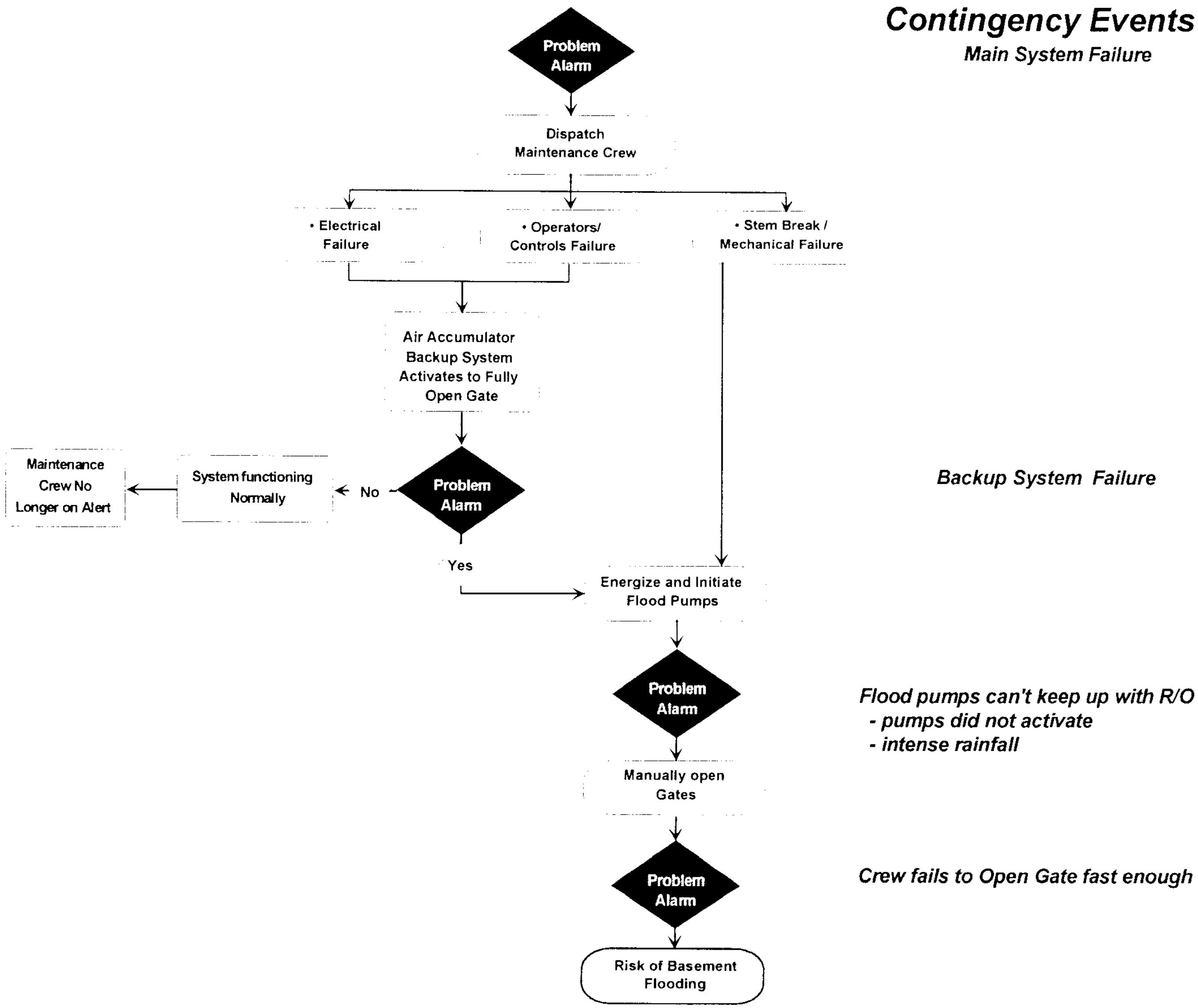
- Dynamically-controlled motorized sluice gate
  - Working session 3-4 (14-Jan-97) found that many of the hydraulic concerns could be addressed by limiting max. storage level to obvert
    - virtual fail-safe operation required
    - prevents water hammer to set up
    - air surge conditions avoided
    - does not increase frequency of sewer surcharging (avoids or minimizes sink hole development and structural integrity concerns)
    - Utilizes significant portion of accessible storage
    - pilot testing required to address concerns with:
      - operator comfort
      - sediment accumulation and flushing requirements
      - odor/H_2S potential
      - water quality changes
      - dewatering rate considerations

Pilot Projects

- **Initiated "test" projects**
  - Clifton CS district
    - Previously relieved for BFR protection
    - 2 outfalls, (1 on CS trunk, 1 on relief system)
    - Use automated gate on CS Trunk
    - Use inflatable dam on relief
    - Project relocated to Hart CS district
      - *potential time constraint problem related to easement negotiations*
  - Hart CS district
    - Previously relieved for BFR protection
    - 1 outfall on CS trunk
    - Use automated gate on CS Trunk
    - City Management Committee
      - expressed concern with gate failing in the closed position
      - suggested several considerations to make it "virtually failsafe" *(e.g.,back water valves, inlet restriction, self-insurance against flooding ...)*
      - developed response plan to mitigate possible modes of failure and assess level of basement flooding risk
      - preliminary cost estimates indicated that a fixed weir control system would be less costly
    - Project discontinued

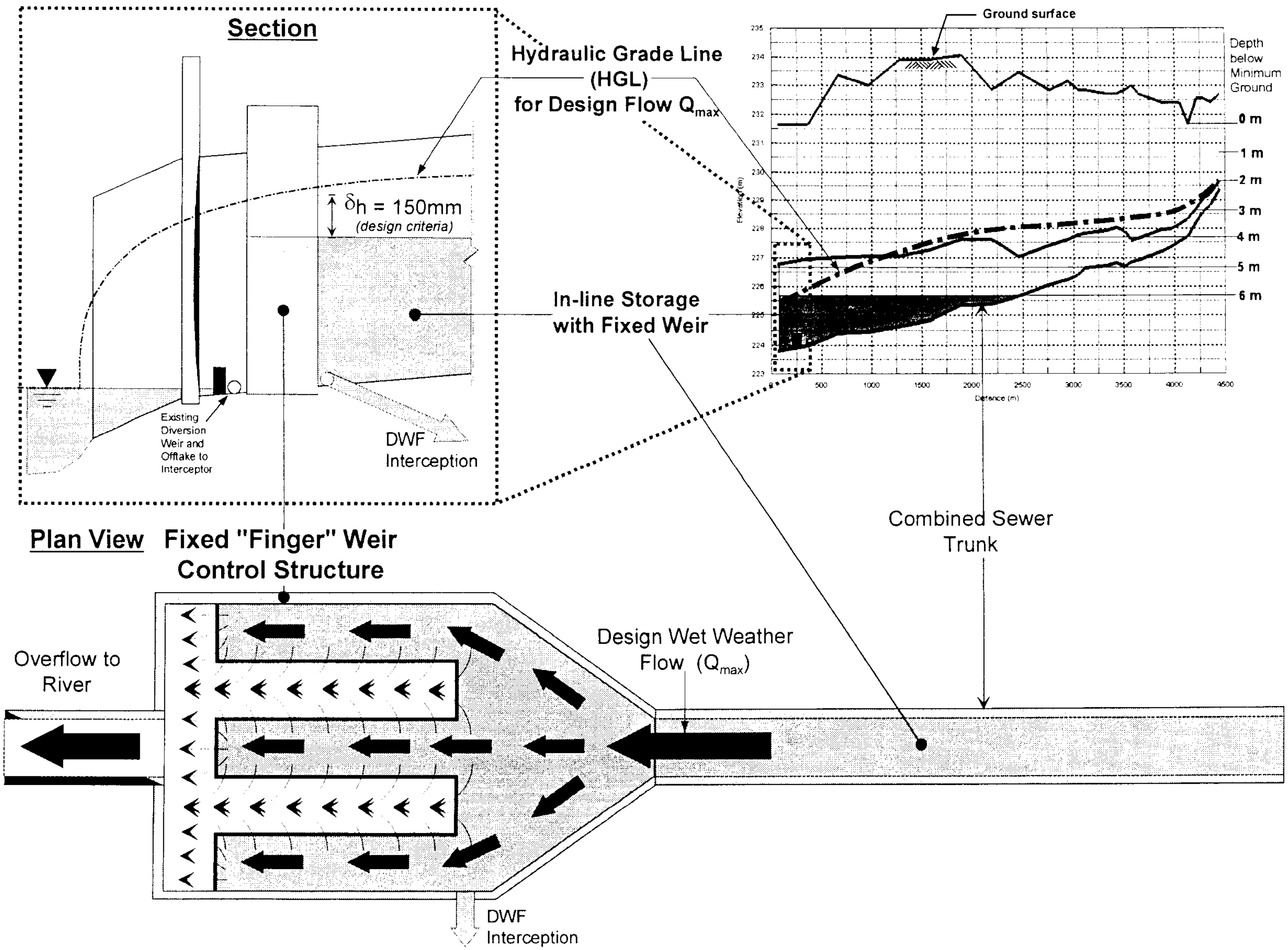
WS3-75

Response Plan



W53-76

Fixed Weir Hydraulics



W53-77

Cost Estimates

- **Automated Gate Control Option**

  = <u>$50 Million</u> *(equivalent tank cost: $450 Million)*

- **Fixed Weir Control Option**

  = <u>$100 Million</u> *(equivalent tank cost: $380 Million)*

- **Accessing Latent Storage**

  = <u>$5 Million</u> *(equivalent tank cost: $210 Million)*

W53-78

Addressing Operations Concerns

- **Opportunity exists to inspect and monitor relief pipes that are partially submerged under normal river water level.**
  - Possible CS districts with relief: Aubrey, Colony, Bannatyne, St. Johns, Hawthorne
  - Need to dewater after each rainfall event of consequence
  - Flap gates seals must be water tight
  - Measure existing sediment depth
    - Structural inspection may be required
  - Monitor odor/H_2S generation
  - Dewatering rate (6 hr to 72^+ hr)
  - Monitor water quality changes (BOD, NH_3, Fecal coliforms,...)
    - dependent on dewatering rate (once every 2 hours)
- **Pilot program still required for operator comfort**
  - future consideration (post CEC Hearings?)

W/53-79

Existing System Concerns

- Many of Winnipeg's combined sewers were constructed in the early 1900's
  - Rehabilitation may be required on all or some of the sewer systems regardless of where in-line storage is proposed
  - Extent of rehabilitation uncertain but will need to be consider in conjunction with in-line storage
  - Inspections will be required to determine if and what remedial actions are required
  - In-line storage has the potential to accelerate future rehabilitation programs
    - Cost and timing consideration

WS3-80

Rehabilitation
Illustrative Cost Perspective

- Costs based on Mission CS experience
  - ➟ for rehabilitation about $600 / m *(not included Eng., Admin., & Fin.)*
    - ❖ Repair costs, $ 200 to $ 500 / m, say $ 350 / m on average
    - ❖ Inspection and cleaning ~ $ 140 / m } Say $ 250 / m
    - ❖ Bulkheads and pumping ~ $ 300 / m }
  - ➟ for reconstruction about $2500 / m *(not included Eng., Admin., & Fin.)*
- How much work could In-Line Storage Accelerate?
  - ➟ Assume 20 CS districts each with 3,000 m of sewer length affected by in-line storage
    - ❖ 3000 m @ $250 / m = $750,000
    - ❖ 1000 m @ $350 / m = $350,000

sub-Total	$1,100,000
Contingency (20 %)	$200,000
add 20 % for EAF	$200,000
Estimated Total	$1,500,000 per district

- Assume it takes two years per district to repair
  - ➟ Rehabilitation Program ~ $ 750 K per year for 40 years

W/53-81

Future BFR Programs

- The previous analyses were based on the existing conditions and <u>did not</u> take into account the possible benefit of future BFR programs
- Partition combined sewer districts based on
  - relief status
  - river they discharge to
  - divide storage volume by tributary area to generate an equivalent depth of storage that could be applied to CS that have not been relieved
  - perform simple statistical analysis and apply to unrelieved CS districts to quantify range of benefit of future relief programs
- Future BFR programs could be a significant source of supplemental in-line storage
  - ➠ Latent storage potential increase 68,000 m^3 to 84,000 m^3
    - equivalent tank cost, 130 to 145 million
  - ➠ Fixed weir storage potential increase 85,000 m^3 to 110,000 m^3
    - equivalent tank cost, 145 to 200 million
  - ➠ Automated Gate storage potential increase 93,000 m^3 to 125,000 m^3
    - equivalent tank cost, 155 to 220 million

W53-82

CSO Control Option *In-Line Storage*

Remaining or Potential Concerns

Issues	Aspects	Comments
Technical	• Basement Flooding Risk - Gate • Weir chamber hydraulics and construction in right-of-way • Structural integrity of sewers • Formation of sink holes and/or sewer collapse • Relief sewer hydraulics / level control	
Operations	• Increased sediment accumulation • Automation controls and reliability • Increased WWF to WPCCs • Access to chambers • Flushing and cleaning • Pilot program for operator comfort • H_2S generation / corrosion	
Environmental	• Changes in stored water quality ↑NH_3, ↑BOD, ↓Fecal coli • Debris in overflows ↑↓ ? • Odor nuisance	
Socio-Economic	• Traffic disruption to install weirs • Costs overstated or understated ⇒ rate impacts - Cost of Inspection Alone ($250/m)	
Regulatory / Public	• Time to implement • No or reduced Basement Flood Protect'n • Implementation provides opportunity for refinement and proving out options	Pilot still desireable
	• Other technologies need to be considered eg., bendable weir, articulated weir inflatable dam • Integration with other programs, BFR, rehab, I/I, other. • Rehab may be required, must be done before implementing In-line storage	} TIMING (LENGTH OF)

• Dewatering rate, storage time

WS3-165

CSO Control Option IN-LINE STORAGE-2
Remaining or Potential Concerns

Issues	Aspects	Comments
Technical	HYDRAULICS OF FIXED WEIR	PHYSICAL MODEL
	EFFECTIVENESS / IMPLICATIONS OF INLET CONTROL	
	BETTER WAYS OF CONTROL, -Cost of Inlet Restrictors	FABRIDAM?
Operations	Mtce of Inlet Restrictors	
Environmental		
ocio-Economic		
Regulatory / Public		

WS3-166

6 - OFF-LINE STORAGE
R. GLADDING

OFF-LINE STORAGE - 1

- **Volumes:** totals based on runoff
  affected by dewatering rate scenarios
  affected by number of overflows

- **Sources:** In-line - yes or no
  Off-line - near surface (if space allows)
  local tunnels (if not)

- **Near surface:** standard unit = 50mx20mx5m deep box

- **Key requirement:** space for box

W53-8-3

Table 5-12: Summary of Storage Required at Each District
NE System 825 ML/d at NEWPCC

District Number	District	Combine With	DWF (m³/s)	Existing Rate (m³/s)	Runoff Based m³/s)	Dewatering Rate (m³/s)	Storage for 4 Overflows	Storage for 0 Overflows	Inline Storage	Storage for 4 Overflows with Inline	Storage for 0 Overflows with Inline
1	Alexander		0.035	0.155	0.230	0.195	7,500	17,000	3,803	3,697	13,197
2	Armstrong		0.020	0.524	0.211	0.181	5,300	19,000	10,060	0	8,940
3	Ash		0.082	0.301	0.895	0.813	22,000	65,000	40,418	0	24,582
4	Assiniboine		0.084	0.425	0.228	0.144	7,000	12,000	8,421	0	3,579
5	Aubrey		0.071	0.214	0.301	0.263	6,800	22,000	50,708	0	0
6	Baltimore		0.028	0.201	0.153	0.041	10,000	30,000	1,553	8,447	28,447
7	Bannatyne		0.153	0.613	0.343	0.190	5,500	17,000	2,378	3,122	14,622
8	Boyle	Syndicate	0.014	0.030							
9	Clifton		0.077	0.236	0.405	0.328	14,000	26,000	27,059	0	0
10	Cockburn		0.033	0.075	0.084	0.050	11,000	31,000	516	10,484	30,484
10a	Calrossie		0.001	0.028	0.000						
11	Colony		0.134	0.425	0.358	0.224	6,800	21,000	12,638	0	8,362
12	Cornish		0.035	0.107	0.106	0.071	1,800	5,600	5,596	0	4
13	Despins	Marion	0.032	0.132							
14	Doncaster		0.025	0.075	0.144	0.119	1,400	5,000	5,616	0	0
15	Douglas Pa	Ferry Road	0.001	0.095							
16	Dumoulin		0.013	0.136	0.157	0.144	3,750	13,000	630	3,120	12,370
17	Ferry Road		0.059	0.126	0.306	0.247	6,500	18,000	4,676	1,824	13,324
18	Hart		0.039	0.101	0.212	0.173	6,200	16,000	13,393	0	2,607
19	Hawthorne		0.036	0.113	0.237	0.201	6,000	18,500	3,875	2,125	14,625
20	Jefferson E		0.143	0.569	0.654	0.511	12,000	42,000	15,484	0	26,516
20a	Jefferson	Jefferson E	0.000	0.000	0.000	0.000				0	0
21	Jessie		0.066	0.176	0.421	0.355	11,500	31,000	6,662	4,838	24,338
22	La Verendr	Dumoulin	0.009	0.015						0	0
23	Linden		0.017	0.060	0.046	0.029	770	2,800	777	0	2,023
24	Mager Drive		0.091	0.309	0.309	0.050	11,500	34,000	7,531	3,969	26,469
25	Marion		0.032	0.220	0.341	0.309	11,000	30,000	4,080	6,920	25,920
26	Metcalfe		0.005	0.044	0.015	0.010	3,000	7,000	1,007	1,993	5,993
27	Mission		0.144	0.518	0.436	0.292	7,700	24,000	7,621	79	16,379
28	Moorgate		0.023	0.085	0.104	0.081	2,900	11,000	3,771	0	7,229
29	Munroe		0.077	0.237	0.472	0.395	13,000	45,000	38,360	0	6,640
30	Newton	Armstrong	0.010	0.166							
32	Polson		0.032	0.356	0.280	0.248	8,000	21,000	23,401	0	0
33	River		0.070	0.094	0.189	0.119	4,000	12,000	4,620	0	7,380
34	Riverbend/Parkside Dr.		0.053	0.107	0.254	0.201	6,500	18,000	293	6,207	17,707
35	Roland		0.026	0.324	0.266	0.240	9,200	20,000	22,455	0	0
36	Selkirk		0.067	0.453	0.254	0.187	5,000	16,000	10,254	0	5,746
37	St. Johns		0.084	0.173	0.460	0.376	12,500	32,000	24,895	0	7,105
38	Strathmillan		0.003	0.062	0.031	0.028	875	4,000	165	710	3,835
39	Syndicate		0.010	0.069	0.144	0.134	4,082	11,000	449	3,633	10,551
40	Tuxedo		0.004	0.036	0.057	0.053	2,000	6,000	405	1,595	5,595
41	Tylehurst		0.050	0.176	0.277	0.227	8,250	20,000	6,394	1,856	13,606
42	Woodhaven		0.00227	0.027	0.039	0.036	1,900	5,800	96	1,804	5,704

OFF-LINE STORAGE - 2
NEAR SURFACE TANKS

- Preliminary Site Assessment:
  - Basis - nearby "public" lands
  - Generally remote from outlet (first not choice)
  - Require pumping

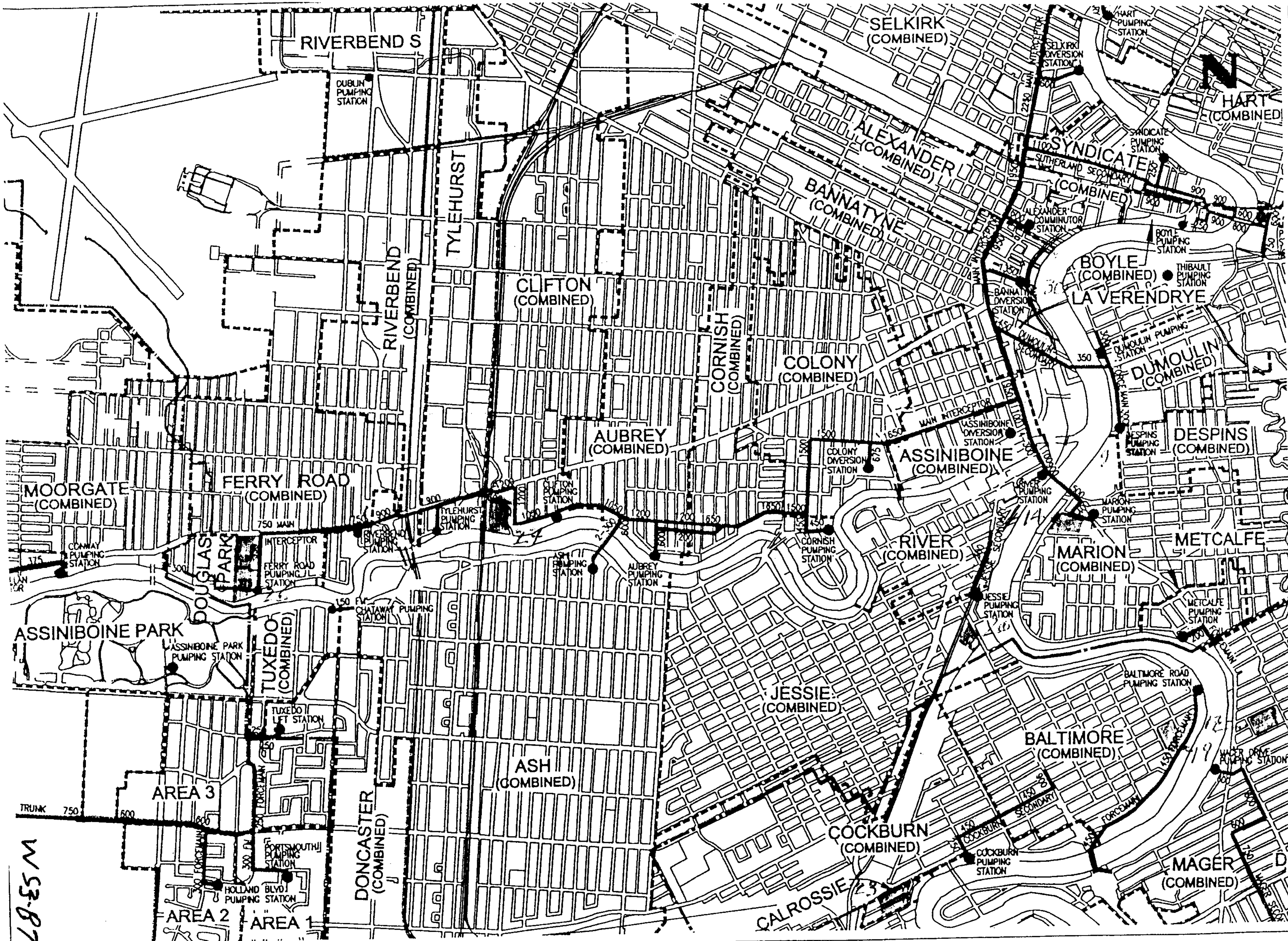
- Identified 18 potential sites (able to serve 25/6 districts)

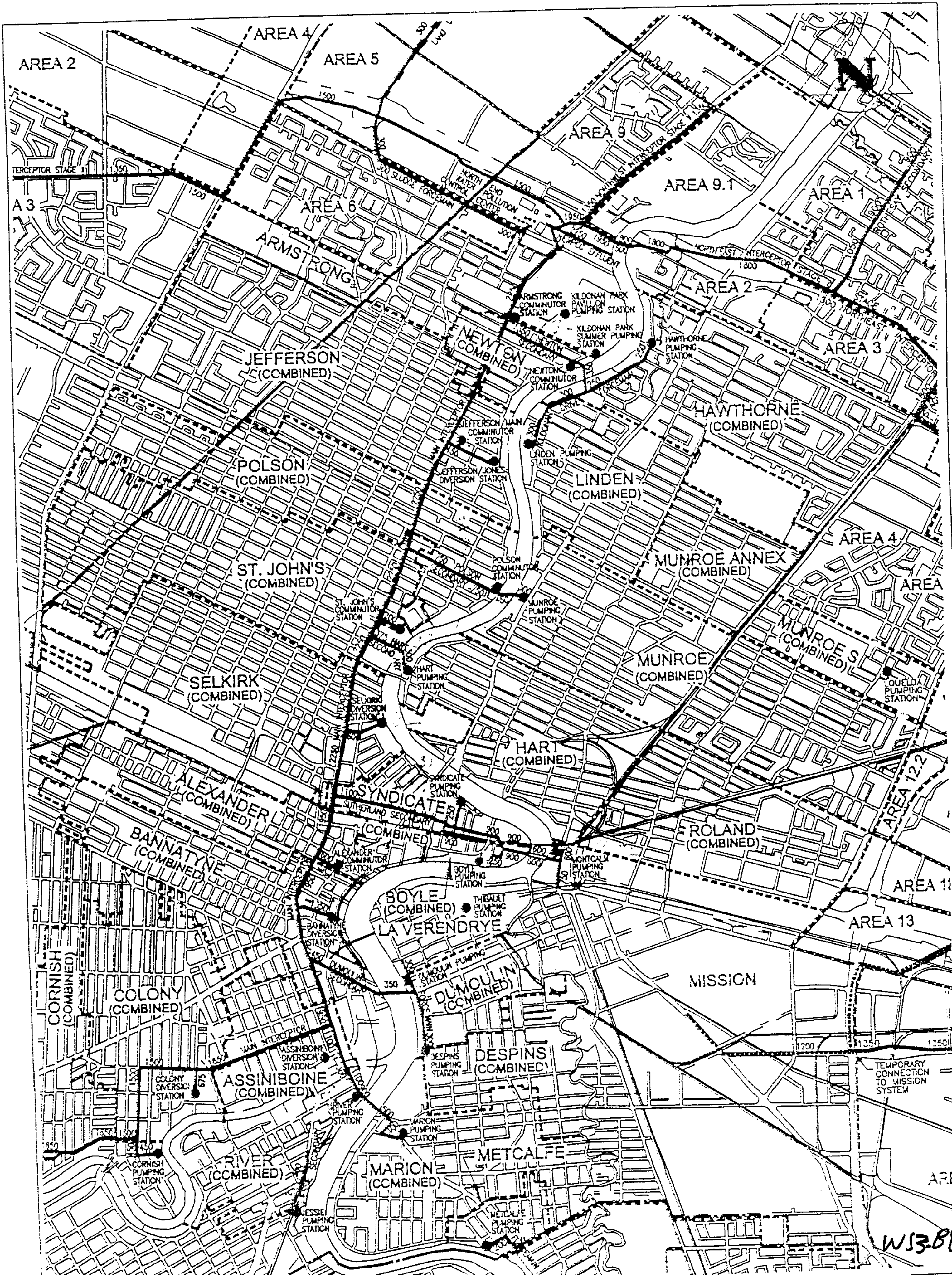
- Each site could accommodate 1 - 8 tanks
  range

WS-85

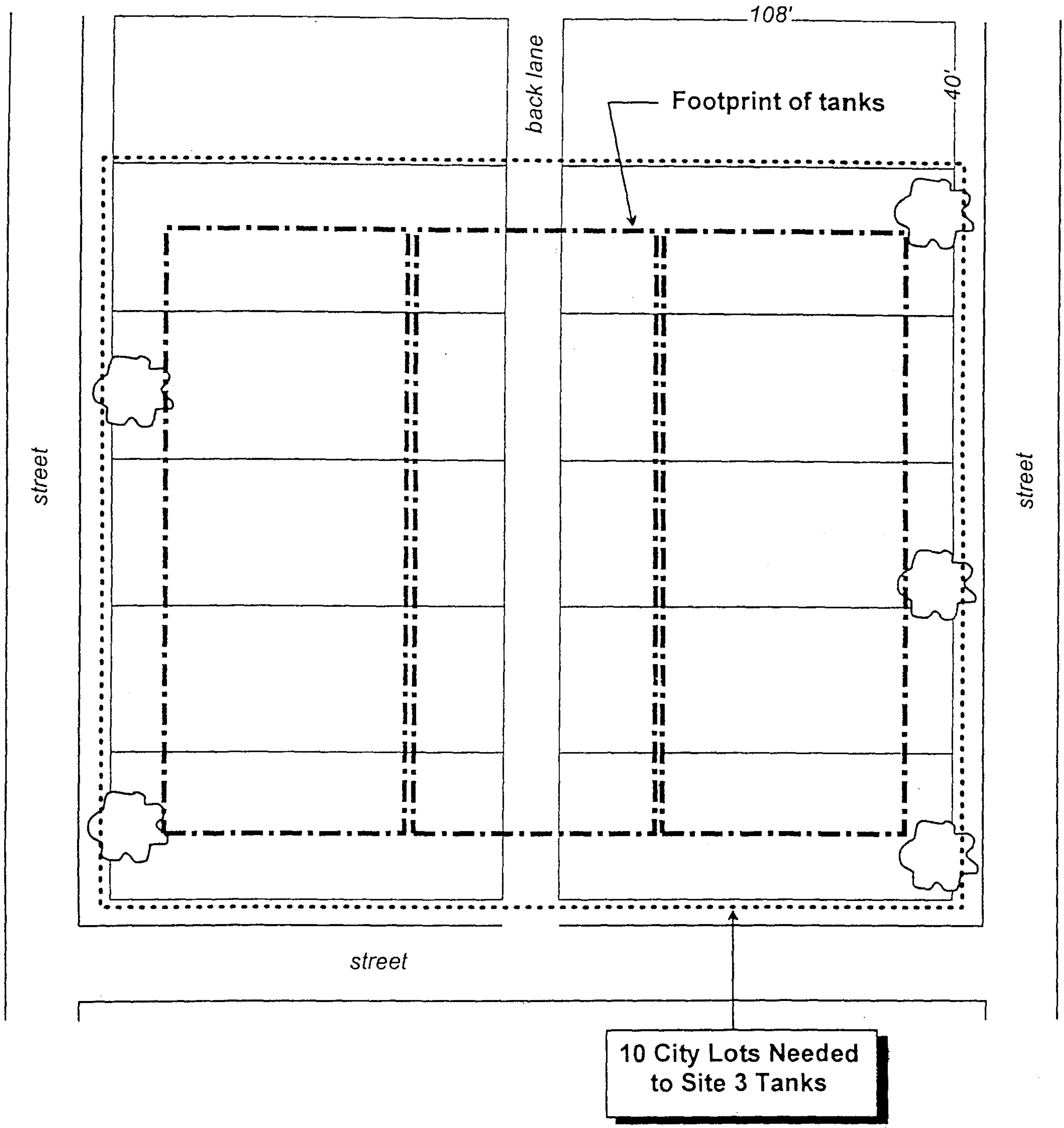
CS AREA	SITE NO.	STORAGE POTENTIAL	REMARKS
1	30	3 UNITS	JUBA PARK
2	35	3 UNITS	KILDONAN PARK SW
3			*NO SITE AVAILABLE*
4	6		*SITE CONSTRAINED (BONNYCASTLE PARK)*
5	4		*SITE CONSTRAINED (AUBREY PK)*
6	19	3 UNITS	RIVERVIEW CC
7	30	3 UNITS	JUBA PARK
8	5		DIFF. SOLUTION FOR BOYLE
9	27	6 UNITS	OMAND PARK
10	23	5 UNITS	BERWICK ATHLETIC FIELD
10	22		McKITTRICK PARK ALSO POSS.
11	28		*GREAT WEST PARKING LOT*
12	28		*GREAT WEST PARKING LOT*
13/16/22	9	1 UNITS	LA VERENDRYE PARK
14/40	25		*HEBREW SCHOOL*
15/17/34	26	8 UNITS	BOURKVILLE CC
18/29	1	4 UNITS	ELMWOOD PARK
19/23	10		*CONSTRAINED BY TREES (FRASER'S GROVE PK)*
20/30	3		*HISTORIC SITE (SEVEN OAKS)*
21	20	5 UNITS	NORTH OF TRANSIT GARAGE
24/26	17	2 UNITS	GLENWOOD SCHOOL
25	14	7 UNITS	NORWOOD CC
27/35	11/12	7 UNITS	MONTCALM/CHALMERS PLAYGROUNDS
28			*NO SITE AVAILABLE*
31			*NO SITE AVAILABLE*
32	2	3 UNITS	LUXTON SCHOOL
33	7	1 UNIT	MAYFAIR PARK (CONSTRAINED - RIVER DIST.)
34			*NO SITE AVAILABLE*
36	32	4 UNITS	NORQUAY CC
37	33	6 UNITS	ST. JOHN'S PARK
38			*NO SITE AVAILABLE*
39	31	1 UNIT	BARBER PARK
41			*NO SITE AVAILABLE*
42			*NO SITE AVAILABLE*

WS3-86


RIVERBEND S
DUBLIN PUMPING STATION
SELKIRK (COMBINED)
HART PUMPING STATION
SELKIRK DIVERSION STATION
N
HART (COMBINED)
ALEXANDER (COMBINED)
SYNDICATE
SYNDICATE PUMPING STATION
SUTHERLAND SECONDARY
(COMBINED)
BANNATYNE (COMBINED)
ALEXANDER COMMINUTOR STATION
BOYLE PUMPING STATION
BOYLE (COMBINED)
THIBAULT PUMPING STATION
LA VERENDRYE
BANNATYNE DIVERSION STATION
TYLEHURST
RIVERBEND (COMBINED)
CLIFTON (COMBINED)
CORNISH (COMBINED)
COLONY (COMBINED)
DUMOULIN SECONDARY
DUMOULIN PUMPING STATION
DUMOULIN (COMBINED)
MAIN INTERCEPTOR
ASSINIBOINE DIVERSION STATION
DESPINS PUMPING STATION
DESPINS (COMBINED)
AUBREY (COMBINED)
COLONY DIVERSION STATION
ASSINIBOINE (COMBINED)
MOORGATE (COMBINED)
FERRY ROAD (COMBINED)
CLIFTON PUMPING STATION
TYLEHURST PUMPING STATION
RIVERBEND PUMPING STATION
750 MAIN
INTERCEPTOR
FERRY ROAD PUMPING STATION
CONWAY PUMPING STATION
DOUGLAS PARK
ASH PUMPING STATION
AUBREY PUMPING STATION
CORNISH PUMPING STATION
RIVER (COMBINED)
ARMSTRONG PUMPING STATION
MARION PUMPING STATION
MARION (COMBINED)
METCALFE
JESSIE PUMPING STATION
METCALFE PUMPING STATION
150 FM
CHATAWAY PUMPING STATION
ASSINIBOINE PARK
ASSINIBOINE PARK PUMPING STATION
TUXEDO (COMBINED)
JESSIE (COMBINED)
BALTIMORE ROAD PUMPING STATION
TUXEDO LIFT STATION
BALTIMORE (COMBINED)
MAGER DRIVE PUMPING STATION
ASH (COMBINED)
AREA 3
TRUNK 750
DONCASTER (COMBINED)
COCKBURN (COMBINED)
COCKBURN SECONDARY
COCKBURN PUMPING STATION
FORCEMAIN
MAGER (COMBINED)
PORTSMOUTH PUMPING STATION
HOLLAND PUMPING STATION
BLVD STATION
CALROSSIE
AREA 2
AREA 1
W53-87



AREA 2
AREA 4
AREA 5
AREA 6
AREA 9
AREA 9.1
AREA 1
AREA 3
ARMSTRONG
JEFFERSON (COMBINED)
NEWTON (COMBINED)
HAWTHORNE (COMBINED)
POLSON (COMBINED)
LINDEN (COMBINED)
ST. JOHN'S (COMBINED)
MUNROE ANNEX (COMBINED)
MUNROE (COMBINED)
MUNROE S (COMBINED)
SELKIRK (COMBINED)
HART (COMBINED)
ALEXANDER (COMBINED)
SYNDICATE (COMBINED)
BANNATYNE (COMBINED)
ROLAND (COMBINED)
AREA 12.2
AREA 11
AREA 13
BOYLE (COMBINED)
LA VERENDRYE
DUMOULIN (COMBINED)
MISSION
CORNISH (COMBINED)
COLONY (COMBINED)
DESPINS (COMBINED)
ASSINIBOINE (COMBINED)
RIVER (COMBINED)
MARION (COMBINED)
METCALFE
NORTH END WATER POLLUTION CONTROL CENTER
ARMSTRONG COMMINUTOR STATION
KILDONAN PARK PAVILION PUMPING STATION
KILDONAN PARK SUMMER PUMPING STATION
HAWTHORNE PUMPING STATION
NEWTON COMMINUTOR STATION
JEFFERSON/MAIN COMMINUTOR STATION
JEFFERSON/JONES DIVERSION STATION
LINDEN PUMPING STATION
POLSON COMMINUTOR STATION
MUNROE PUMPING STATION
ST. JOHN'S COMMINUTOR STATION
HART PUMPING STATION
SELKIRK DIVERSION STATION
LOUELDA PUMPING STATION
SYNDICATE PUMPING STATION
ALEXANDER COMMINUTOR STATION
BOYLE PUMPING STATION
MONTCALM PUMPING STATION
THIBAULT PUMPING STATION
BANNATYNE DIVERSION STATION
DUMOULIN PUMPING STATION
DESPINS PUMPING STATION
ASSINIBOINE DIVERSION STATION
COLONY DIVERSION STATION
RIVER PUMPING STATION
MARION PUMPING STATION
CORNISH PUMPING STATION
JESSIE PUMPING STATION
METCALFE PUMPING STATION
MAIN INTERCEPTOR
NORTHEAST INTERCEPTOR STAGE
NORTHWEST INTERCEPTOR STAGE
SUTHERLAND SECONDARY
TEMPORARY CONNECTION TO MISSION SYSTEM
BALTIMORE ROAD
ARE
WS3-88



10 properties @ $125K	= $1.25M
3 tanks @ 5.1 x 1.58	= $8M
Pump & forcemains @ 2.5 (say) x 1.58	= 4M
	$12M

exproplots
s\01\0510

WS3-89

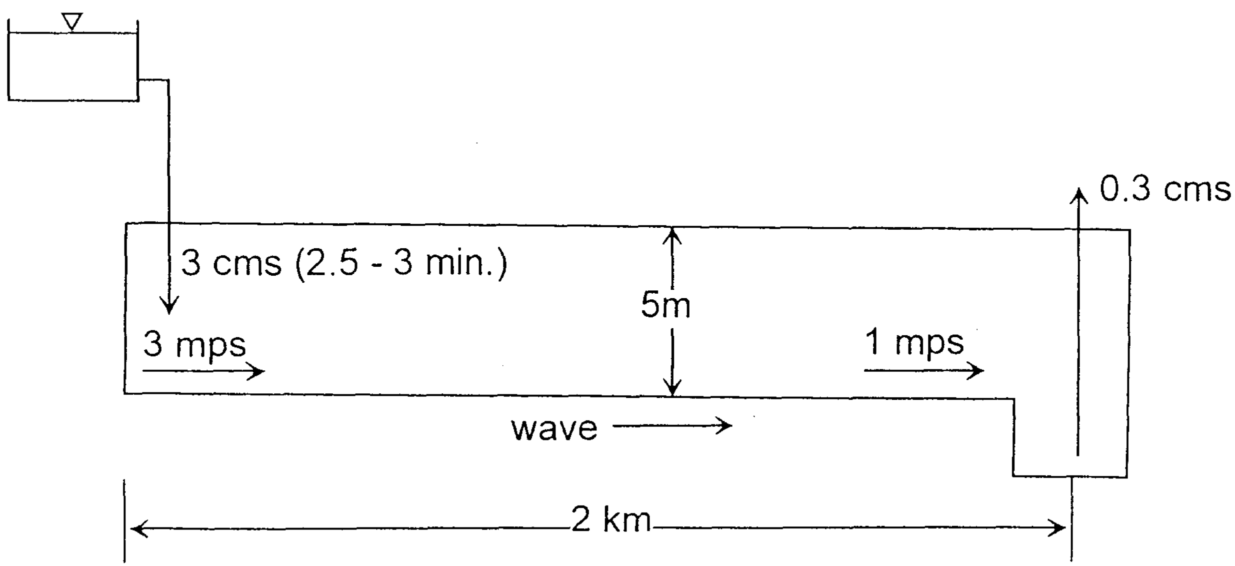
- Operating concerns: odour & cleaning
  Similar units have been installed at Toronto Beaches.

- Odour scrubbing facilities addressed former (hardly used at time of site visit)

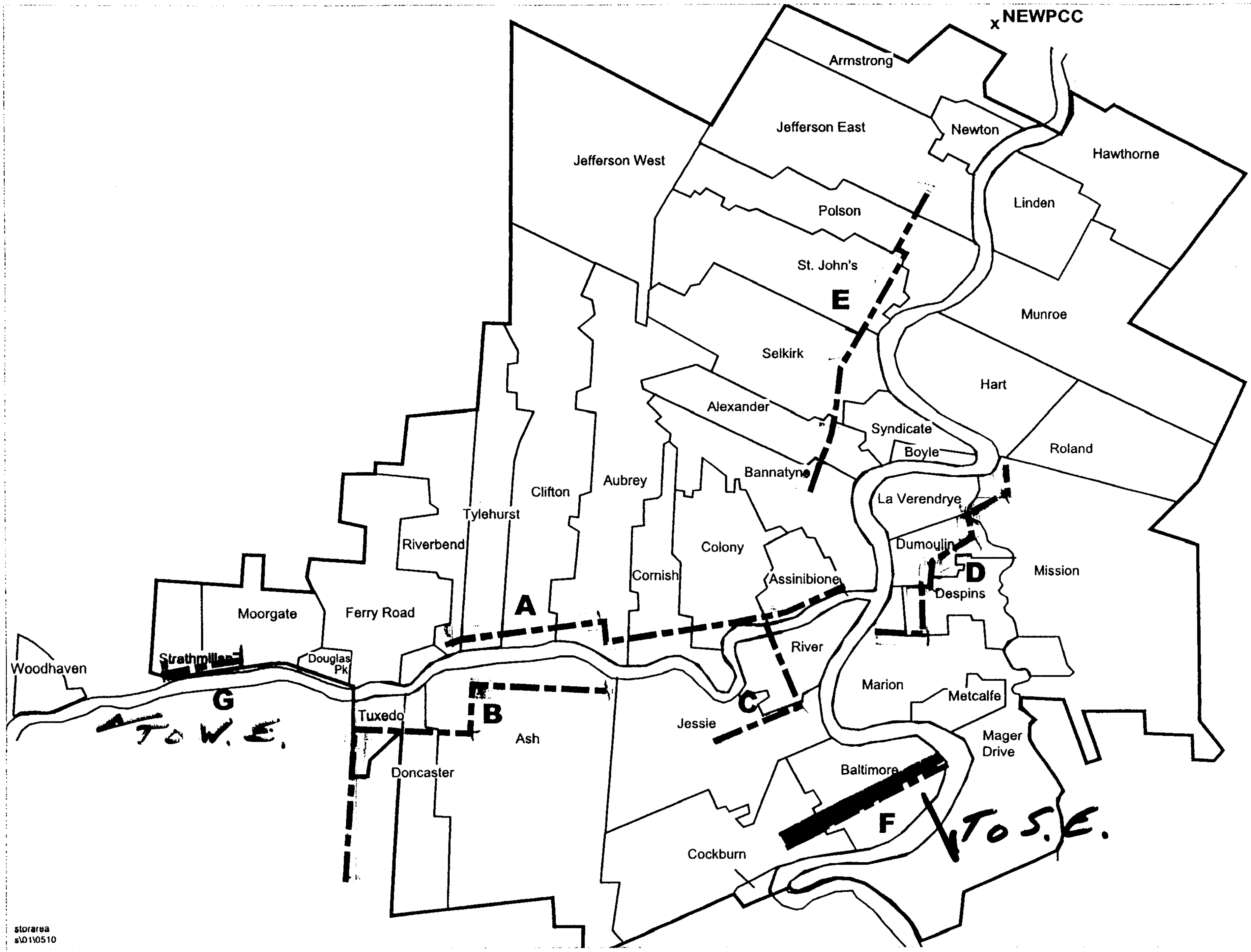
- Automatic flushing via a flushing wave device has worked very well - moderate cost low O&M

OFF-LINE STORAGE - 3
LOCAL STORAGE TUNNELS

- Simply deep-buried storage
- Collector tunnels parallel to rivers
- Main concern - flushing

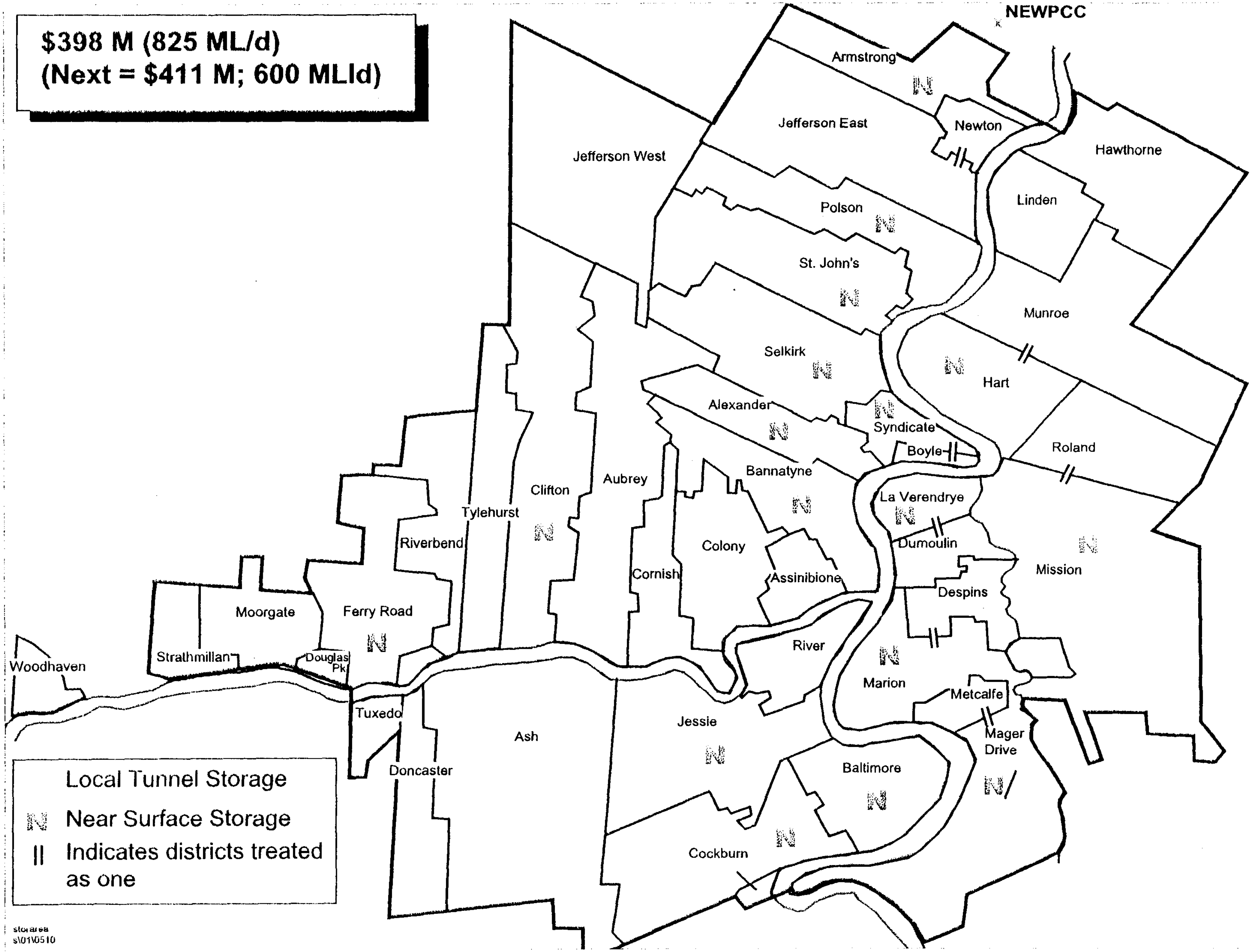


W53-91



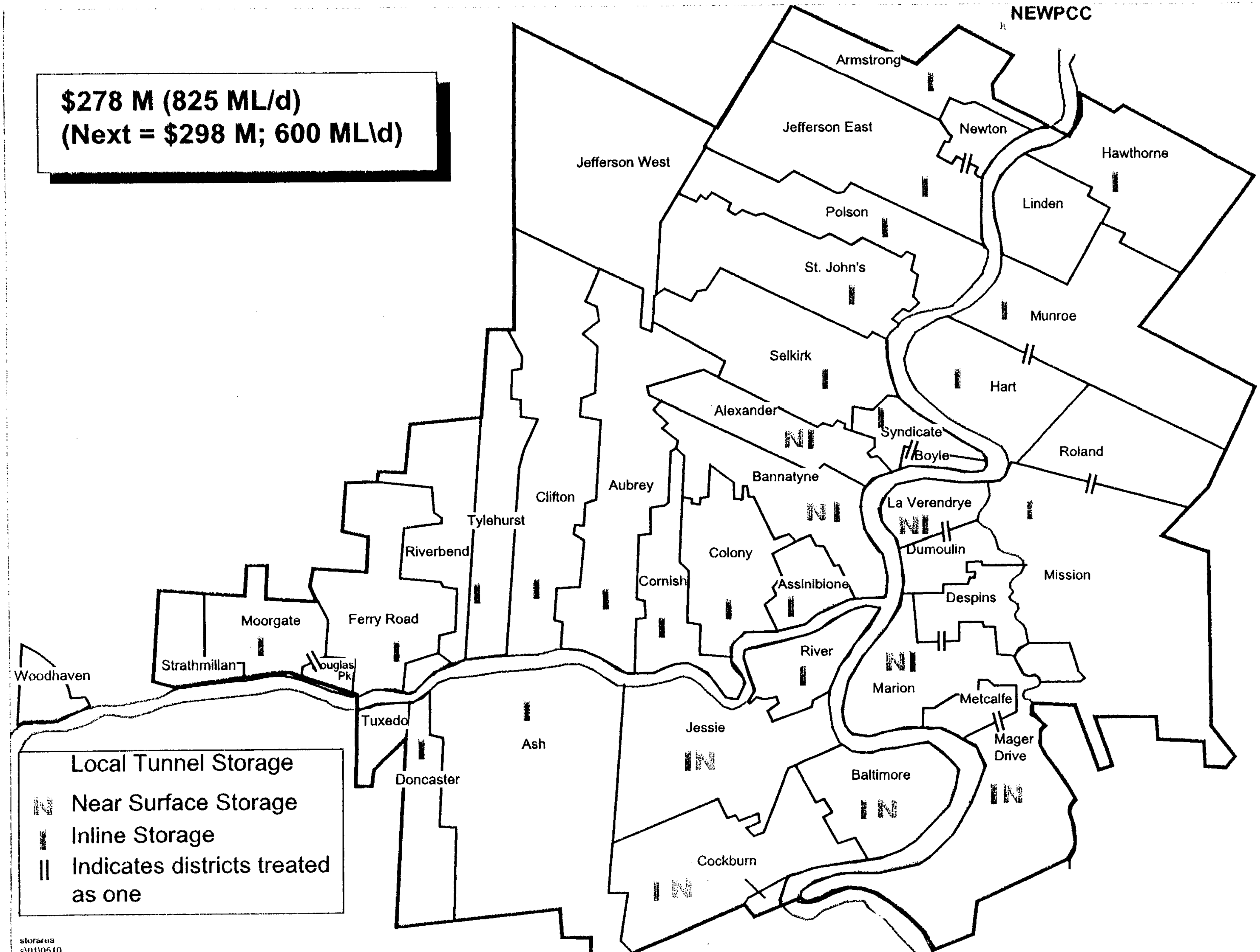
Off-Line Tunnels Grouping
Figure 5-17

W 5-92

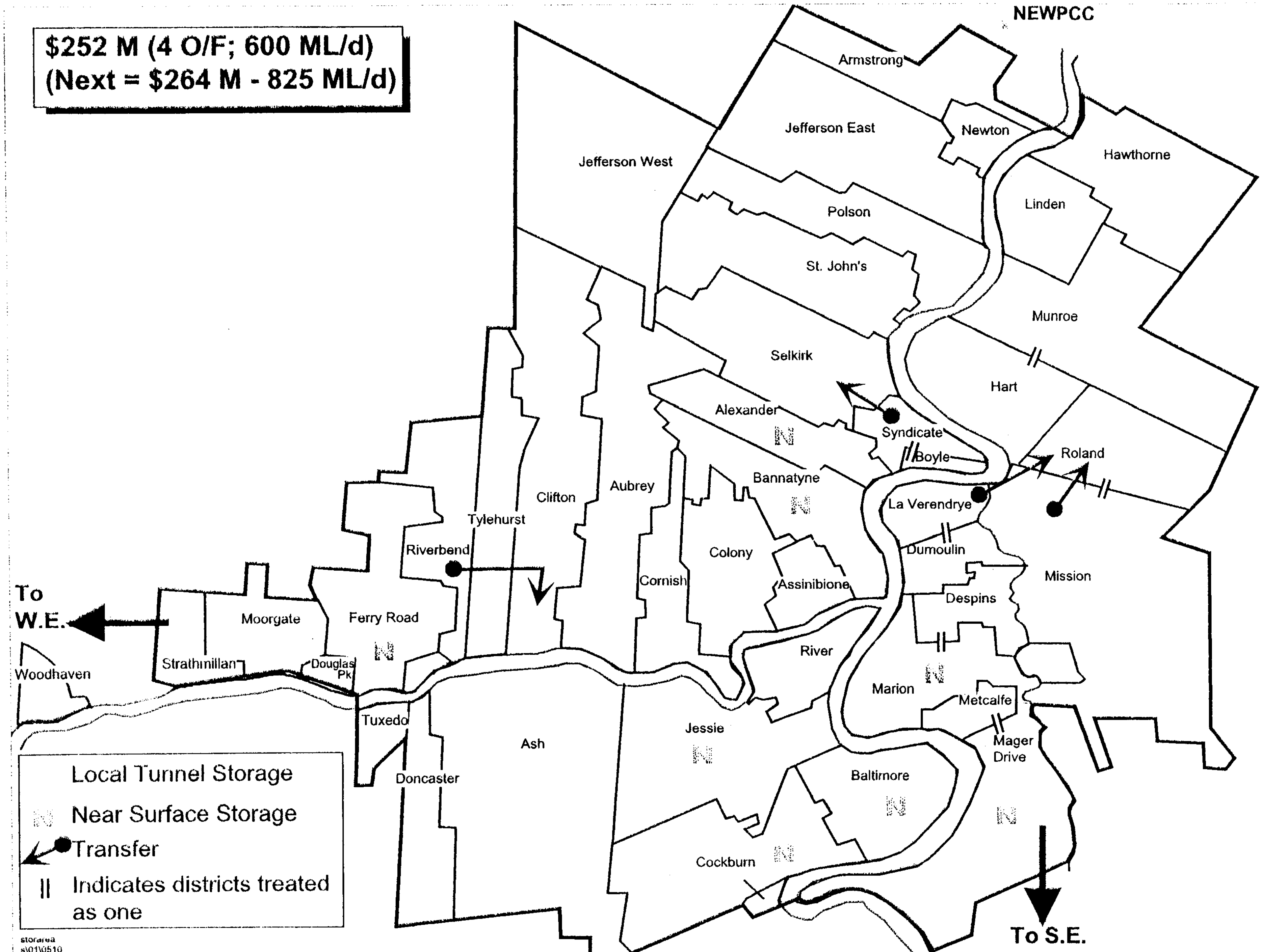


WSS-93

Off-Line Storage (No In-Line):
Least Cost Configuration - 4 Overflows
Figure 5-19



In-Line / Off-Line Storage:
Least Cost Configuration - 4 Overflows
Figure 5-18



W53-95

In-Line / Off-Line / Transfer: Practicable Configuration - 4 Overflows

Figure 5-20

May 1, 1998

OFF-LINE STORAGE - COST SUMMARY

1992 REPRESENTATIVE YEAR

	WITH IN-LINE STORAGE			WITHOUT IN-LINE STORAGE		
DEWTR RATE	600 ML/d	825 ML/d	1060 ML/d	600 ML/d	825 ML/d	1060 ML/d
0 OVRFLOWS	$M	$M	$M	$M	$M	$M
STRGE VOL.	820,000 m^3	610,000 m^3	530,000 m^3	820,000 m^3	610,000 m^3	530,000 m^3
BASE COST*	570	425	415	781	647	520
FLO CNTROL				12	12	12
IN-LN STRGE	100	100	100			
FLUSHING	43	31	28	64	50	44
INTERCEPTOR		15	46		15	46
NEWPCC	15	36	70	15	36	70
TOTAL 0 O/F	$728M	$608M	$659M	$872M	$760M	$691M
4 OVRFLOWS	$M	$M	$M	$M	$M	$M
STRGE VOL.	300,000 m^3	220,000 m^3	185,000 m^3	300,000 m^3	220,000 m^3	185,000 m^3
BASE COST*	168	119	90	358	313	280
FLO CNTROL				12	12	12
IN-LN STRGE	100	100	100			
FLUSHING	16	8	8	26	22	23
INTERCEPTOR		15	46		15	46
NEWPCC	15	36	70	15	36	70
TOTAL 0 O/F	$298M	$278M	$315M	$411M	$398M	$430M

* BASE COSTS INCLUDE MULTIPLIERS

OFLNcst1.wpd

W 53-96

Off-Line Storage - Near Surface Tanks
Remaining or Potential Concerns

Issues	Aspects	Comments
Technical	ODOUR	Experience shows control OK - Toronto
	FLUSHING	
	POTENTIAL FOR REMOTE MONITORING	
Operations	- LEVEL OF EFFORT NEEDED	
	AT TANKS	
	AT PUMPING STATIONS	
	- UP TO 17 INSTALLATIONS	
Environmental	- TANK BELOW GRADE	
	- GROUND RESTORED	
Socio-Economic	- COSTS COULD BE REDUCED BY LAND ACQUISITION; $TANKS < $TUNNELS	
	- POSSIBLE?	
	- Multiple Use of Land (Surface)	
Regulatory / Public	- NEED A LICENCE FOR EACH TANK?	
	- Land Acquisition.	
Other	MONITOR FLUSHING/ ODOURS ELSEWHERE	

Off-Line Storage - Local Tunnels
Remaining or Potential Concerns

Issues	Aspects	Comments
Technical	ODOUR FLUSHING POTENTIAL FOR REMOTE MONITORING	
Operations	- FLUSHING OPERATIONS NEAR SURFACE (AS MUCH AS PRACTICABLE) (DEWATERING PUMP SUBMERSIBLE)	
Environmental	- LITTLE VISIBLE IMPACT - LITTLE OR NO DISTURBANCE TO PUBLIC LANDS	
Socio-Economic	- MINIMAL IMPACT ON PUBLIC LANDS - MORE EXPENSIVE THAN NEAR SURFACE TANKS (BUY LAND?)	
Regulatory / Public	NO MORE LIKELIHOOD OF LICENCE THAN FOR SEWERS	
Other	MONITOR FLUSHING/ ODOURS ELSEWHERE	

WS3-168

7 - HIGH RATE TREATMENT

D. MORGAN

High Rate Treatment Review

- Phase 2 indicated that overflow rates of 10 m/hr for VSS (Scarborough Visit June 1995) and 4 m/hr for RTB
- It was recommended in Workshop #2 to use 10 m/hr for both

W 53-87

Treatment Effectiveness Study

- XCG - Summer of 1996 at Aubrey (residential)
- 5 minute settling -VSS
- 50 minute settling - Conventional Sedimentation
- Large fraction of light material
- Disinfection Studies (Including Chemical Addition)
  - not suitable for VSS
  - use more conventional sedimentation Basin
  - Aubrey may not be representative

W53-98

High-rate Design
Sizing and Costing

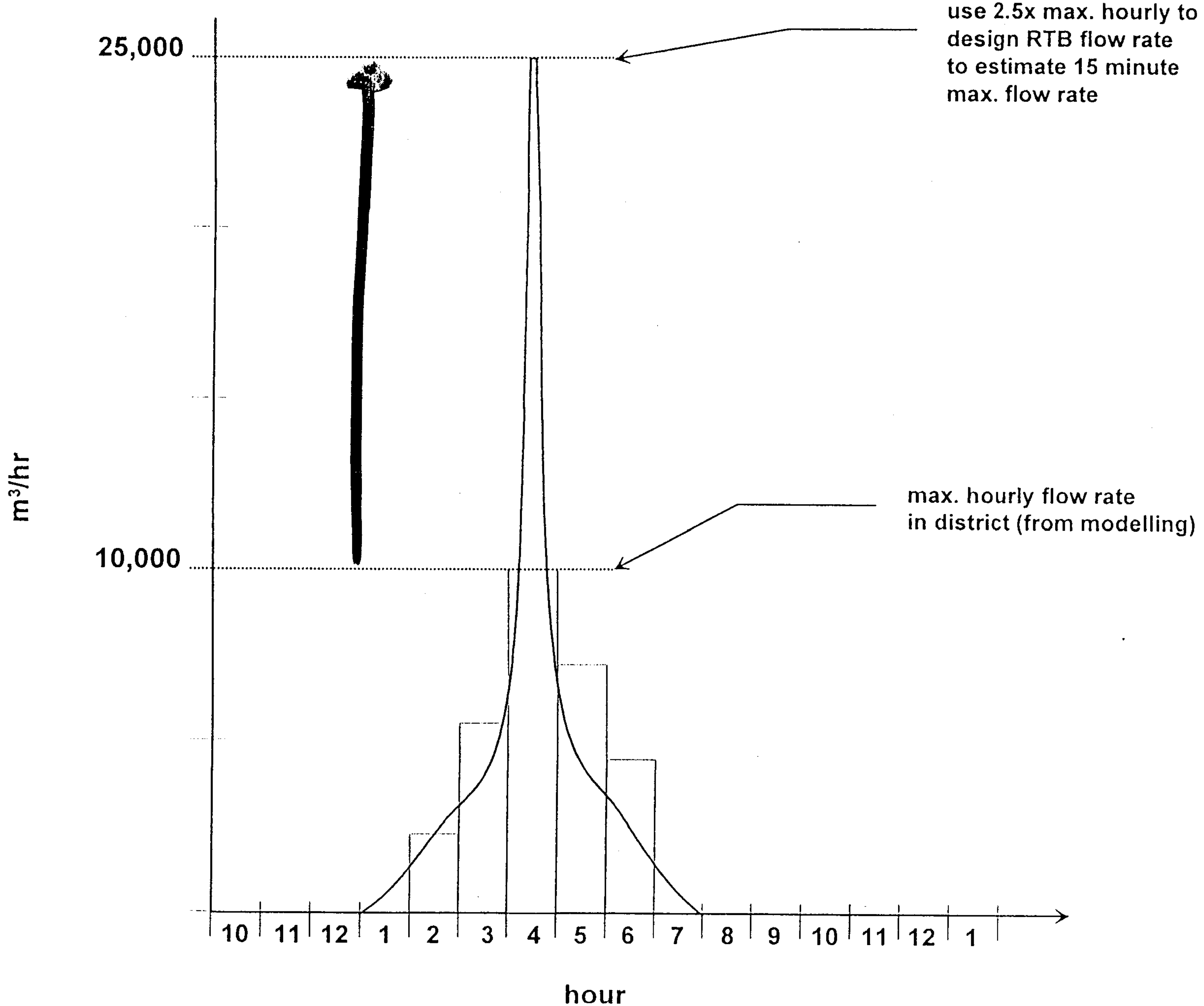
- Use RTB as a Surrogate for both
- VSS may not be feasible for chlorination
  - treatment effectiveness study for one district
- RTB can be readily buried and maintained (flushing)
- assume 20m x 50m x 5m tank as basic unit then sized tank for each district based on model results

RTB Design Method

- For each district find largest storm (by hourly peak rate) and 5th largest storm
- multiply peak hourly rate by 2.5 to estimate 15 minute peak rate (based of Winnipeg Design Storm analysis)
- assume 10 m/hr to obtain surface area required
- assume 5m deep to obtain volume

W 55-100

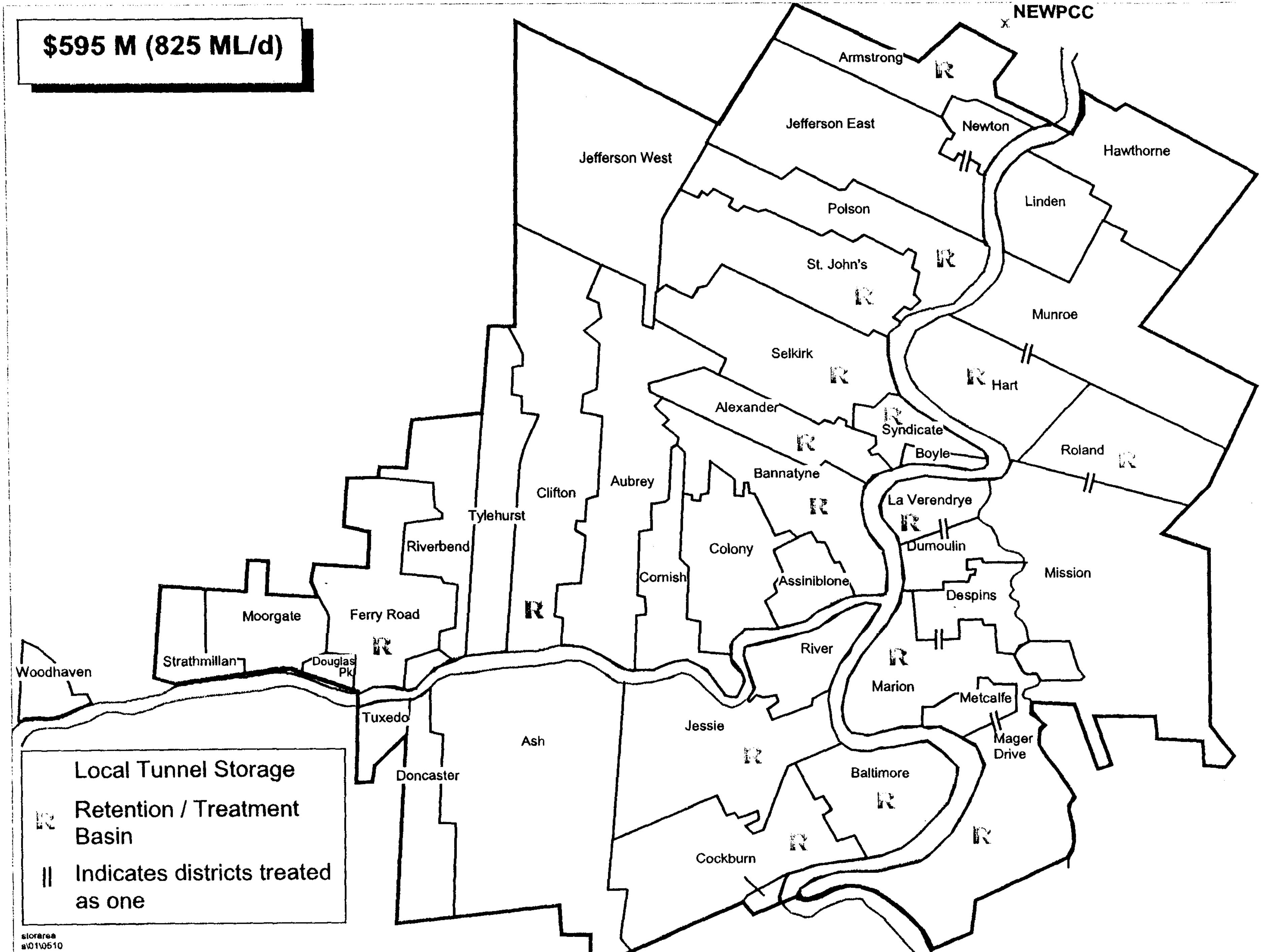
Design of RTB



rtbdesgn
s\01\0510

Locating RTB

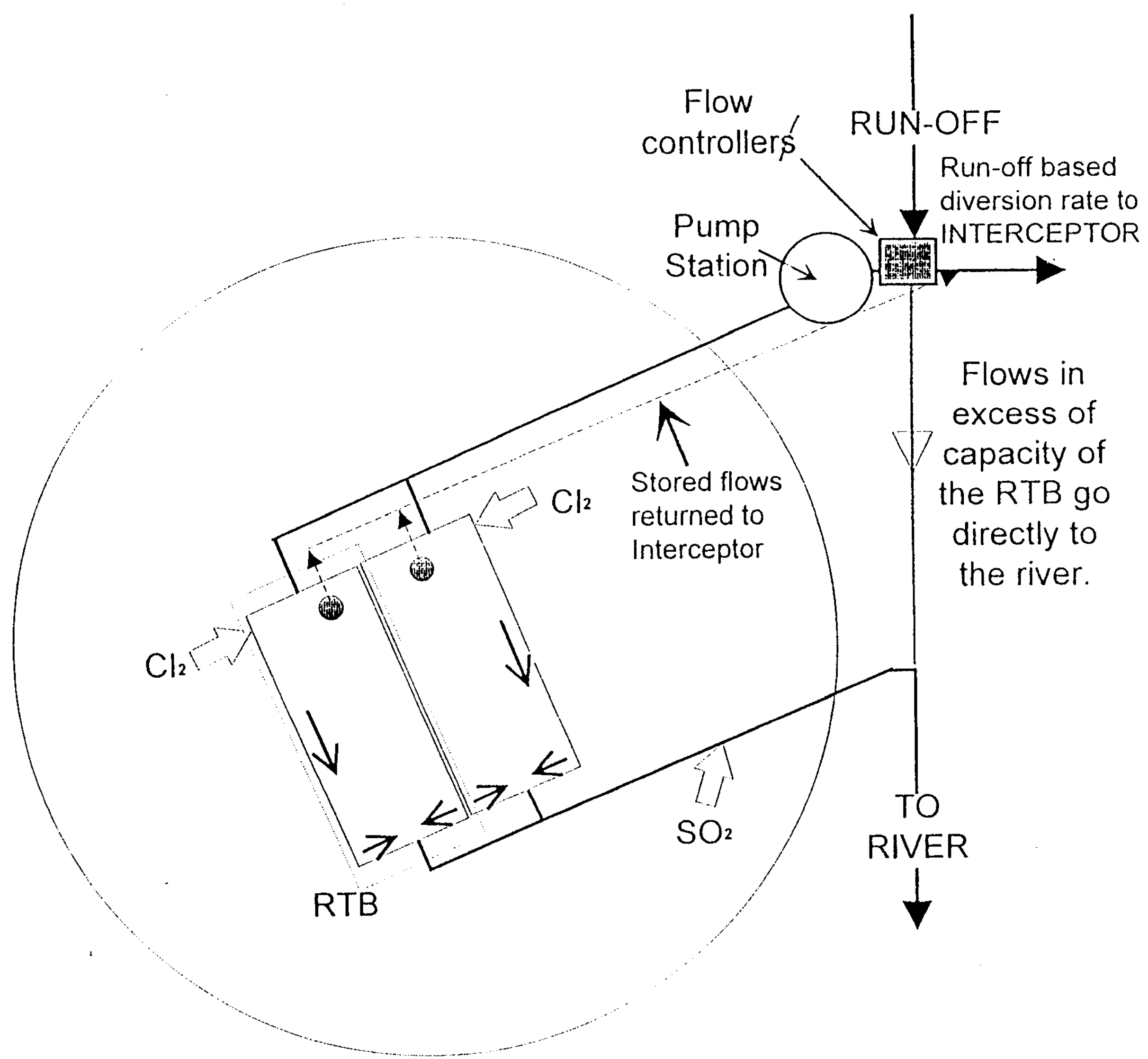
- Where space available on public land place RTB or else use local tunnel (as with offline)
- compared to offline more smaller tanks would be installed and less tunnels since smaller RTB can fit on public land which larger offline storage would not



RTB / Tunnel Storage
Representative Year - 0 Overflows

WS3-102

Schematic of Retention/Treatment Basins (RTB)



rtbonly
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WS3-104

Performance

- 4 bypasses/ year - all but 6 stored
- 0 bypasses/ year (representative year) all but 3 stored
- all flow into tanks chlorinated
  - i.e. difficult to predict which storm will exceed storage capacity during event
- only flows to the river dechlorinated

WS3-105

Concerns

- As with all options there is concern with potential odours and effectiveness of flushing
- Using Chlorine at multiple locations (20) raises the risk of malfunction which could lead to killing fish
- this would be reduced to 3 (i.e WPCCs) locations for storage options

Conparison of Costs of Offline Storage and RTBs

4 Overflows

	Offline Storage Millions	Retention Treatment Basin Millions	Saving Millions
TOTAL P.S. COST	$39	$39	
TOTAL TUNNEL COST	$92	$85	$7
TOTAL TANK COST	$67	$57	$10
TOTAL NET COST	$198	$181	$17
*TOTAL BUDGET COST (1.58*NET)*	*$313*	*$287*	*$26*
+ FLOW CONTROL	$12	$12	
+ IN-LINE STORAGE			
+ INTERCEPTOR	$15	$15	
+ NEWPCC	$36	$36	
+ FLUSHING	$22	$18	$4
+Disinfection(Cap + O&M)		$22	($22)
TOTAL ESTIMATED COST	$398	$390	**$8**

0 Overflows

			Saving
TOTAL P.S. COST	$39	$39	
TOTAL TUNNEL COST	$269	$162	$107
TOTAL TANK COST	$101	$84	$17
TOTAL NET COST	$409	$284	$125
*TOTAL BUDGET COST (1.58*NET)*	*$646*	*$449*	*$197*
+ FLOW CONTROL	$12	$12	
+ IN-LINE STORAGE			
+ INTERCEPTOR	$15	$15	
+ NEWPCC	$36	$36	
+ FLUSHING	$50	$35	$15
+Disinfection(Cap + O&M)		$48	($48)
TOTAL ESTIMATED COST	$759	$595	**$164**

WS3-107

Costs

- For details of costs see page 5-48 and tables 5-24 and 5-25
- Costs
- Without Inline Storage (Including Operating Costs)
  - 4 overflows/year $420 M
  - 0 overflows/year $620 M

WS3-108

CSO Control Option___High rate Treatment

Remaining or Potential Concerns

Issues	Aspects	Comments
Technical	10 m / hr for 15 minute overflow rate CONTACT CHAMBER 5 min	CONSERVATIVE Review water quality data and determine if disinfection could be achieved w/o Vortex to attain 5 minute contact
Operations	Odour / Flushing What are the issues for City Operations of a 17 location system ?	MAN POWER?
Environmental	Does RTB/VSS give same Benefit as stored / NEWPCC treatment Chlorine threat to fisheries	
ocio-Economic	Land-Use less than RTB Chlorine through the City Perception of Chlorine in Neighborhood	
Regulatory / Public	Licence required for each of 17 sites?	

W53-169

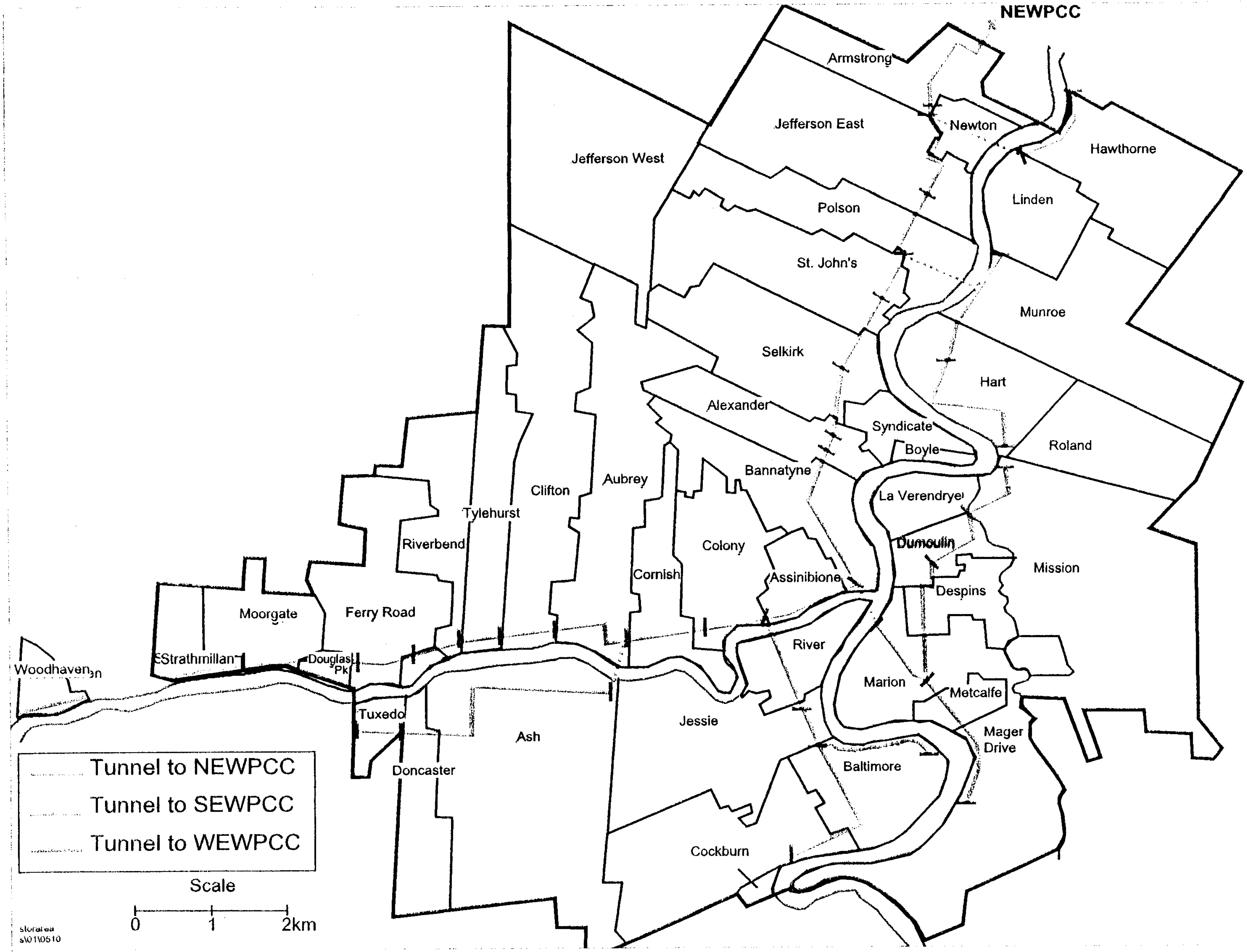
8 - <u>REGIONAL TUNNEL</u>

R. GLADDING

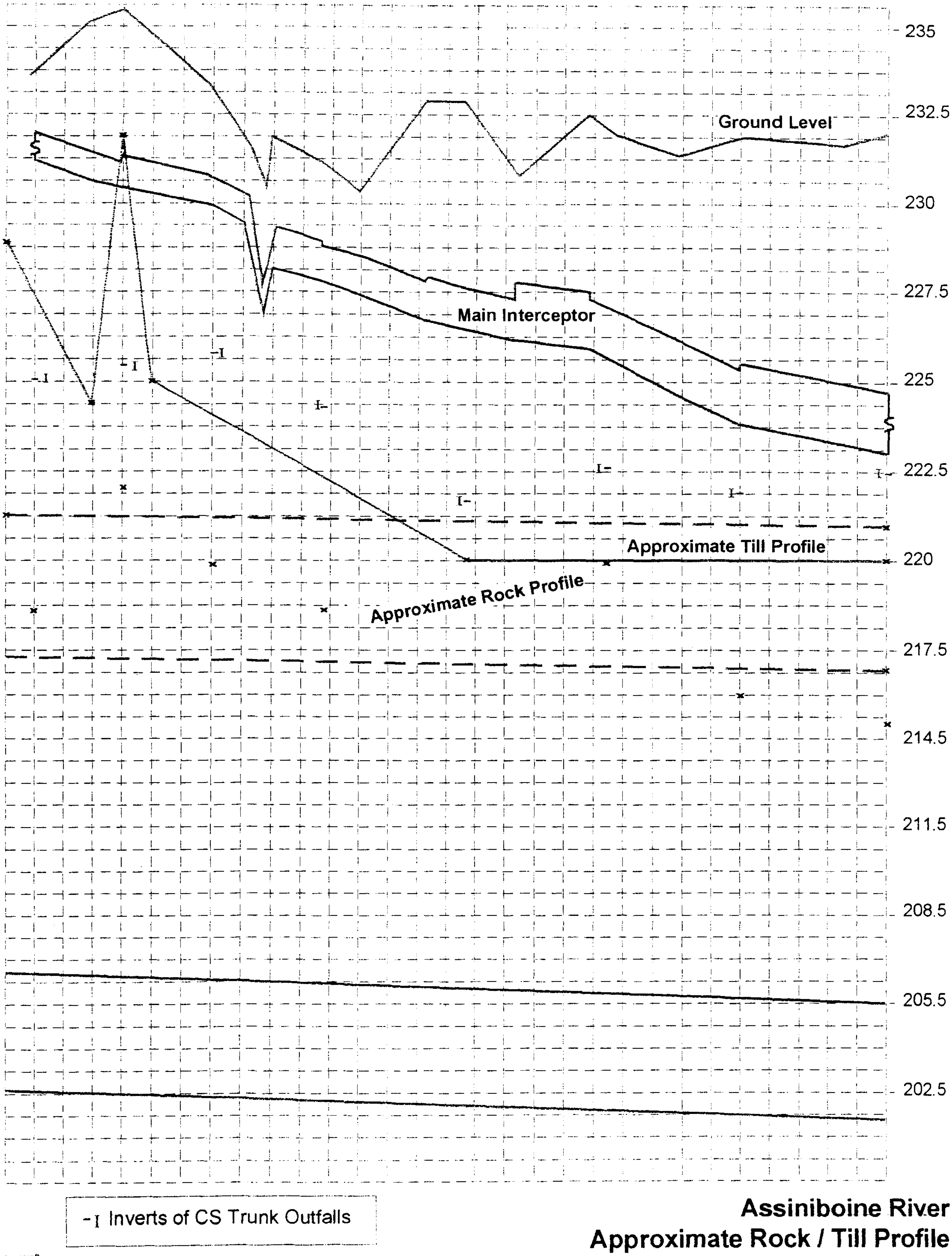
REGIONAL TUNNELS

- Deep-buried storage/transport
- Volumes ("Representative Year") same as off-line
- Larger tunnels sized for 0 & 1 overflows (long term)
- Configuration - similar to local tunnels but continuous to NEWPCC
- Main tunnel sloped for self cleaning velocities
- Branch tunnels will be flushed as per local tunnels

WS3-109



Regional Tunnels Conceptual Layout
Figure 5-21



Assiniboine River
Approximate Rock / Till Profile
Figure 5-23

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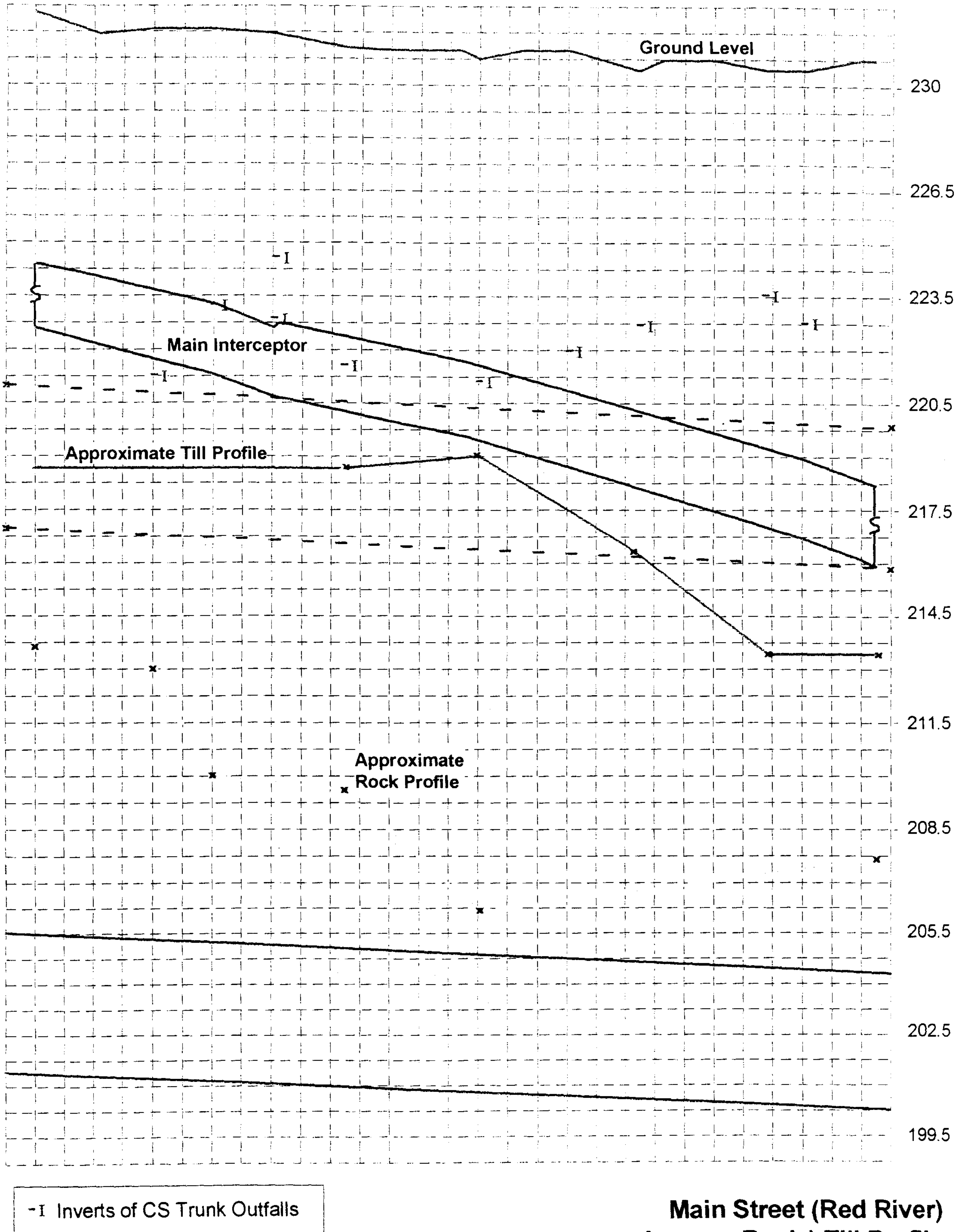
WS 3-111



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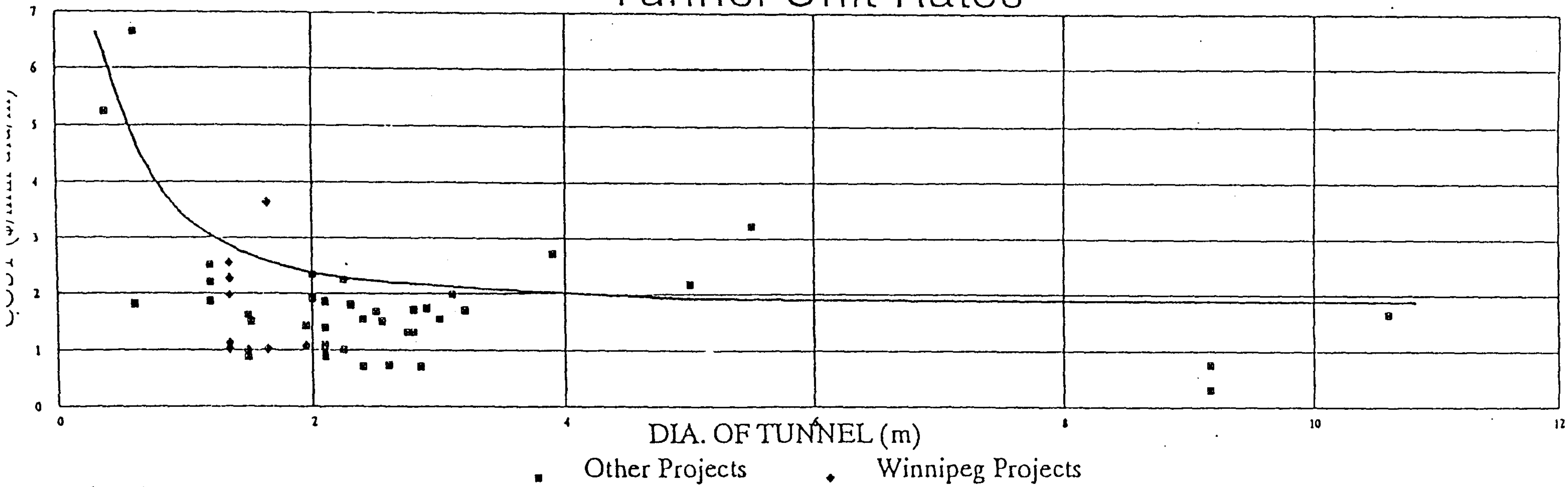
Main Street (Red River)
Approx. Rock \ Till Profile
Figure 5-24

WS3-112

Tunnel Unit Rates



City of Winnipeg 1995 Costs

Figure 5-25

WS3-113

May 4, 1998

REGIONAL TUNNEL - COST SUMMARY
1992 REPRESENTATIVE YEAR

	WITH IN-LINE STORAGE			WITHOUT IN-LINE STORAGE		
DEWTR RATE	600 ML/d	825 ML/d	1060 ML/d	600 ML/d	825 ML/d	1060 ML/d
0 OVRFLOWS	$M	$M	$M	$M	$M	$M
STRGE VOL.	820,000 m³	610,000 m³	530,000 m³	820,000 m³	610,000 m³	530,000 m³
BASE COST*	565	479	406	676	612	600
FLO CNTROL				12	12	12
IN-LN STRGE	100	100	100			
FLUSHING	23	20	16	27	24	22
NEWPCC	15	36	70	15	36	70
TOTAL 0 O/F	$703M	$635M	$592	$729M	$684M	$704M
4 OVRFLOWS	$M	$M	$M	$M	$M	$M
STRGE VOL.	300,000 m³	220,000 m³	185,000 m³	300,000 m³	220,000 m³	185,000 m³
BASE COST*	288	264	263	468	416	377
FLO CNTROL				12	12	12
IN-LN STRGE	100	100	100			
FLUSHING	11	10	11	17	16	14
NEWPCC	15	36	70	15	36	70
TOTAL 4 O/F	$414M	$410M	$444M	$512M	$479M	$473M

* BASE COSTS INCLUDE MULTIPLIERS

regcost.wpd

WJ3-114

TABLE 5-23

TUNNELS REQUIRED FOR 0-1 OVERFLOWS, LONG TERM*

NUMBER OF OVERFLOWS	VOLUME (m^3)	DIAMETER (m)	ESTIMATED BASE COST $M
1 OVERFLOW			
• 600 ML/d	1,200,000	1 @ 6.1	685
• 825 ML/d	1,000,000	1 @ 5.6	630
• 1,060 ML/d	825,000	1 @ 5.1	575
0 OVERFLOW			
• 600 ML/d	2,438,000	1 @ 8.8	990
• 825 ML/d	2,175,000	1 @ 8.35	950
• 1,060 ML/d	2,000,000	1 @ 8	900

*Tunnel Length = 40,000 m

CSO Control Option *Regional Tunnels*

Remaining or Potential Concerns

Issues	Aspects	Comments
Technical		
Operations	Flushing - frequency	- Supp in Milwaukee is not req'd - Toronto expect to flush frequently (after each event?)
	Central (ie 1.) flexibility but access difficult	
Environmental	ground water contamination	- Chicago models indicated extrusion not a problem (won't go far) - Toronto tunnels are lined (shale)
ocio-Economic		
Regulatory / Public		

WS3-170

9 - SEPARATION

N. SZOKE

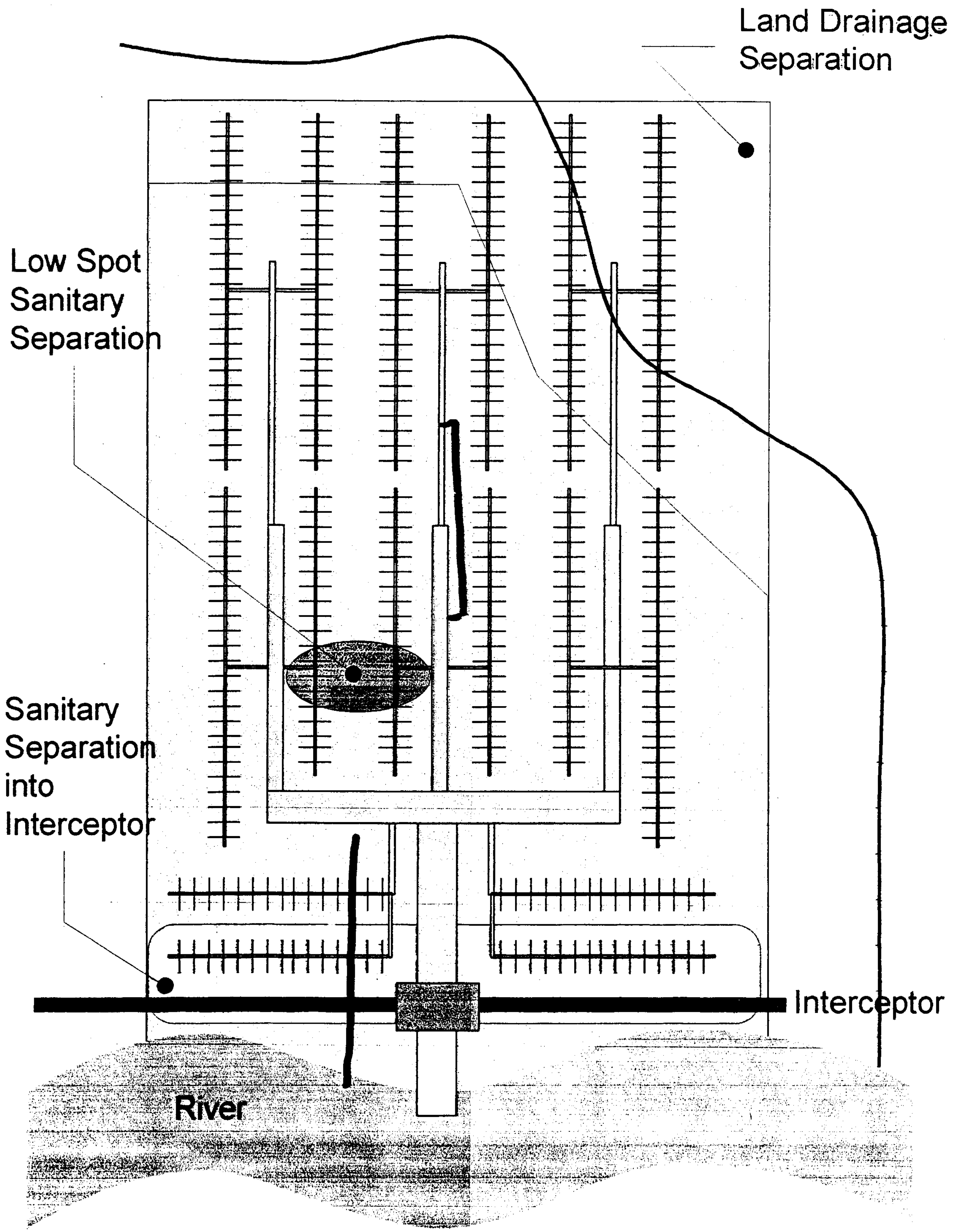
Sewer Separation
CSO Control Option

Phase 3 Workshop
May 7th, 1998
Winnipeg Canoe Club

Background

- Approximately 9000 ha (~22, 000 ac) serviced by combined sewers in Winnipeg
  - ➠ most prone to basement flooding for large rainfall events
- City has ongoing program to improve basement flood protection
  - ➠ minimum of a 1-in-5 year return frequency storm
    - ❖ increase to about 1-in-10 with inlet restriction
  - ➠ each district assess individually to determine most cost effective solution(s)
    - ❖ selective localized separation (land drainage or sanitary)
    - ❖ addition relief pipes to lower HGL
    - ❖ reduction of tributary area
    - ❖ other

W53-117


Land Drainage Separation
Low Spot Sanitary Separation
Sanitary Separation into Interceptor
Interceptor
River

WS3-118

Sewer Separation

- Option most readily identify by public
- Most expensive option
- Not as effective as other control options from receiving stream perspective
  - ➠ greatest benefit to BFR
- Separation can be done in one of two ways
  - ➠ New land drainage network, or
  - ➠ New wastewater sewer system
    - ❖ more expensive
    - ❖ more complicated
    - ❖ more disruption to customers

WS3-119

Cost Estimates

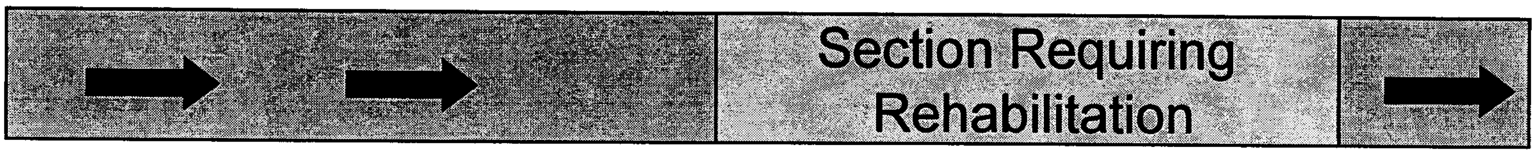
- Estimates are based on New LDS
  - ➠ Local experience finds separation cost to range between $700 to $1,000 Mil
    - ❖ based on $60K to $90K / ha
  - ➠ U.S.A. experience finds separation cost to range between
    - ❖ $1,700 Mil (Sacramento)
    - ❖ $1,600 Mil (Hartford)
  - ➠ Recent Canadian experience finds separation cost to range between
    - ❖ $1,500 Mil (Edmonton) to $1,900 Mil
- Estimates indicate that complete separation will be greater than $1,000
  - ➠ cost are adequate for planning level estimates (carrying $1,500 Mil)
  - ➠ regional estimate to improve cost estimate required if deem worthy for further consideration

WS3-120

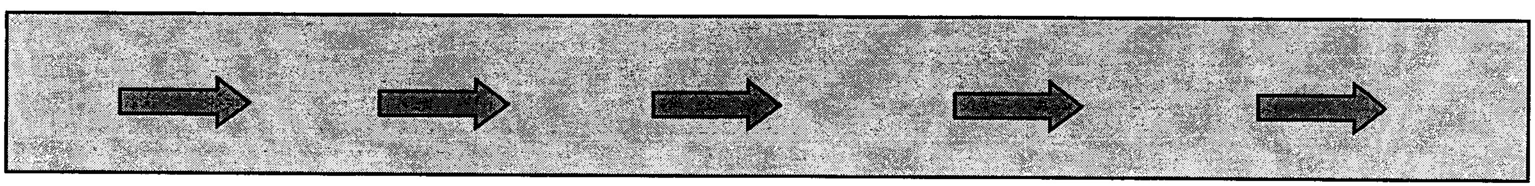
Integration with other Program

- Rehabilitation required regardless of sewer separation programs

Existing Combined Sewer (wastewater)



New Land Drainage Sewer



WS3-121

CSO Control Option Separation
Remaining or Potential Concerns

Issues	Aspects	Comments
Technical	• New LDS • New Wastewater • Reduce I/I • Opportunistic separation should be considered when rehab'ing or installing	doesn't provide the same benefit to receiving waters as other alternatives - need to abate floatables, oil + grease from stormwater BFR
Operations	• Rehab of existing trunks • Flap Gates and sluice gates • Mtce on combined sewer after separation (reduced flow)	
Environmental	• Future permitting of LDS discharges • Can cause non-compliance w/ Fecal coli objective • Does not capture floatables and other debris from streets	
Socio-Economic	• Very expensive • Long-term program • disruption (Commercial, industrial	
Regulatory / Public	Disruptive. • Stormwater impacts	

WS3 - 171

10 - FLOATABLES
R. REMPEL

Floatables Control

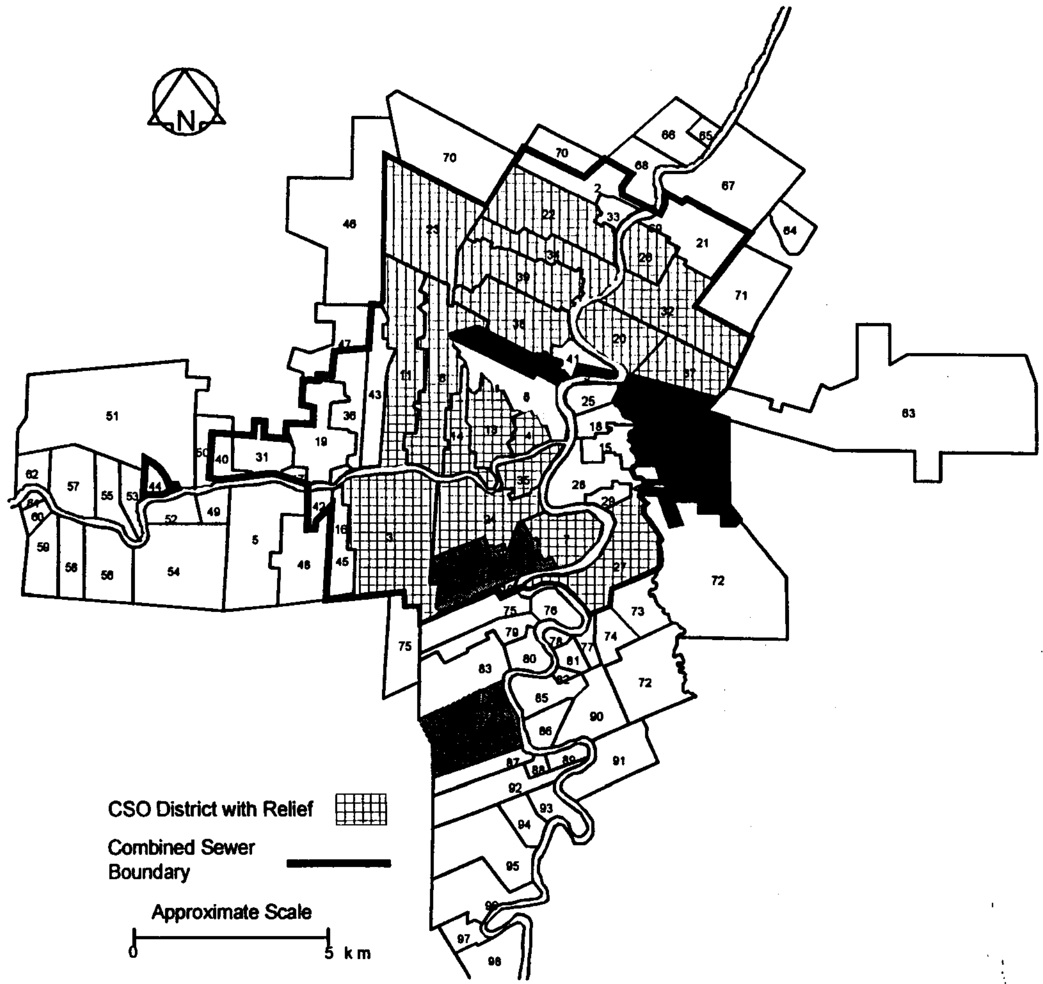
Introduction

- Buoyant debris, a.k.a "Floatables" may contain:
  - ➠ paper and plastics
  - ➠ spent hygienic wastes
  - ➠ used medical wastes
  - ➠ residential/commercial/ industrial wastes which are aesthetically unappealing
- Floatables have been identified as being an offensive aspect of CSO's by the public.

WS3-123

Floatables 1996 and 1997 Field Programs

- **Over two summer programs, 5 outfalls were monitored for floatables**
  - each outfall fitted with boom/netting collection system
    - 4 CS outfalls
    - 1 LDS outfall



1997 Results

TABLE 5-27

1997 SUMMER FLOATABLES - RECOVERY PROGRAM

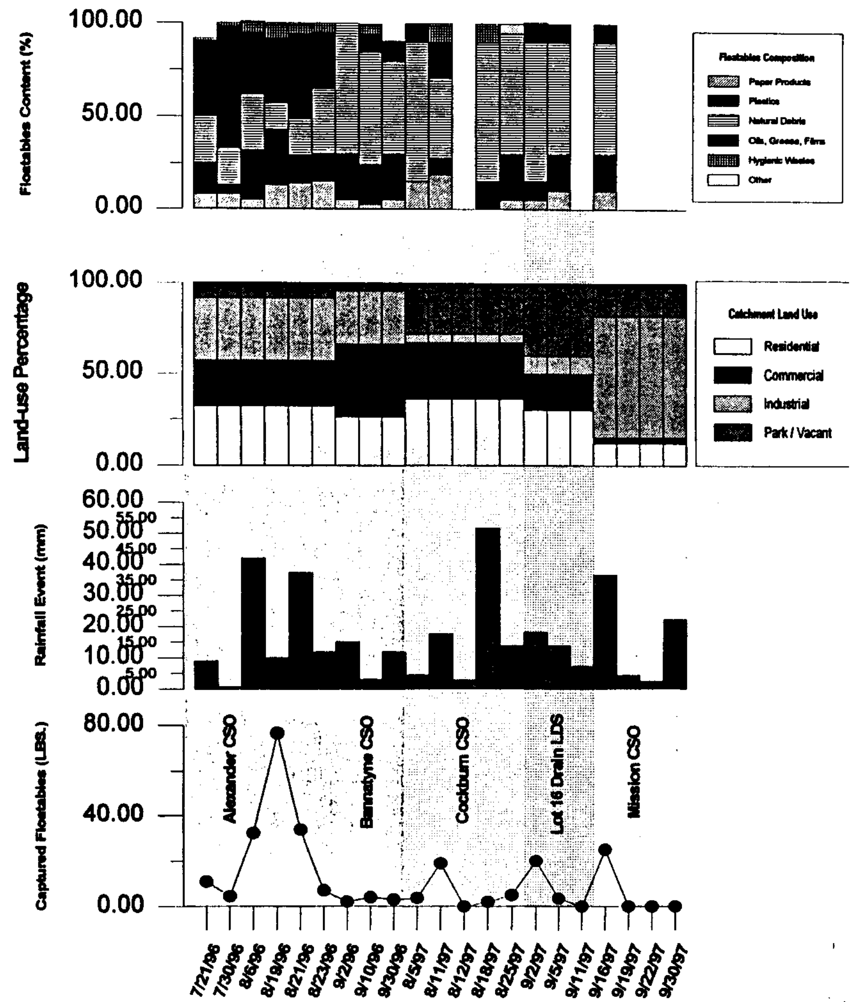
					Fraction of Total Captured (Percent of Area)						
						Plastics					
Outfall Location	Boom Service Date	Previous Event Accumulated Rainfall (mm)	Captured Floatable Mass kg (lbs)	Spread-flat Area m2 (ft2)	Paper Products	Hard	Soft	Natural Debris (branches, leaves, grass)	Surface Films (oil, grease, scrum)	Health & Hygiene	Other Material
Cockburn	Aug 5	4.6	1.7 (3.7)	0.4 (4.0)	15			75	10		
Cockburn	Aug 11	16.2	8.6 (19)	1.9 (21)	19		9	43	19	9	hockey ball, fishing gear
Cockburn	Aug 12	2.8	Negligible	-	-	-	-	-	-	-	-
Cockburn	Aug 18	51.8	0.9 (2)	0.2 (2)		10	5	75		10	
Cockburn	Aug 25	13.8	2.3 (5)	0.44 (5)	5	10	15	65			5
Lot 16 Drain	Sept 2	14.6	9.1 (20)	0.53 (6)	5		10	75	10		1 dead muskrat
Lot 16 Drain	Sept 5	13.8	1.6 (3.5)	0.40 (4)	10		20	60	10	-	
Lot 16 Drain	Sept 11	6.0	Negligible	-		-	-	-	-	-	Plastic pop bottles
Mission	Sept 16	36.6	11.3 (25)	1.42 (16)	10	10	10	60	10		Dark oil slick, animal tissues, strong diesel odour, large wood chunks
Mission	Sept 19	4.4	no debris								
Mission	Sept 22	2.4	no debris								
Mission	Sept 30	12.8 9.6	no debris								
Boom Removal for Winter Storage	Oct 1	-	-	-	-	-	-	-	-	-	-

TetrES
CONSULTANTS

WS 3-125

Monitored Results, *(cont'd)*

- Some outfalls episodically loaded significant floatables, others discharged low volumes
- Debris can be specific to certain industries (animal processing, restaurants)
- Selective targeting of problematic outfalls is a good first step
- Priority issues exist:
  - ➟ get control of hypodermic needles in floatables



WS3-126

Costs

Control Option	Cost	Issues
Free- Standing Screens	$110M	Land, operating, odour control, NIMBY
Trash Trap System	$30M	Op. Costs $1.2M/year, some river reaches too narrow

- Estimates from Phase 2 still valid
- Issues dictate that one technology will be difficult to apply city-wide
- Optimal approach will use a mix of control options, assessed site-by-site

WS3-127

CSO Control Option *Floatables*

Remaining or Potential Concerns

Issues	Aspects	Comments
Technical	TRASH TRAP - SOME REACHES TOO NARROW	
Operations	SCREENS - OPERATING EFFORT - ODOUR • Labour intensive • Disposal	
Environmental	LDS contributions	
Socio-Economic		
Regulatory / Public		

WS3-172

11 - OVERVIEW OF CONTROL PLANS

G. REMPEL

Performance Targets

- Optimizing Existing Infrastructure
- Limiting CSOs to about 4 overflows per year
- 85% capture
- Limit CSO to 0 per year
  - separation or primary treatment/disinfection of combined sewage
- Overall Compliance with MSWQO
  - DWF & WWF

WS3-128

A		**Existing Situation**
	1	Existing
B		**Optimizing Existing Infrastructure**
	1	Inline Storage
C		**Target of 4 Overflows**
	1	Distributed Offline Storage
	2	Distributed Inline/Offline Storage
	3	Distributed Inline/Offline Storage with Transfers
	4	Tunnel Transport/Storage
	5	Inline withTunnel Transport/Storage
	6	Hirate Treatment RTB
D		**Target of 0 Overflows - Representative Year**
	1	Distributed Storage
	2	Distributed Inline/Offline Storage
	3	Tunnel Transport/Storage
	4	Inline PlusTunnel Transport/Storage
	5	Hirate Treatment RTB
E		**Target of 1 Overflows - Long Term 85% Captu**
	1	Tunnel Transport/Storage
F		**Target of 0 Overflows - Long Term**
	1	Tunnel Transport/Storage
G		**Separation**
	1	

TRADEOFF.WK4

WS3-129

Table 5-30
Summary of Candidate Options Costs

	Plan Number	Dewatering Rate at NEWPCC ML/d	Treatment Cost Millions	Interceptor Cost Millions	Inline Storage Cost or Regulator for Offline[1]	Required Offline Storage Volume m³	New Structural Cost Millions	O & M Cost PV	Total Cost Millions
Existing Situation									
Existing	0	825							$0
Optimizing Existing Infrastructure									
Inline Storage	1	600	$15		$100				$115
	2	825	$36	$15	$100				$151
	3	1060	$70	$46	$100				$216
Target of 4 Overflows									
Distributed Offline Storage	4	600	$15		$12	300,000	$384	$19	$430
	5	825	$36	$15	$12	215,000	$335	$22	$420
	6	1060	$70	$46	$12	185,000	$303	$34	$465
Distributed Inline/Offline Storage	7	600	$15		$100	102,000	$184	$15	$314
	8	825	$36	$15	$100	66,000	$127	$18	$296
	9	1060	$70	$46	$100	38,000	$98	$28	$342
Distributed Inline/Offline Storage with Transfers	10	600	$15		$100	80,000	$137	$15	$267
	11	825	$36	$15	$100	54,000	$113	$18	$282
	12	1060	$70	$46	$100				
Tunnel Transport/Storage	13	600	$15		$12	300,000	$485	$13	$525
	14	825	$36		$12	215,000	$432	$17	$497
	15	1060	$70		$12	185,000	$391	$28	$501
Inline withTunnel Transport/Storage	16	600	$15		$100	102,000	$299	$13	$427
	17	825	$36		$100	66,000	$274	$17	$427
	18	1060	$70		$100	38,000	$274	$28	$472
Hirate Treatment RTB	19	825	$36	$15	$12	160,000	$327	$29	$419
Target of 0 Overflows - Representative Year									
Distributed Storage	20	600	$15		$12	825,000	$845	$22	$894
	21	825	$36	$15	$12	600,000	$697	$25	$785
	22	1060	$70	$46	$12	530,000	$564	$33	$725
Distributed Inline/Offline Storage	23	600	$15		$100	606,000	$613	$22	$750
	24	825	$36	$15	$100	393,000	$456	$23	$630
	25	1060	$70	$46	$100	230,000	$443	$28	$687
Tunnel Transport/Storage	26	600	$15		$12	825,000	$703	$13	$743
	27	825	$36		$12	600,000	$636	$17	$701
	28	1060	$70		$12	530,000	$622	$28	$732
Inline PlusTunnel Transport/Storage	29	600	$15		$100	606,000	$588	$13	$716
	30	825	$36		$100	393,000	$519	$17	$672
	31	1060	$70		$100	230,000	$422	$28	$620
Hirate Treatment RTB	32	825	$36	$15	$12	385,000	$532	$32	$627
Target of 1 Overflows - Long Term									
Tunnel Transport/Storage	33	600	$15		$12	1,200,000	$685	$13	$725
	34	825	$36		$12	1,000,000	$630	$17	$695
	35	1060	$70		$12	825,000	$575	$28	$685
Target of 0 Overflows - Long Term									
Tunnel Transport/Storage	36	600	$15		$12	2,438,000	$990	$13	$1,030
	37	825	$36		$12	2,175,000	$950	$17	$1,015
	38	1060	$70		$12	2,000,000	$900	$28	$1,010
Separation									
	39								$1,500

TRADEOFF.WK4

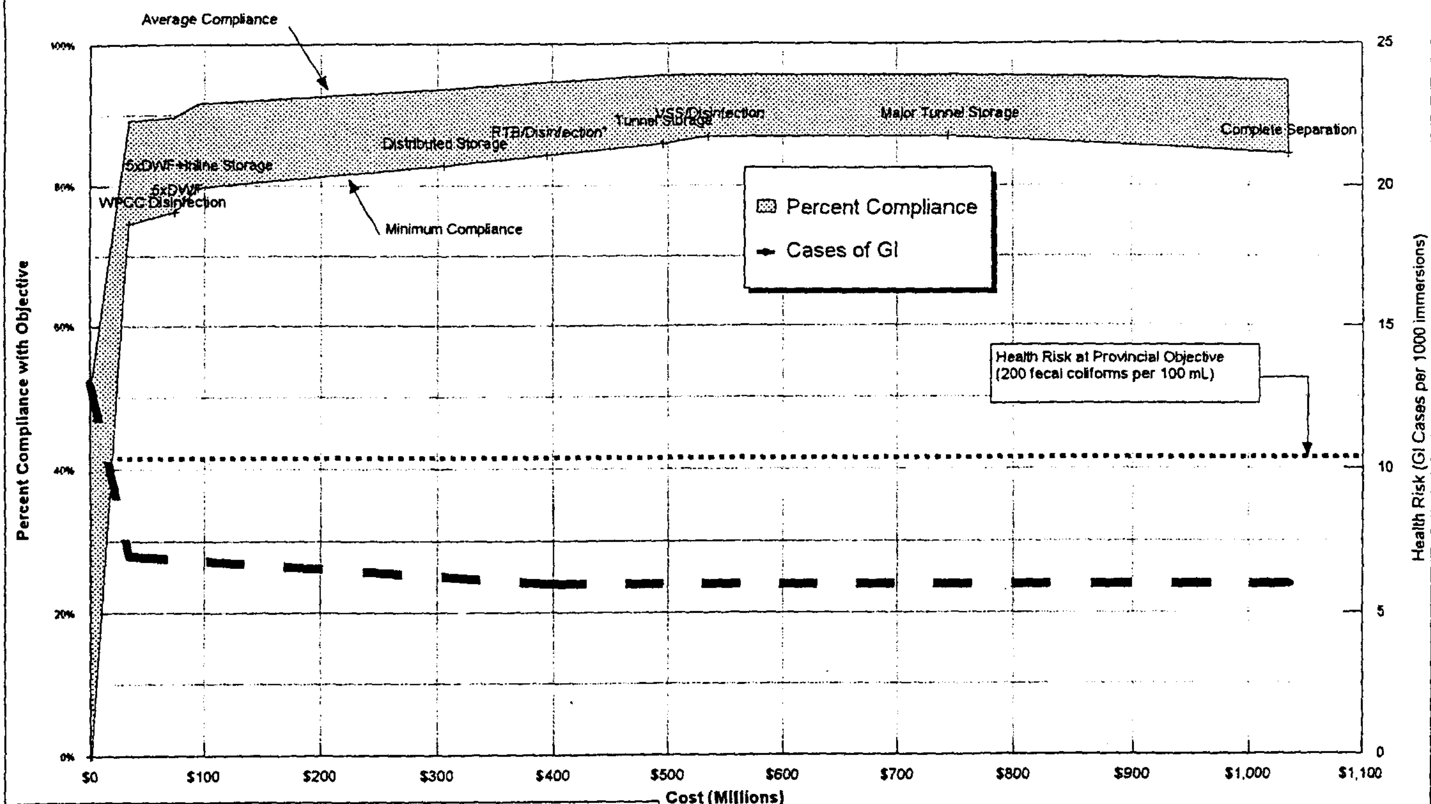
WS3-130

Existing System Assessment

- After Disinfection of DWF from WPCCs compliance with MSWQO will be improved to 75% to 90% of time
- Additional control will improve compliance marginally at high cost
- there are still numerous CSOs (>20) at multiple locations

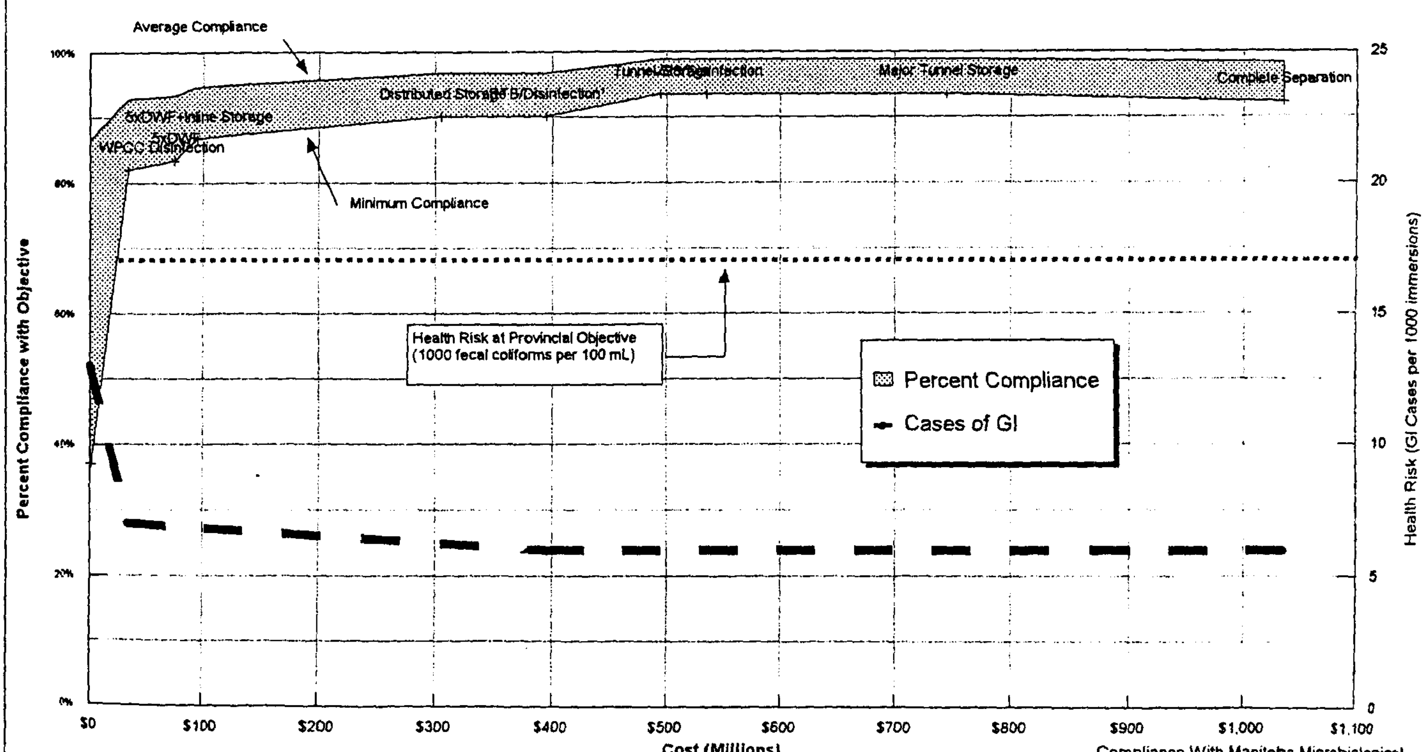
WS 3-131

Compliance with 200 Fecal Coliforms per 100 mL Objective
for Different Control Scenarios



1. Average Compliance is the average compliance for all 14 monitoring stations throughout the Study Area reaches
2 Minimum Compliance is the lowest compliance frequency of the 14 stations

Compliance with 1000 Fecal Coliforms per 100 mL Objective
for Different Control Scenarios

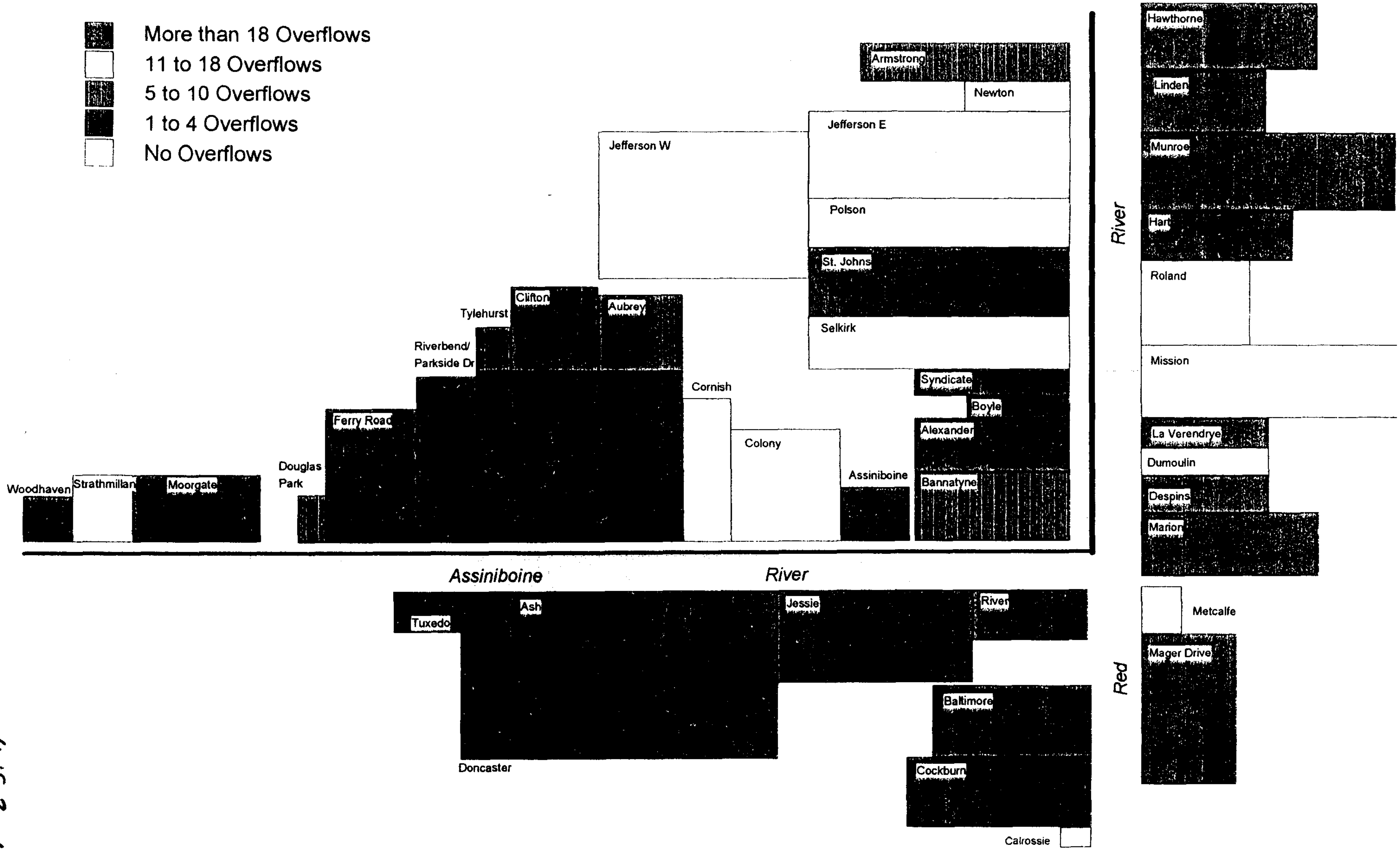


Compliance With Manitoba Microbiological
Objectives and Associated Health Risk

1. Average Compliance is the average compliance for all 14 monitoring stations throughout the Study Area reaches
2 Minimum Compliance is the lowest compliance frequency of the 14 stations

Figure 6-2

No Inline Storage and Existing Interception Rate



WS 3.133

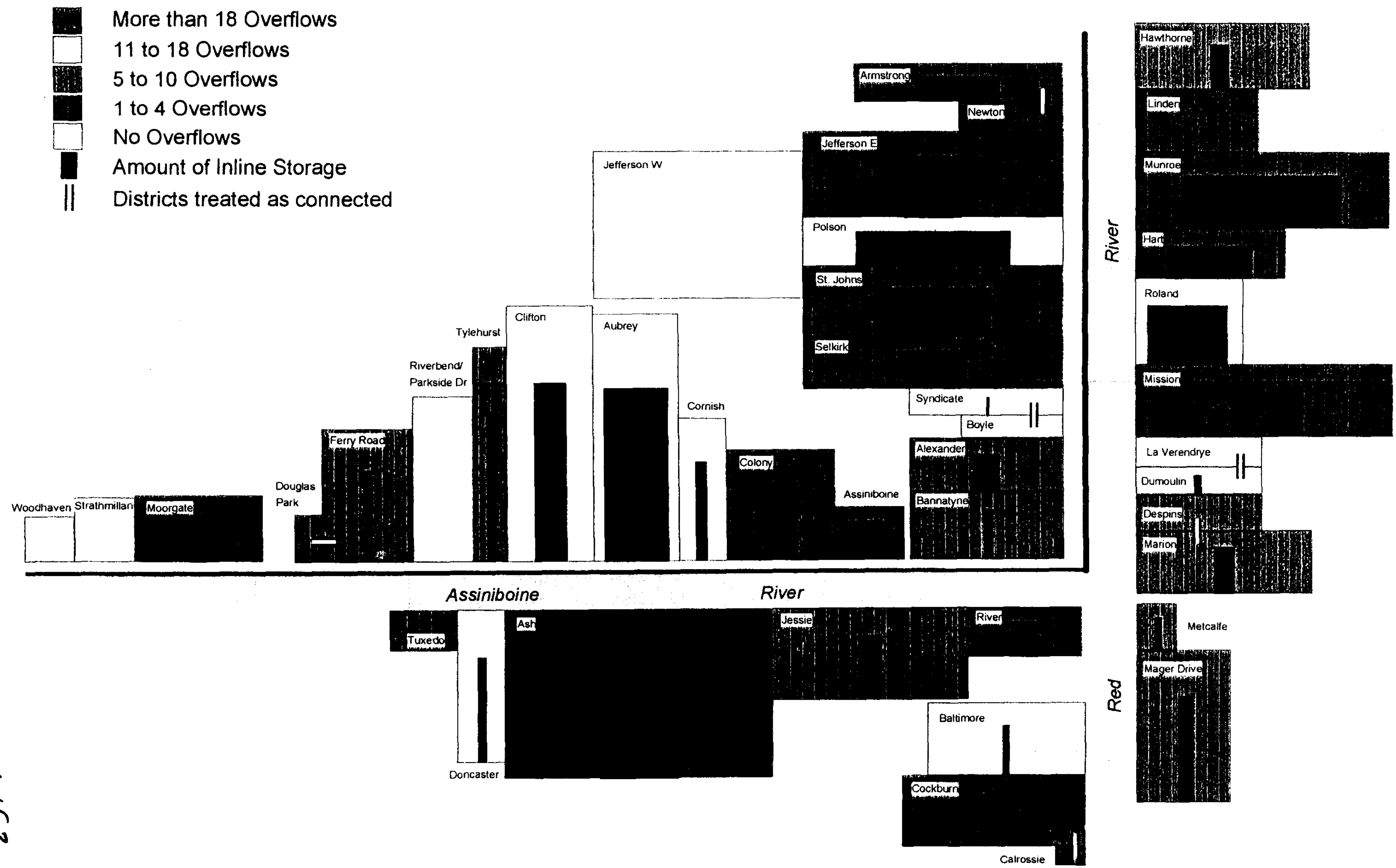
pdoxmdl2

Inline Storage Assessment

- Inline Storage is effective in reducing CSOs
  - from 17 overflows/year (long term) to 5 to 8
  - from 32% capture to 52 % to 62 %
  - cost $115 million to $215 million
- the reduction is not evenly distributed
  - some are as high as 18 overflows /year
- good potential for proposed BFR to address almost all of the high overflow districts

WS3-134

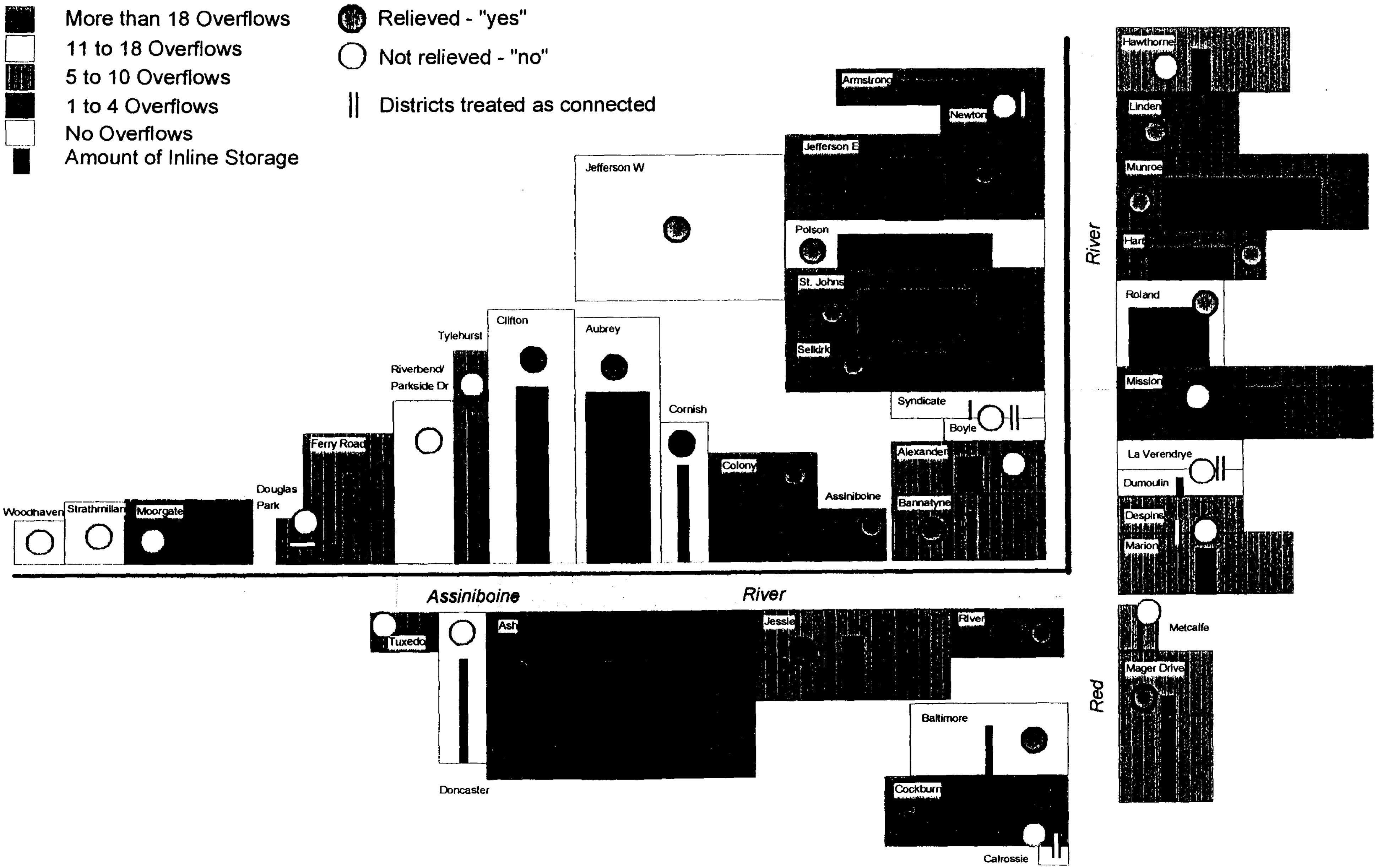
Inline Storage and 825 ML/d at NEWPCC



NS3-135

pdoxmodl

Inline Storage and 825 ML/d at NEWPCC

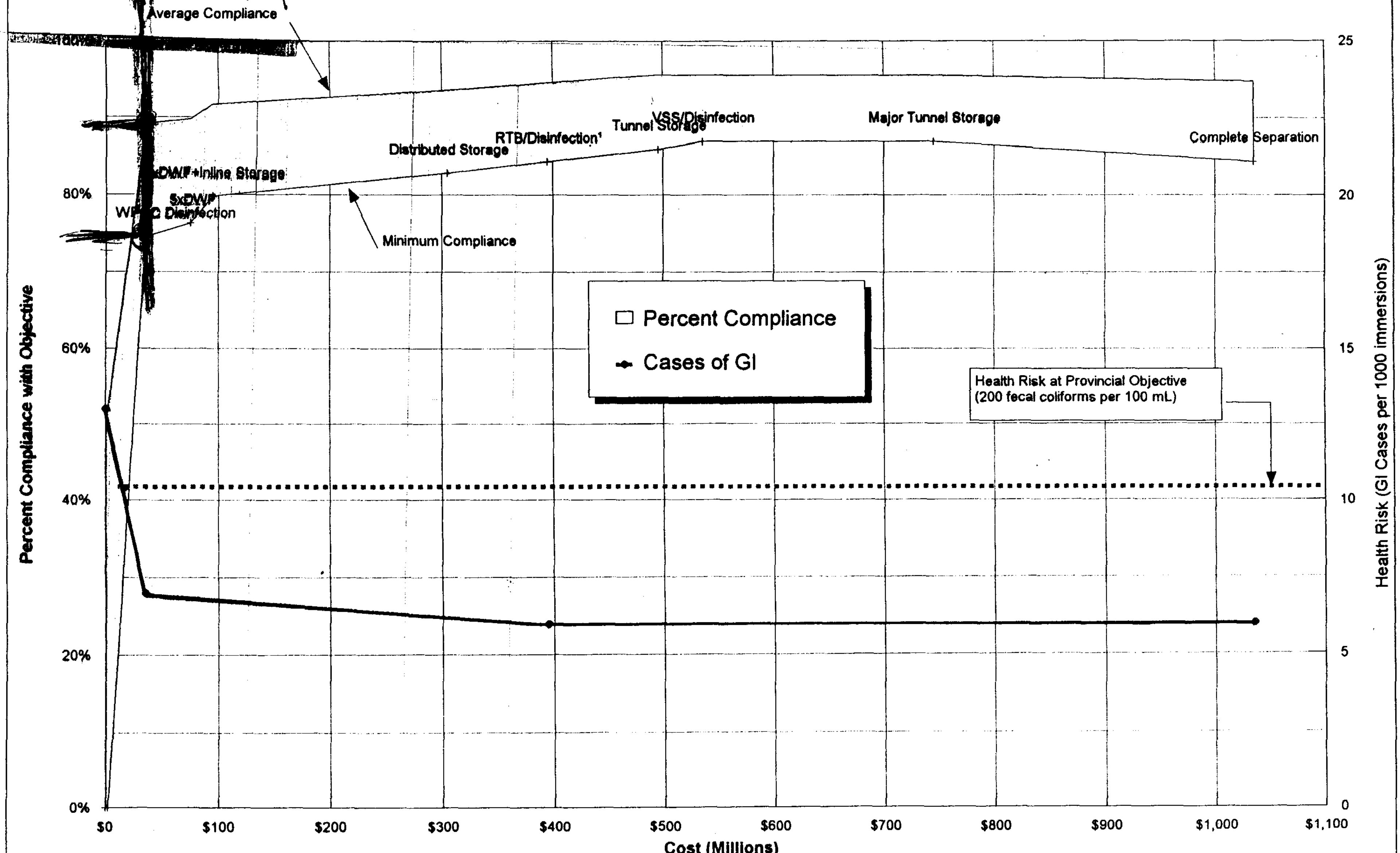


WSB-136

pdoxmodl

After Effluent Disinfection

Compliance with 200 Fecal Coliforms per 100 mL Objective
for Different Control Scenarios



1. Average Compliance is the average compliance for all 14 monitoring stations throughout the Study Area reaches
2 Minimum Compliance is the lowest compliance frequency of the 14 stations

From Phase 2

WS3-137

Class 5 - Categories A & B - Primary & Secondary Recreation

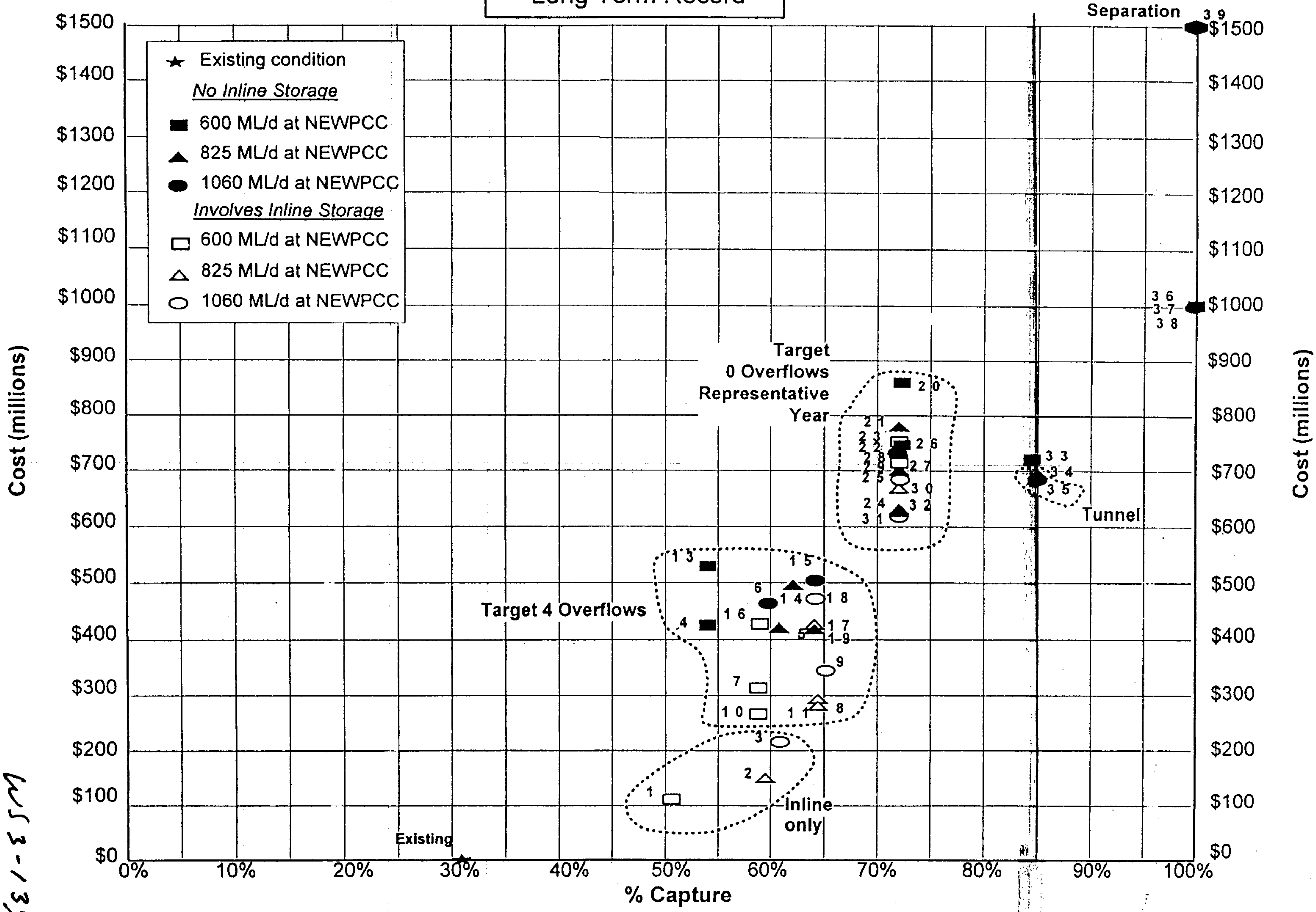
Manitoba Environment has proposed that only the Red River be classified for primary recreation and that all rivers and streams within the classification area be classified for secondary recreation. The Department provided evidence to show significant use for both categories of recreation and has indicated that use numbers would increase if river quality was improved. Numerous individual presenters and interest groups stressed their agreement with the proposed classification.

The key specific requirement for recreational use is the fecal coliform objective. Primary recreation advocates a 200 organisms per 100 mL and secondary recreation a 1,000 organisms per 100 mL level. The City of Winnipeg considers that natural river conditions make the Red River unsafe as well as unsuitable for primary recreation and the most prominent use - water-skiing - is so limited that benefits do not justify the costs of disinfection. Disinfection of wastewater treatment plant effluent would likely bring the City of Winnipeg into full compliance with the primary and secondary recreation objectives during dry-weather flows. During wet-weather flows, objectives would not be met because of the impact of combined sewer overflows. Land drainage also contributes to the coliform load. This would also require that discharges of raw sewage to storm or combined sewers during dry weather would have to be limited to emergency situations only.

The Commission feels there is insufficient site-specific information on the composition and impact of CSOs to advocate a blanket requirement for all CSOs to be regulated and treated or to separate combined sewers. It is known from Winnipeg's estimates and from experience elsewhere that the costs are high. It may be that, even with complete regulation and treatment of CSOs, fecal coliform objectives could not be met at all times.

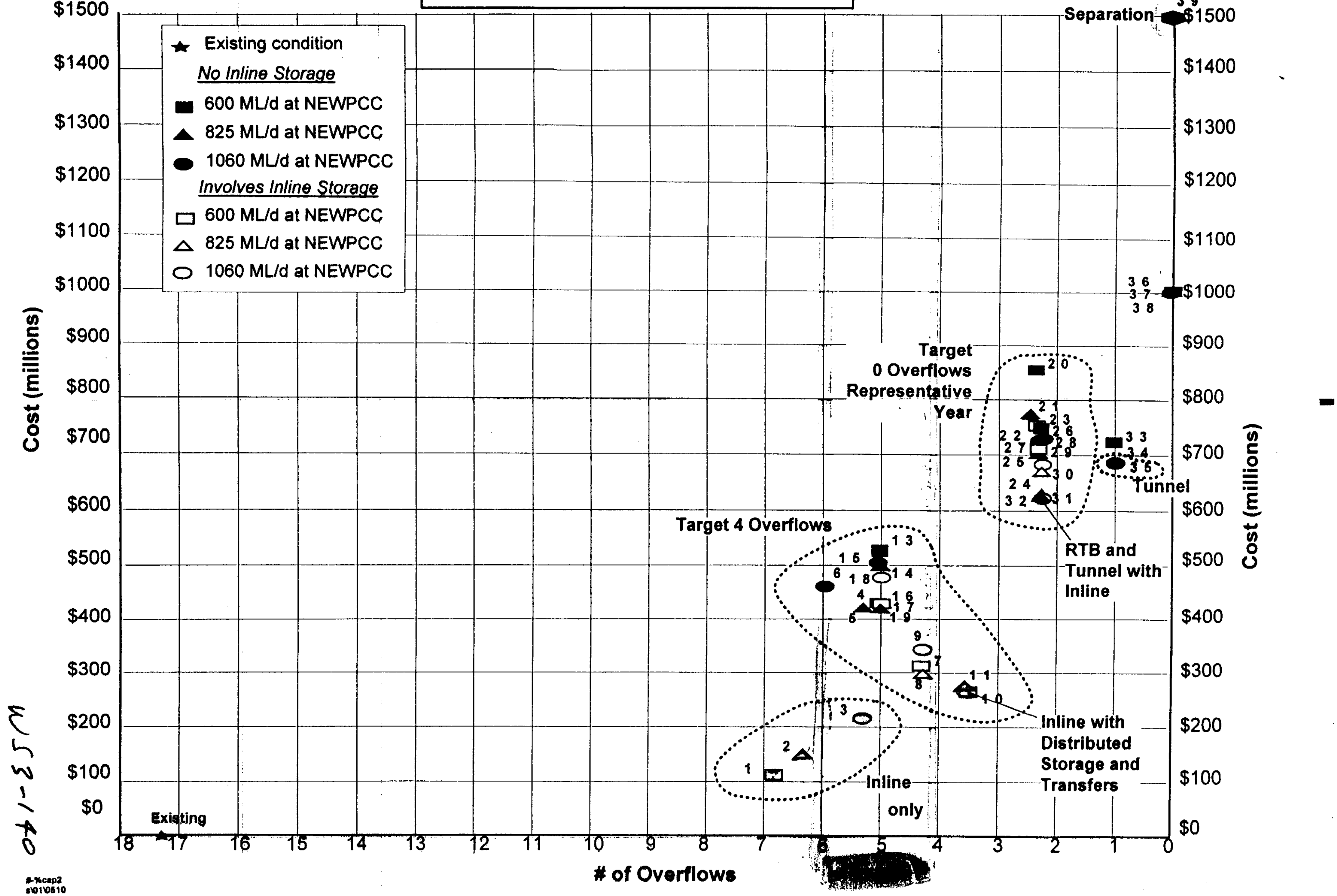
WCS-138

Cost vs. % Capture
Long Term Record



WS 3-139

Cost vs. Number of Overflows
Long Term Record



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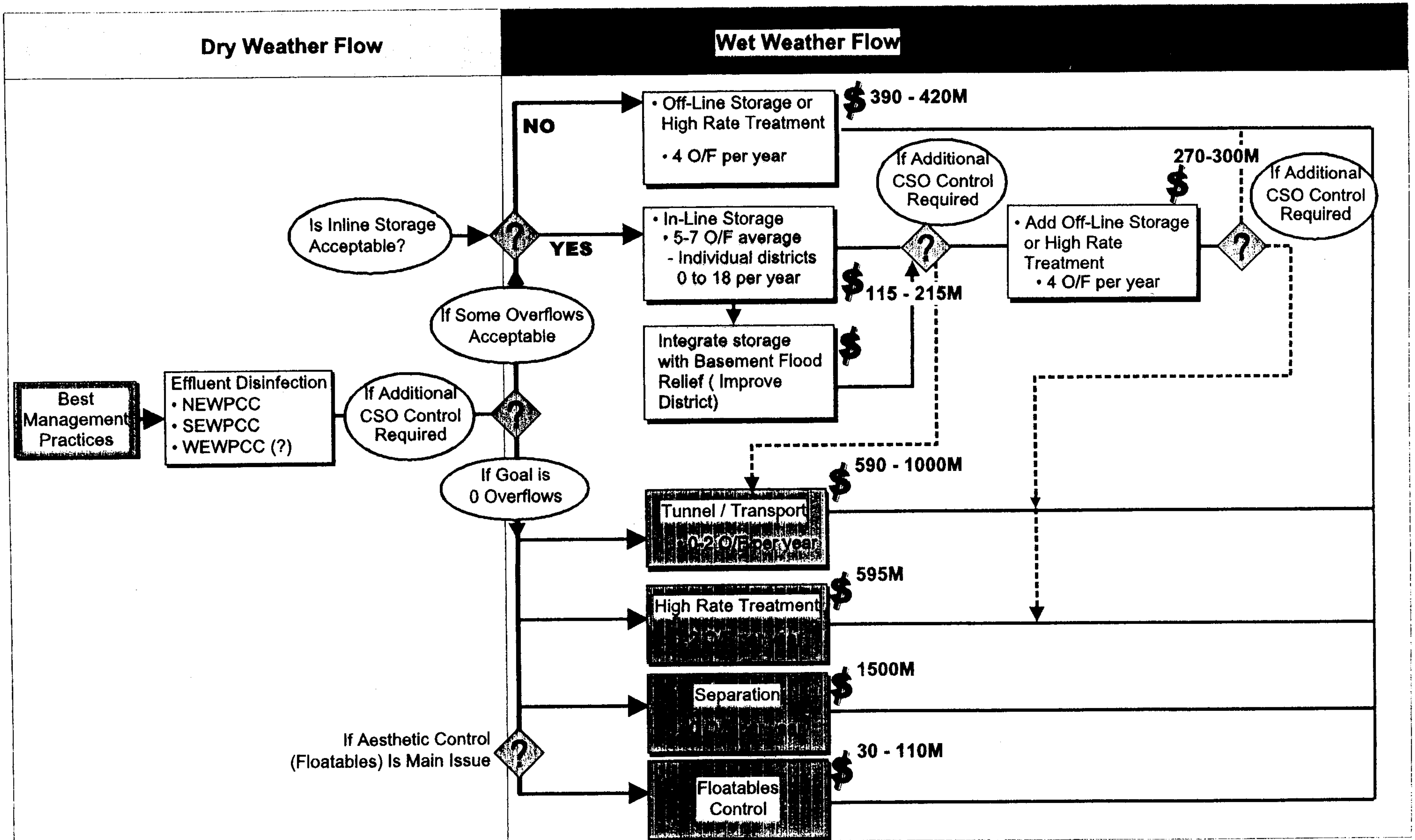
KEY QUESTIONS

- Is additional CSO control required?
- Are some overflows acceptable?
- Is the goal to eliminate overflows entirely?
- Is use of in-line storage acceptable?
- Is control of floatables a central issue?



Note: Costs are in millions (M) and are cumulative

Potential CSO Management Strategies: Phase 3

Figure 6-10

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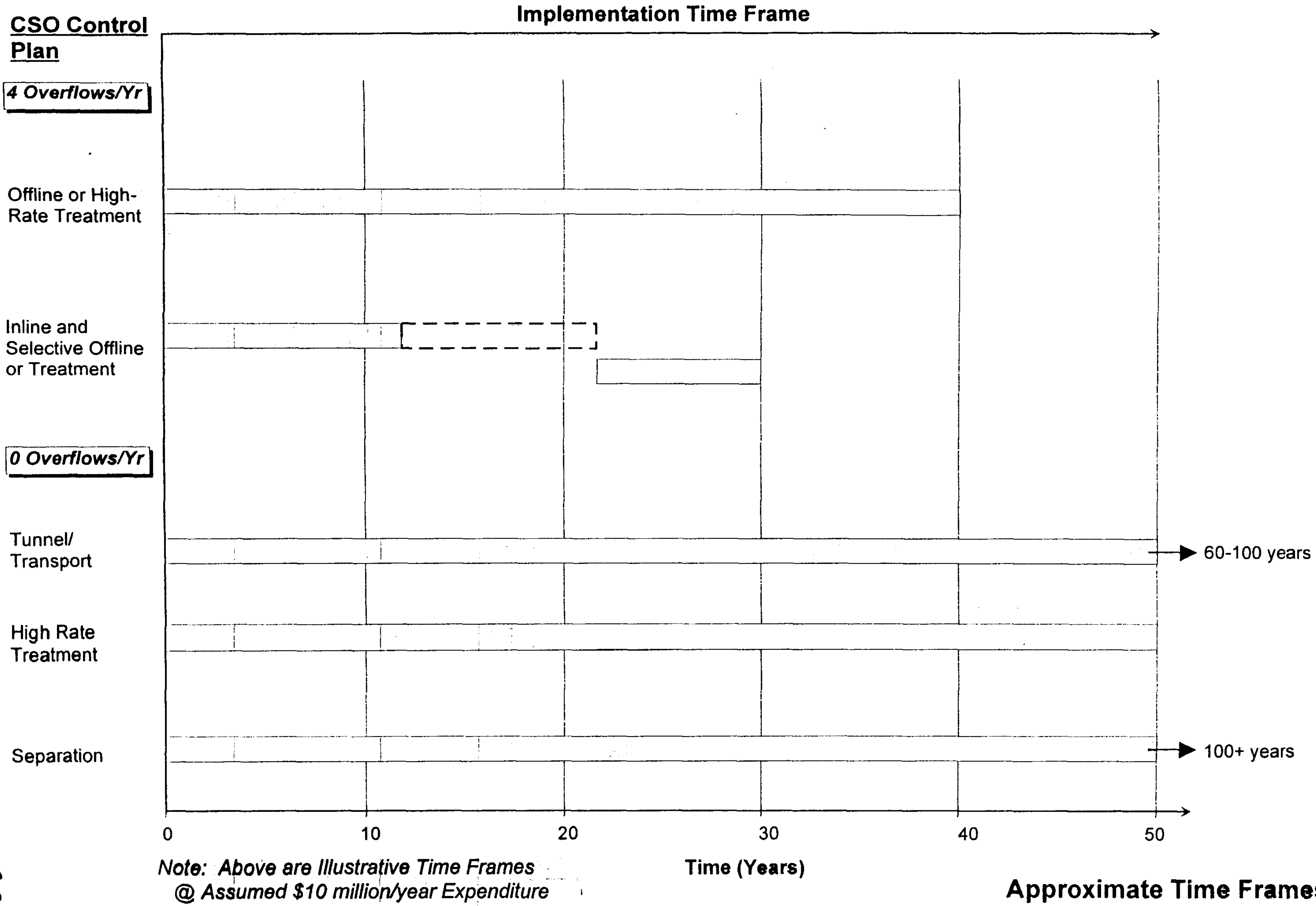
WS 3-142

FACTORS IN DEFINING A PLAN

- Cost
  - capital
  - O&M
- Cost-Effectiveness
- Environmental Benefits
  - compliance
  - health risk
- Operational Considerations
  - complexity
  - reliability
- Constructability
- Staging/Flexibility
- Effect on Basement Flooding
- Public Acceptance
  - land use, safety, aesthetics, disruption
- Affordability
- Political Acceptability
- Regulatory Acceptability



Approximate Time Frames for Different Plans
Figure 6-9

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WS3-144

CSO Control Option OVERVIEW

Remaining or Potential Concerns

Issues	Aspects	Comments
Technical	COULD INCREASE DEWATERING RATES FOR SMALL DISTRICTS (TO IMPROVE COMPLIANCE). IMPLEMENT LATENT STORAGE FIRST. - IF PROGRAM PROCEEDS - IMPROVE LATENT STORAGE (RAISE EX. WEIRS)	
Operations	ADD SCADA FOR MONITORING	
Environmental		
Socio-Economic	REPLACEMENT COST ALLOWANCE ? STRONG CASE FOR INTEGRATION OF BFR / REHAB PROGS BENEFIT FOR AVOIDED COSTS FOR CSO CONTROL (VIS À VIS BFR)	
Regulatory / Public	HOW TO ILLUSTRATE BENEFITS OF TECHNOLOGY ON RIVER QUALITY SEPARATE PLOT FOR COMPLIANCE / W/ & W/O DWF DISINFECTION	

WS3-173

12 - <u>IMPACT ON RATES</u>

E. SHARP

CSO STUDY

Financial Considerations

Project Economics

Impact on Rates *

Fiscal Policy Issues

WS3-145

PROJECT ECONOMICS

- Economic Analysis is used to
  - evaluate a project's viability
  - compare alternatives
- Uses Life-Cycle analysis
  - average annual or present value
  - Benefit-Cost or Cost Effectiveness
- Does not reflect the impact on rates to customers

WS3-146

IMPACT ON RATES

- Decision makers and public will be interested in "*Cost to the Customer*"
- Customer Billings must cover
  - Capital Costs
    - construction/engineering/administration
  - Additional Operating Costs
    - labour/electrical/chemicals/repairs

Example Program

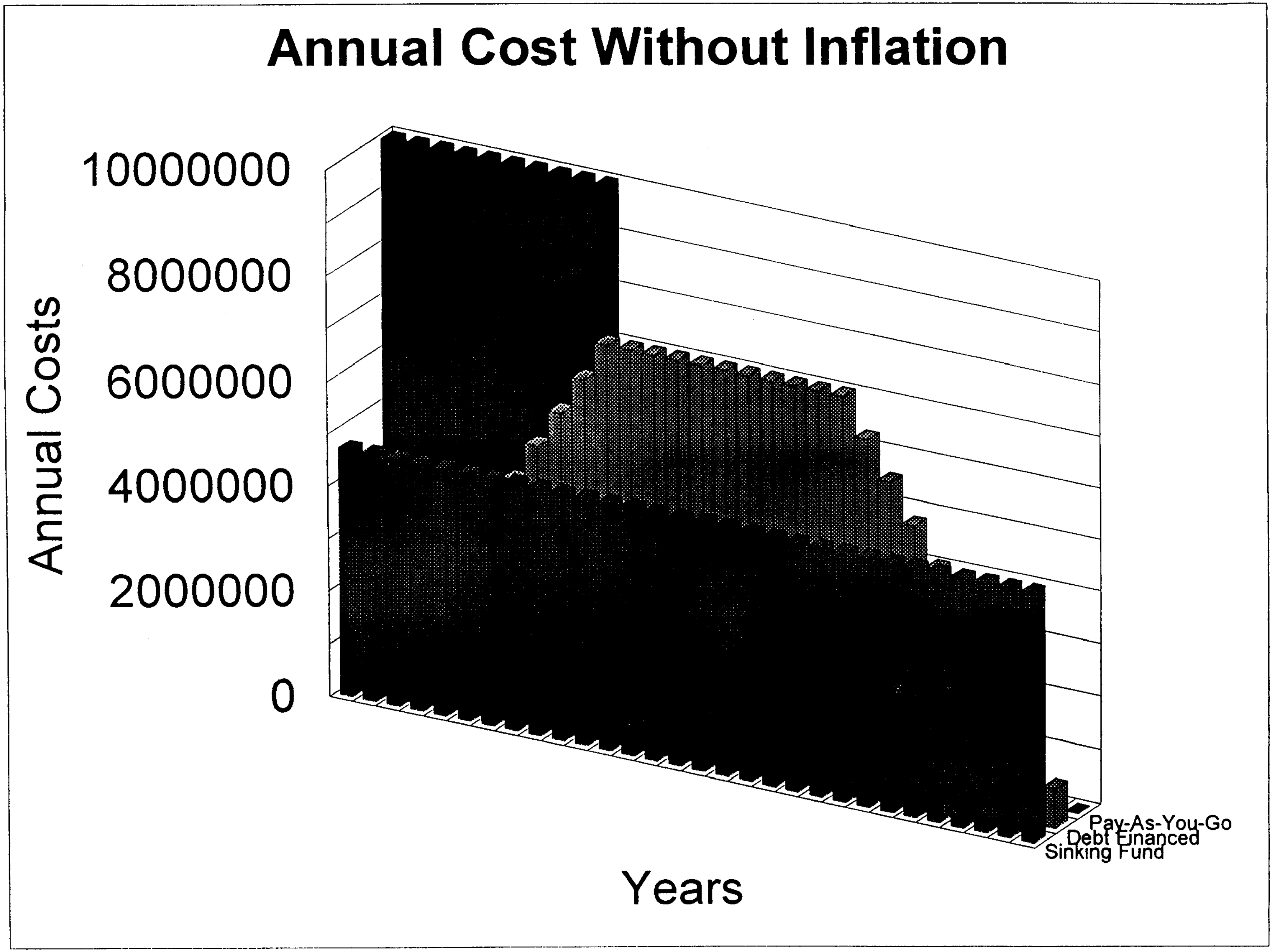
- $100 million Capital Program
  - Spend $10 million per year for 10 years
  - At 2% inflation, direct project cost to the Utility would be $111.7 million
    - – capital budget
  - Total amount collected from customers would depend on Method of Financing

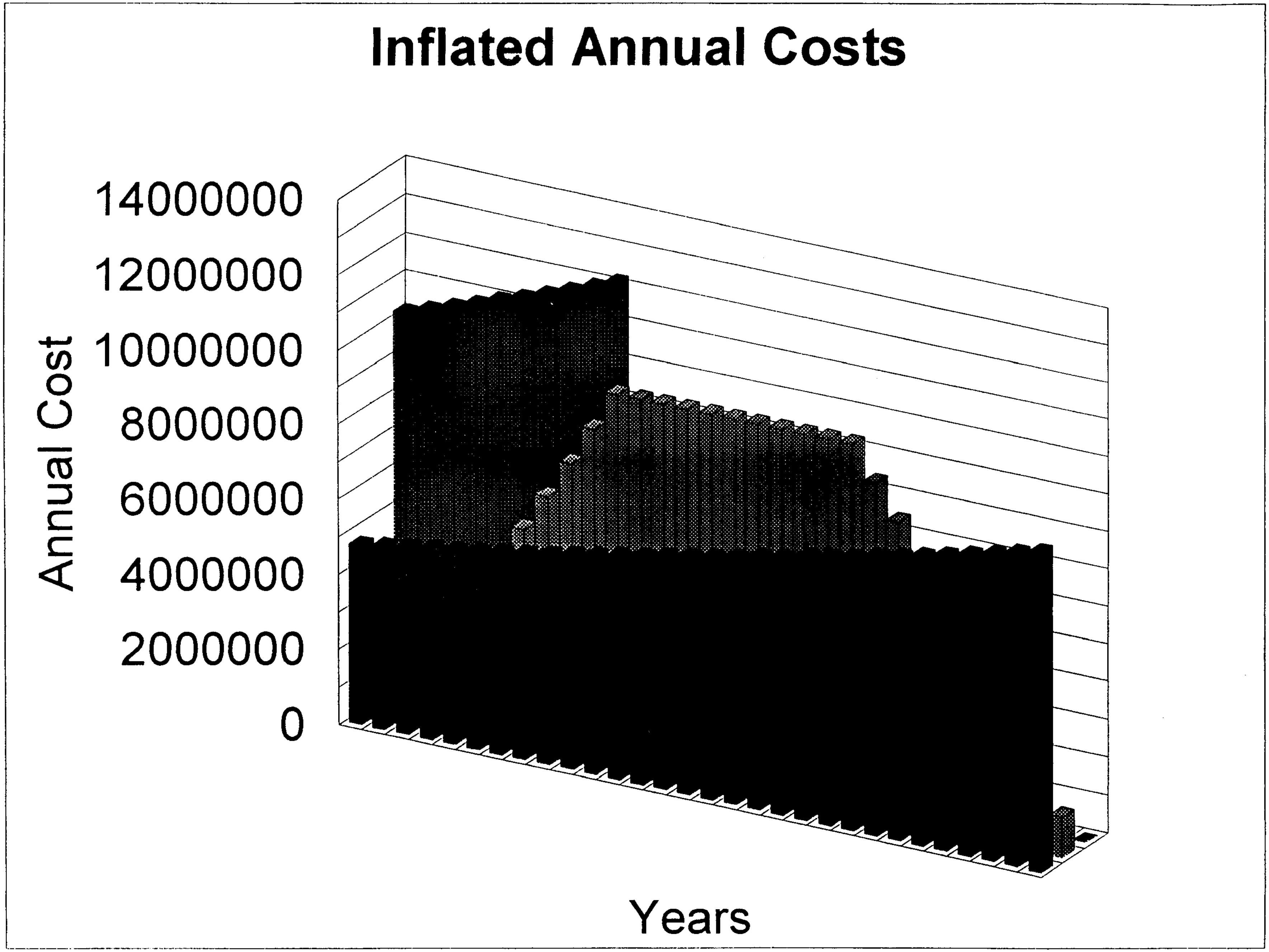
WS3-148

Methods of Financing

- Sewer Utility Rates will depend on the Method of Financing
    1) Debt Financed
    2) Pay-As-You-Go
    3) Sinking Fund

WS3-149


Annual Cost Without Inflation
10000000
8000000
6000000
4000000
2000000
0
Annual Costs
Years
Pay-As-You-Go
Debt Financed
Sinking Fund


Inflated Annual Costs
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
Annual Cost
Years

1) Debt Financing

- Traditional Approach for Capital Projects
  - Payments are made in the future
    - those who benefit will incur the expense
  - Amortization periods are typically 20 years
  - Results in capital and interest being collected directly from customers
- Accumulated debt has become a concern to the City

WS3-152

2) Pay-As-You-Go

- City moving to Pay-As-You-Go
  - Reduces reliance on long term debt
    - improves credit rating, lowers borrowing rates
- Annual costs equal annual expenditures
- Only the capital is recovered from customers
  - there is no cost of borrowing to the Utility

WS3-153

3) Sinking Fund

- A uniform series of payments
  - Method of averaging annual costs
  - Duration can be arbitrary
    - does not have to equal design life
    - does not have to coincide with construction
  - Example applications
    - bond issues
    - public/private lease payments

Revenue Requirements

- Example Program
  - Revenue required from Customers over a 30 year duration (inflated at 2%)

    Debt = $194.7 million

    PAY= $111.7 million

    SF= $193.0 million

Current Revenue Sources

- Sewer Utility
  - Costs recovered from customers
    - not mill rate/tax supported
  - Revenue Streams
    - Water Consumption based - Water Bill
      - source of operating revenue
      - includes Environmental Projects Reserve
    - Frontage Levy - Property Tax Bill
      - Sewer Renewal Reserve
      - Basement Flooding Protection Reserve

1997 Sewer Utility Revenue

Revenue in Millions

■ Consumption based	
– single family	$25,903
– multiple family	$13,475
– ind/com	$35,634
Subtotal	**$75,012**
■ Frontage Levy	$ 7,000
■ Other	$4,776
■ TOTAL	**$86,788**

Average Residential Water Bill

- Average Single Family Water Bill (1997)
  - $48.00 fixed charge (19% sewer)
  - $130.00 metered water consumption
  - $175.00 sewer (consumption based)
- ■ $353.00 TOTAL per year
  - $88.25 per quarterly bill
  - 6,200 cubic feet average annual per residence
  - sewer based on $2.83/100 cubic feet
    - ■ includes $0.194 for Environmental Projects

Typical Residential Water Bill

- Typical Water Bill (1997)
  - – $48.00 Fixed Charge
  - – $185.00 Water consumption
  - – $249.00 Sewer (consumption based)
- ■ $482.00 TOTAL per year
  - $120.50 per quarterly bill
  - 8,800 cubic feet average annual per residence
  - Sewer based on $2.83/100 cubic feet
    - ■ includes $0.208 for Environmental Projects

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CSO Questionnaire

- Survey Question

  Would you be willing to pay:

  No More, continue at 21 overflows per year

  $___ to reduce the overflows by half

  $___ to reduce the overflows to 4 per year

  $___ to eliminate all overflows

- Requires a common cost basis
  - 20 year construction program
  - 20 year coincident financing period
    - Pay-As-You-Go / Sinking Fund

CSO Program Impact

- For a $100,000,000, 20-year Program
  - Spend $5 million per year for 20 years
  - Across-the-board Rate Increase

    = $5,000,000/$75,000,000

    = 6.7%
  - For a Single Family Residential Customer

    = ($48 x 19% + $175) x 6.7%

    = $12.50 / year

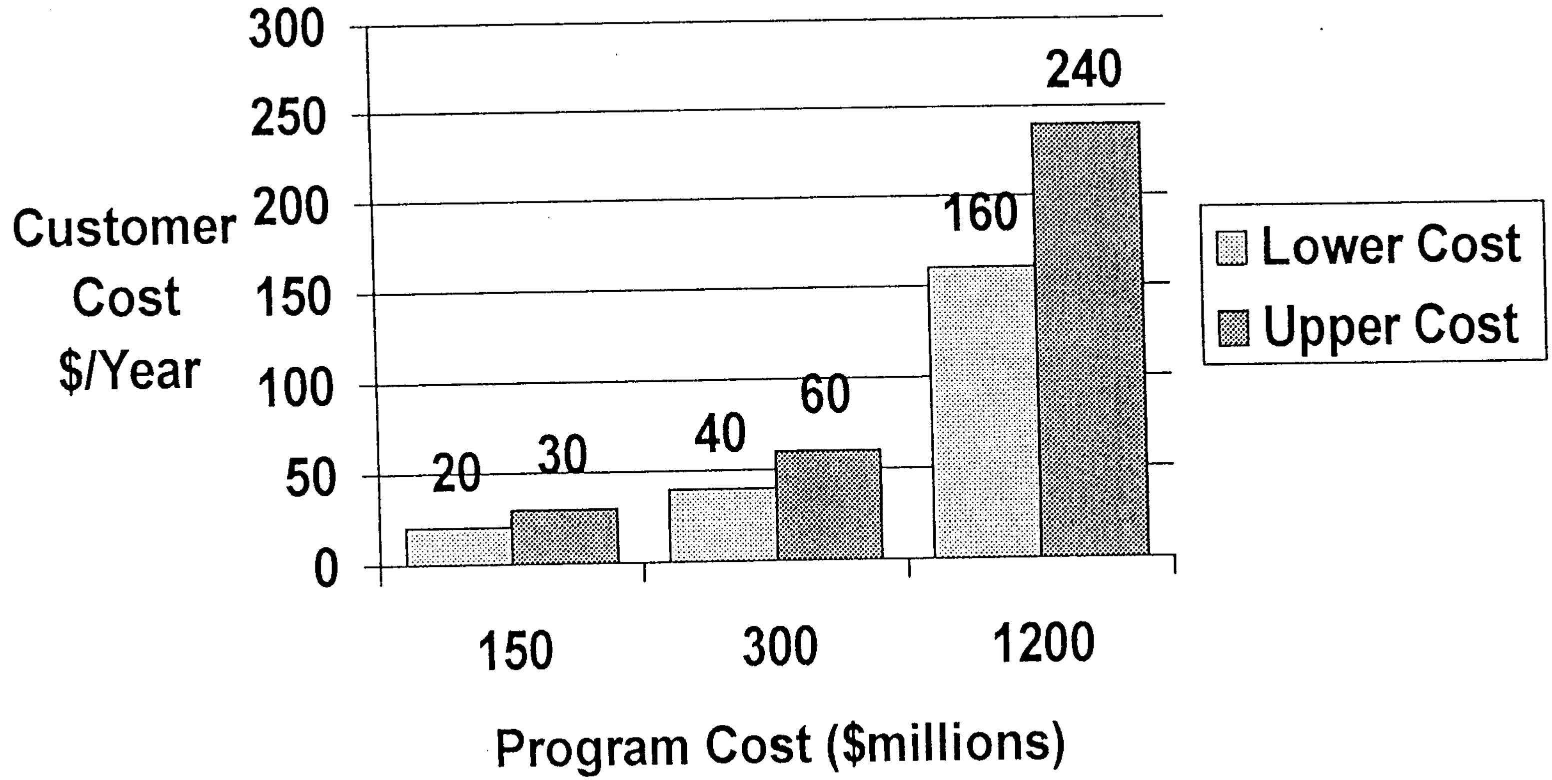
CSO Alternatives

- Capital Cost Estimates
  - Reduce by half = $ 150,000,000
  - Reduce to 4 = $ 300,000,000
  - Eliminate = $ 1,250,000,000
- Operating Cost Estimates
  - Present Values have been included in the Capital Cost Estimates

WS3-162

Cost Impact of CSO Alternatives

Annual Residential Customer Cost Increase
(20-year Implementation Program, Non-inflated)



WS3-163

FISCAL POLICY ISSUES

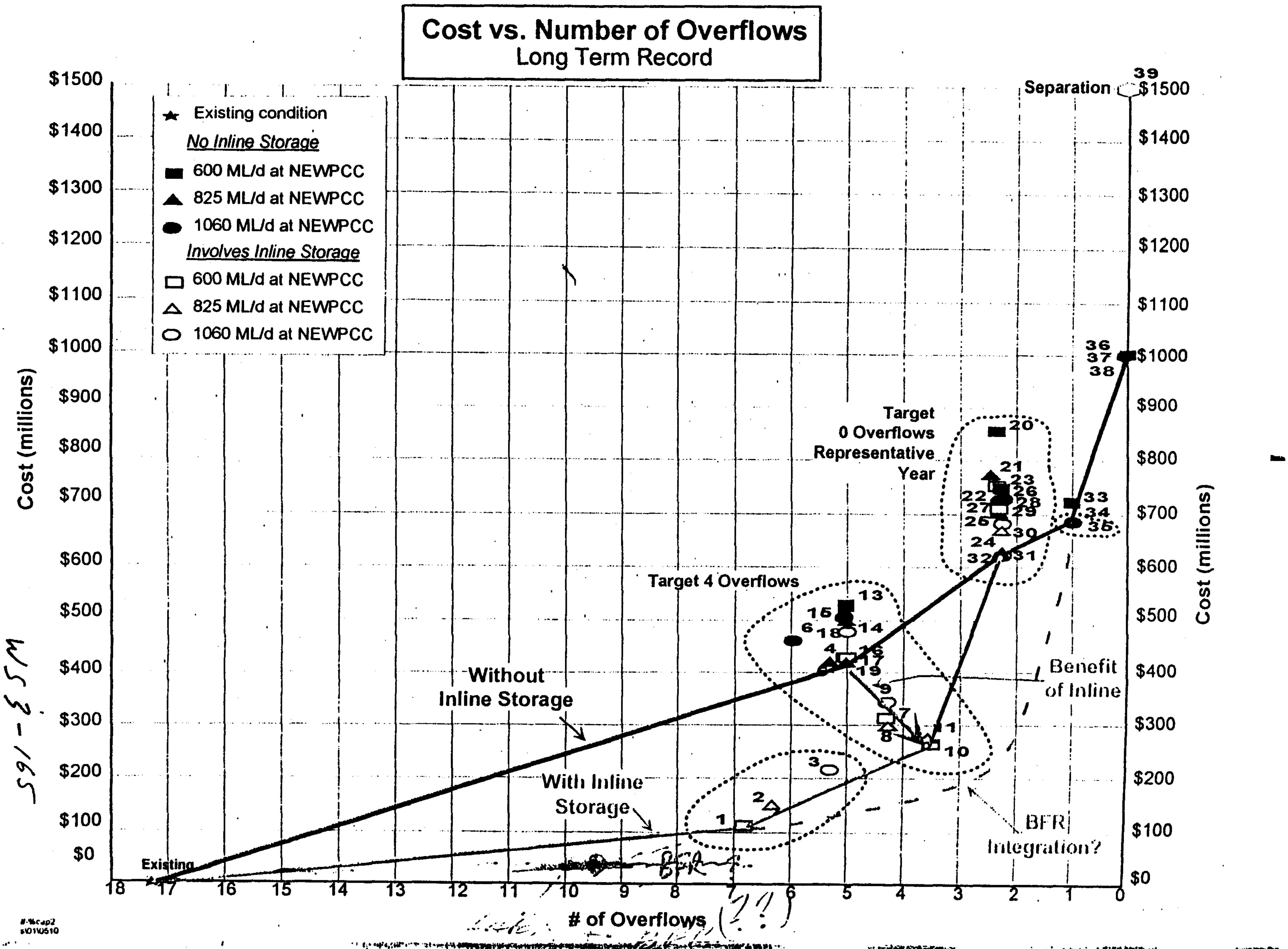
- Affordability
  - Who Pays What
  - Ability to Pay
- Willingness To Pay
  - Opportunity Costs
  - Priorities

CSO Control Option FINANCE
Remaining or Potential Concerns

Issues	Aspects	Comments
Technical		
Operations		
Environmental		
ocio-Economic	ADD DOLLARS FOR REHAB	$ 30 M FOR IN-LINE?
	- INLET RESTRICTION	? " " "
	- REPLACEMENT	- NOTED, NOT INCLUDED
	INDUSTRIAL/COMMERCIAL RATES ARE A CONCERN. NUMBERS TO BE REFINED FOR QUESTIONNAIRE	Should include costs of routine replacement + maintaince.
Regulatory / Public		

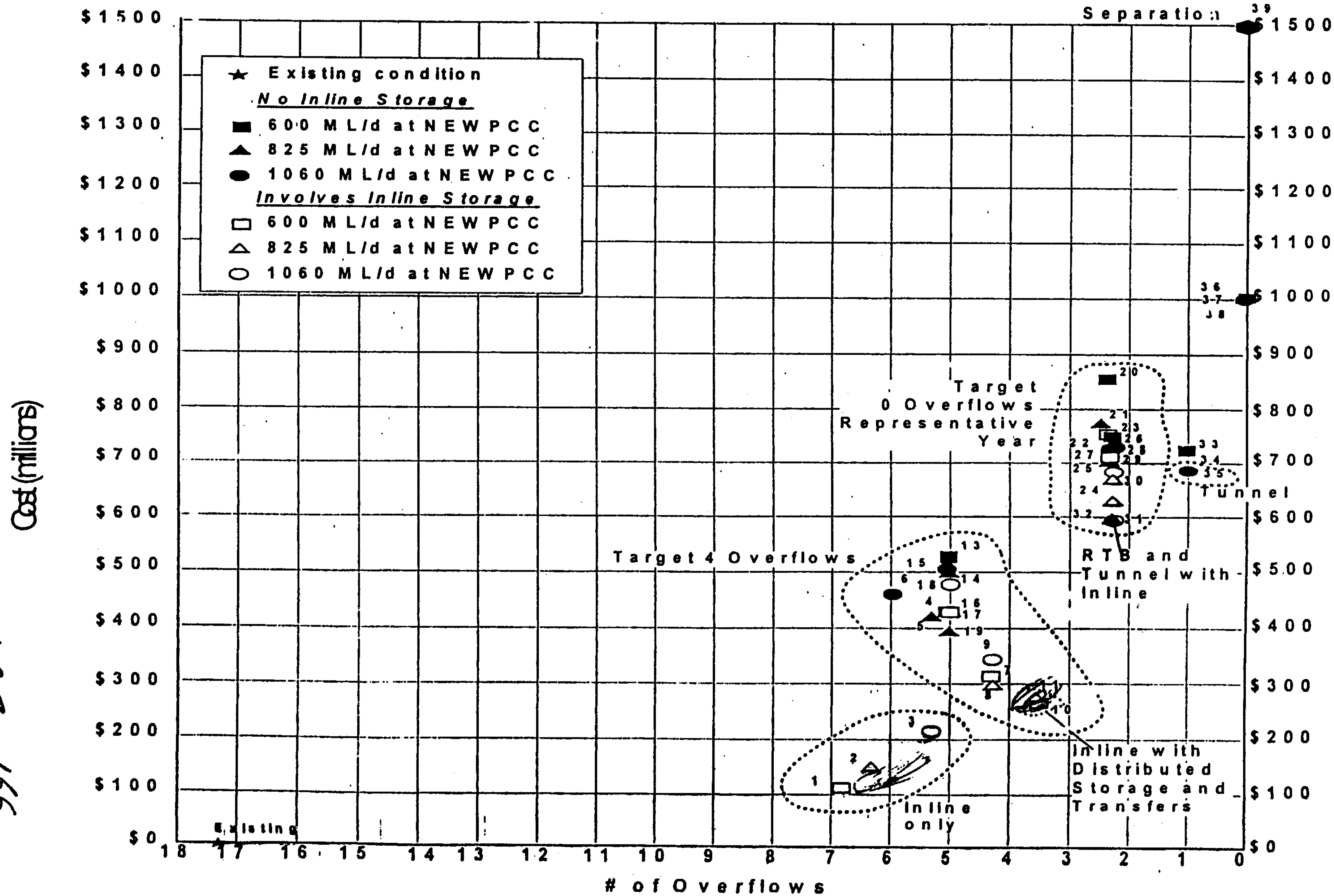
WS3-174

13 - WRAP-UP
G. REMPEL

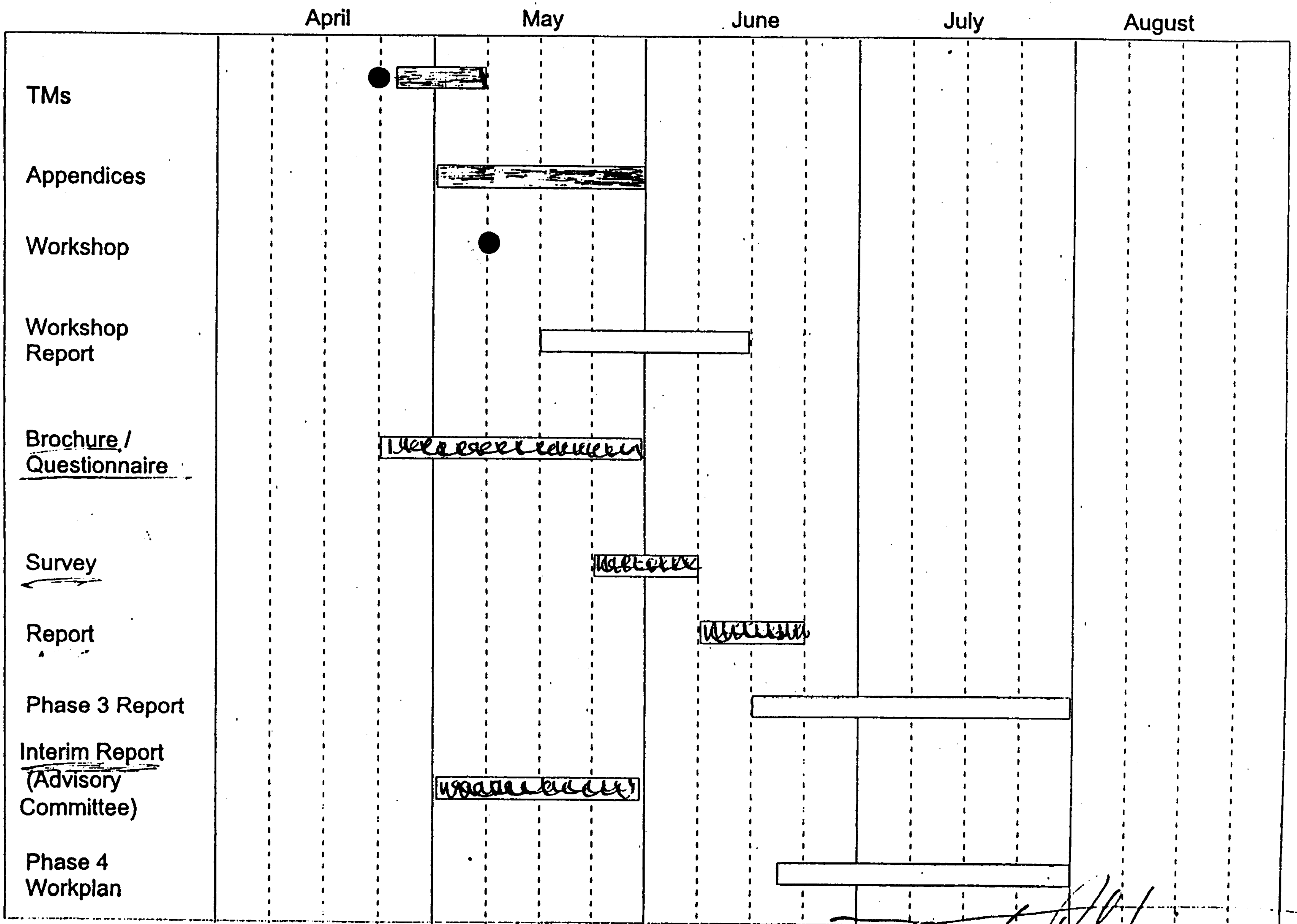


Cost vs. Number of Overflows
Long Term Record
Existing condition
No Inline Storage
600 ML/d at NEWPCC
825 ML/d at NEWPCC
1060 ML/d at NEWPCC
Involves Inline Storage
600 ML/d at NEWPCC
825 ML/d at NEWPCC
1060 ML/d at NEWPCC
Separation
Target 0 Overflows Representative Year
Target 4 Overflows
Without Inline Storage
With Inline Storage
Benefit of Inline
BFR Integration?
Existing
Cost (millions)
# of Overflows
$0
$100
$200
$300
$400
$500
$600
$700
$800
$900
$1000
$1100
$1200
$1300
$1400
$1500
18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

Cost vs. Number of Overflows
Long Term Record



PRELIMINARY



Go to Politicians (after Election)

Study Approach Overview

Phase 1 WWF Management Issues and Objectives

- Questions
- Issues
- What do we know?
- What don't we know?
- Expectations?
- Policies
- What are other cities doing?
- What do we hope to achieve?
- What is needed?
  - technical information
  - public input
  - regulatory
  - policy
- Products
  - Issues
  - Preliminary Objectives
  - Data Assessment / Deficiency
  - Current WWF perspective (Land Drainage/CSO)
  - Recommended Hydraulic/Water Quality Modelling & Monitoring
  - Identify Conceptual Range of Options
  - Public Communication Strategy
  - Work Plan (Confirm/Revise)

Phase 2 Addressing the WWF Problems

- Design and initiate data gathering programs
- Review capacities / limitations / conditions of existing infrastructure
- Field inspections
- Review means of enhancement / optimizing of existing infrastructure (preliminary)
- Implement modelling
- Upgrade review of experience elsewhere (site visits)
- Upgrade WWF Perspective
- Pilot testing needs
- Define CSO impacts
- Commence public relations programs
- Screen available technology

Phase 3 Evaluation of Candidate Options

- Continue Monitoring/ Analysis/Pilot Testing
- Monitor experience elsewhere
- Conceptualize candidate options
- Assess CSO Reduction / Impacts / Effects on uses
- Initiate further pilot tests, run and monitor
- Comprehensive cost/ benefit evaluation
- Continue public consultation programs
- Evaluation of Candidate Options

Phase 4 Recommended Implementation Plan

- Continue Pilot Testing
- Evaluation of Plans
  - short term
  - long term
  - integration of objectives
  - costs / benefits
  - priorities
- Define strategies, short and long-term priorities
- Detail recommended plan
  - Effects on uses
  - Integration of sewer/ interceptor rehabilitation programs
  - compliance with regulations
  - costs / benefits
  - schedule
  - residual issues
  - environmental issues
  - funding implications
  - prepare report
  - regulatory strategy

Milestone Review (end of Phase 1) — Review — Milestone Review (end of Phase 2) — Milestone Review (end of Phase 3) — Milestone Review — Milestone Review (end of Phase 4)

Figure 2-3

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Options

Phase 4
Recommended Implementation Plan

- Continue Pilot Testing
- Evaluation of Plans
  - short term
  - long term
  - integration of objectives
  - costs / benefits
  - priorities
- Define strategies, short and long-term priorities
- Detail recommended plan(s)
  - Effects on uses
  - Integration of sewer/ interceptor rehabilitation programs
  - compliance with regulations
  - costs / benefits
  - schedule
  - residual issues
  - environmental issues
  - funding implications
  - prepare report
  - regulatory strategy

Milestone Review | Milestone Review | Milestone Review

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POST PHASE 3 WORKSHOP

- Follow-up studies as appropriate
- Workshop Report
- Consider public feedback
- Evaluation of plans (Working Session)
- Phase 4 Strategic Planning Working Session
- Workplan

APPENDIX B
FIXED WEIR HYDRAULICS

CALCULATION OF HEAD LOSS OVER SUBMERGED WEIR

Assumptions: Weir structure will be introduced into CS trunk hydraulic gradient. Top of outlet will be approximately equal to obvert at inlet.

With a weir height of 6" below the inlet, it will also be 6" below the outlet and will be submerged by 6" + the entrance loss into the outfall pipe.

Assuming a semi-rounded entrance to the outlet, $C_{entrance}$ would be approximately 0.3 [C = 0.05 for rounded entrance and 0.5 for square entrance].

Using Hart outlet as an example, and assuming full flow:

DIAMETER = 8'
Q = 213 cfs (5 year storm flow)
Area = 51 ft^2
V = 4.2 fps
h_v = 0.27'
Weir length = 181'

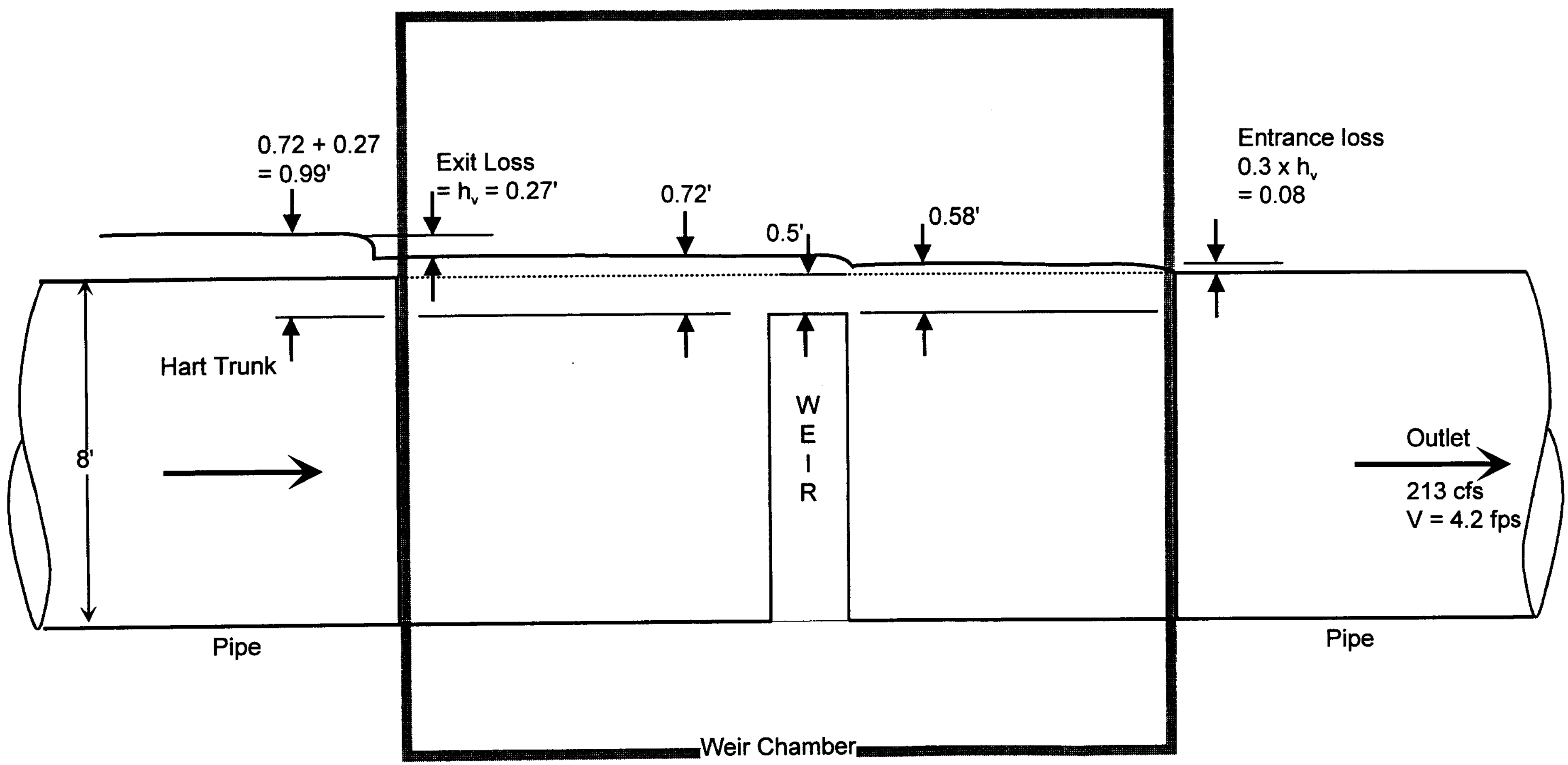
h_L at outlet = 0.3*0.27 = 0.08'
Submergence downstream of weir = 0.5 + 0.08 = 0.58'

The U.S. Department of the Interior Water Measurement Manual approach, to approximate flow over a submerged weir, comprises the calculation of the free flow over the weir (i.e., without surcharge) [I used Table 8 for a standard suppressed rectangular weir] and then the application of a Discharge Correction Coefficient, C' from Table 12 of the manual. C' is applied to the free Q to determine the effect of weir submergence based on d/H, where d is the downstream head and H, the upstream. The resultant Q is an approximation but is likely adequate for the present purpose.

Assuming a head over the weir of 0.72', the free flow over the weir, from Table 8, =10.17 cfs/5' of weir. This = 10.17*181/5 = 368 cfs over 181' of weir. The C' for a d/H of 0.58/0.72 (0.81) = 0.576 (Table 12). Accordingly. The flow over the submerged weir = 0.576*368 = 212 cfs. Close enough.

The exit loss out of the Hart trunk into the weir chamber = 1*h_v = 0.27. Therefore the surcharge imposed on the upstream hydraulic gradient = 0.72' + 0.27' = 1' over the weir or 0.5 ' above the crown of the pipe.

Hydraulic Grade Line



hydgrdln
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Figure A2-1