CITY OF RICHMOND

REPORT TO COMMITTEE

TO: General Purposes Committee
DATE: April 5, 2001

FROM: Jeff Day, P. Eng.
Director, Engineering
FILE: 6060-01

RE: **Ageing Infrastructure Replacement Costs**

STAFF RECOMMENDATION

That staff report back to Committee with financial strategies to address long term infrastructure funding requirements.

Jeff Day, P. Eng.
Director, Engineering

Att. 1

FOR ORIGINATING DIVISION USE ONLY

ROUTED TO:	**CONCURRENCE**	**CONCURRENCE OF GENERAL MANAGER**
Water Services	Y ☑ N ☐	
Sewerage and Drainage	Y ☑ N ☐	
Roads and Construction Services	Y ☑ N ☐	
Budget	Y ☑ N ☐	

STAFF REPORT

ORIGIN

This report is in response to Council's request for the life cycle costs on the City's infrastructure assets, arising from the June 10, 2000, Council and Senior Staff Workshop.

The City has over $2.38 billion of engineering infrastructure including roads, storm sewer, sanitary sewer and water systems. With many components of each system nearing the end of their design life, the City is, for the most part, in a reactive mode, replacing infrastructure as it fails. Maintenance costs are rising and will continue to rise disproportionately if the infrastructure is not replaced at the end of its economical design life (i.e., the cost to replace a pipe after it fails, is generally more expensive than replacing it prior to failure).

There are no Council endorsed strategies in place to address the long-term replacement of infrastructure or to deal with future growth in infrastructure services. Funding implications need to be identified, and replacement strategies developed, if we want to ensure the continuation of our current level of service with our water, sewerage, drainage and road systems.

This report is a preliminary review of four infrastructure groups, (water, sewerage, drainage and roads), with respect to replacement costs and associated financial impacts on the annual budget and utility rates. Also included are some financing strategies for their respective replacement programs.

ANALYSIS

A similar methodology was used to collect the data and determine the replacement costs for three of the infrastructure groups (water, sanitary and drainage).

1) An inventory of the infrastructure was completed to collect information such as size and material, installation date and length or quantity. (Note: GIS information was used for the water and sanitary systems). For our drainage system, the installation year and material type was estimated based on a manual review of "as-built" drawings for three or four pipe sections out of approximately 30 in each subdivision. (Because of a lack of completeness in our GIS records, we had to assume that the selected pipe sections are representative of the subdivision drainage system. We have requested funding support in the 2001 budget to address this current limitation to our modelling effort.)
2) The design life for the different material types and assets was estimated.
3) The replacement year for all the assets was determined based on the installation date and the design life.
4) The replacement cost of the assets were calculated based on estimated unit rates.
5) An annual replacement cost for the infrastructure for each five year period was determined.
6) Average annual funding required to replace the infrastructure at the optimum time was calculated using 2% inflation and 8% rate of return.

WATER

Background

The Greater Vancouver Regional District (GVRD) supplies the City's potable water, with a majority of the water coming from the Capilano and Seymour watersheds. From the GVRD mains, the system pressure is lowered to a level suitable for municipal users and the water is then conveyed to the consumers via the City's distribution network.

Richmond's distribution system consists of over 620 kilometers of watermain, 13 pressure regulating chambers and over 4,000 hydrants. Approximately 80% of the water infrastructure was installed prior to 1980 (see Figure 1). For a large part of our system, the infrastructure will soon be near the end of its estimated design life.

Findings

A variety of pipe materials are used to convey water in our system. They include asbestos cement, cast iron, concrete, ductile iron, fiberglass reinforced pipe, PVC, and steel. Figure 2 summarizes the pipe material usage based on length of pipe. Approximately 75% of the distribution network is composed of two materials, asbestos cement and steel, both of which are subject to rapid deterioration under Richmond's aggressive soil conditions. A majority of these two pipe materials was constructed in the 1950's and 1960's, and as such, a large portion of the water distribution system is now nearing the end of its design life.

Figure 3 summarizes the projected annual water system replacement costs in five year intervals. The graph indicates that a significant portion of the replacement costs will be incurred in the next 30 years followed by a reduced 30 year period. Then, as the PVC pipe reaches its design life, the replacement costs will increase again.

The projected annual water system replacement expenditure is $10.3M for the next 30 years followed by a reduction to $2.1M. Our current utility rates and reserve provides for an ongoing annual capital expenditure of $3.0M.

The replacement costs (bar graphs on Figure 3), should theoretically be repeated every 75 years based on our underlying assumptions. This does not necessarily mean that the expenditures (the line graph on Figure 3) will again show a dramatic increase in 75 years. By developing a fiscally sound funding strategy, the water utility reserve could be sufficiently funded to moderate sharp future increases.

Funding Options

Our analysis indicates that the water capital budget will have an average annual shortfall of $7.3M for the first 30 years followed by a surplus of $0.9M (from the current annual capital budget) for the remainder of the analysis period. The water utility is the primary funding source for replacement of failing infrastructure. Possible funding strategies available to address this shortfall include the following:

1) Immediately increase the water utility rate to provide for the required average annual funding deficit of $7.3M for the first 30 years. This will have a significant impact on the taxpayer. For example, for each $1,000,000 increase there will be a 6% or $8 increase (approximate) in the residential utility rate. This is exclusive of any increases from the GVRD.

2) Increase the water utility rate over a period of time. The increased rate will remain constant until 2030, at which time the rate could be reduced. This strategy will reduce the immediate financial impact on the taxpayer, but carries a degree of risk since it will not provide sufficient funding to replace the infrastructure as it fails. Instead, any infrastructure that fails during this period will draw funds from the water utility reserve (provided the reserve has sufficient funding). Once the reserve is depleted, the City will need to borrow the money to finance necessary repairs or replacement.

3) Borrow money to fund the necessary improvements. This will still require raising the rates in order to repay the principle and interest payments. However, the advantage of borrowing is that more money can be leveraged up front. For example, for the same $1M increase in the rate collected and put towards principle and interest payment, $11M can be leveraged (based on a 20 year term at 6.3% interest and 5% capitalization rate). The cost of borrowing and therefore the cost of replacing the infrastructure would be shared by the future generations that would be benefiting from these improvements.

4) A combination of the above.

5) The final option would be to leave the situation "as is" and perform the repairs as failures occur. Using this approach, the water utility reserve of $16.5M as of December 31, 2000, will be consumed in approximately 2 years.

SANITARY SEWER

Background

The City of Richmond's sewerage collection system conveys the majority of sewage from private properties through the City's collection system to the Lulu Island Treatment Plant. A small portion of our sewage is sent to the Iona and Annacis Island Treatment Plants. At the treatment plants, the effluent undergoes secondary treatment, (with the exception of Iona which has primary treatment), and is discharged to the Fraser River under permit.

The City's sewerage collection system consists of over 430 kilometers of gravity sewer, 140 lift stations, and over 90 kilometers of sanitary forcemains. Figure 4 shows summaries for the sewer infrastructure installation dates. Over 70% of the gravity sewers were built prior to 1980 and approximately 65% of the forcemains and lift stations were constructed prior to 1980.

Findings

A summary of the pipe materials are listed in Figure 5. The figure shows that the most prominent pipe materials are asbestos cement and PVC with a small percentage of fiberglass reinforced pipe for the gravity mains, and reinforced concrete for the forcemains.

The predicted annual replacement costs for the sewerage collection system, including pump stations, is $6.3M for the first 5 years and declines to $4.77M for the remainder of the analysis period as shown in Figure 6. Our current utility rates and reserve provides for an ongoing annual capital expenditure of $2.0M. Although the replacement cost increases sharply in 2045, the required funding will still be approximately $4.77M, because the funding payment from previous years will be used to stabilize rates.

Based on the underlying assumptions, the predicted annual sewerage replacement costs (bar graphs in Figure 6) should repeat itself every 75 years. However, this will not require an increase in expenditures in 75 years time as the sewer utility reserve will have significant funds to eliminate the replacement spikes.

Funding Options

The sewerage infrastructure has a utility that will be the primary source of funding for the $6.3M average annual cost in the first 5 years, and the $4.77M annual cost for the remainder of the analysis period. The funding options available for the sewer utility includes the following:

1) Immediately increase the sewer utility rate to provide for the required average annual funding deficit of $4.3M in the first 5 years. The impact to the residential taxpayer will be approximately 9.8% or $16 per $1.0M required, exclusive of any GVRD increases. In 2006, the utility rate may be reduced.

2) Slowly increase the sewer utility rate over a period of time. The increased rate will remain constant until 2075. This will reduce the immediate financial impact on the taxpayer, but carries a degree of risk since it will not provide sufficient funding to replace the infrastructure as it fails. Instead, any infrastructure that fails during this period will draw funds from the sewer utility reserve (provided the reserve has sufficient funding). Once the reserve is depleted, the City will need to borrow the money to finance repairs.

3) Borrow money to fund the necessary improvements. The benefits of borrowing are the same as those identified in the "Water" section.

4) A combination of the above.

5) The final option would be to leave the situation "as is" and perform the repairs as potential failures occur. Using this approach, the sewer utility reserve of $10.83M will as of December 31, 2000, be consumed in approximately 2 years.

DRAINAGE

Background

Richmond's drainage conveyance system consists of approximately 450 kms of interconnected storm pipes and box culverts, along with numerous ditches and canals. This conveyance system directs the storm water to the outer edges of the island, where 32 lift stations, consisting of 102 pumps, pump the water through the dykes into the Fraser River.

The storm sewer network consists generally of three pipe materials: asbestos cement, concrete and PVC. The quantities of these materials are shown in Figure 7. Over the years, a number of the original pipes, such as wood stave, have been replaced. Therefore, the oldest pipes currently in service date back to the 1950's. Figure 8 shows that over 70% of the storm sewers were built prior to 1980.

Findings

Figure 9 indicates that the first significant increase in replacement costs will occur around 2020. This is the result of rapidly deteriorating asbestos cement pipe. The largest cost for the drainage infrastructure occurs in 2085-2100 when the box culverts are expected to fail.

The City does not have an annual replacement program for our drainage infrastructure. As a consequence, there is currently no budget provision for an annual expenditure for system replacement. Fortunately, a significant portion of the replacement costs will be incurred in the later years. A predicted average annual expenditure of $4.85M is required to replace the infrastructure in the first 30 years and $4.25 M for the remainder of the analysis period. The City does not currently have a funding mechanism to accommodate the required replacement costs.

By creating a utility or statutory reserve, some of the funds gathered in the earlier years will grow from accrued interest and allow the expenditures to remain at a relatively constant rate.

Funding Options

Currently, the City does not have a drainage utility to fund the replacement program. It is evident from Figure 9 that there is an opportunity to develop a funding mechanism to finance the replacement of our drainage infrastructure. The first peak of the failing infrastructure graph occurs in 2020. The annual budget, required to prepare for these future costs is estimated at $4.85M per year for the first 30 years, and $4.25M per year for the remainder of the analysis period. The possible funding options include the following.

1) Develop a utility for drainage to begin collecting revenue for the predicted future replacement costs. As with water and sanitary utilities, the drainage utility would also include the operating and maintenance costs (approximately $1.9M) for the drainage system. Consequently, the general tax rate would be reduced accordingly (by the same $1.9M) to reflect the reallocation of the taxes and eliminate the perception of "double dipping". The utility rate required to fund the existing $1.9M operating and maintenance costs plus the $4.85M replacement program would therefore be in the order of $65 per residential taxpayer.

   a) Start collecting the full capital component immediately. This may impact the taxpayer significantly, however, this will allow the utility to accommodate all the repairs that are required.

   b) An alternative to option 1 (a) would be to develop the utility and increase it slowly over a 10 year period. This slow increase will minimize the financial impact on the taxpayers. However, it may not provide sufficient funding to replace the infrastructure as it fails. Any infrastructure that fails during this period will require the City to borrow the money to finance repairs.

2) Establish a statutory drainage reserve fund that is funded through general taxes as opposed to a utility rate. Similar to the above option, this could be implemented in a similar way, by collecting the full amount immediately or by slowly increasing the amount over a 10 year period. The primary benefit would be that this will be identified as a charge for drainage improvements on the tax assessment and that the charge can be deferred by seniors, "as taxes", to a later date.

3) Borrow money to fund the necessary improvements. The benefits of borrowing are the same as those identified in the above "Water" section.

4) A combination of the above.

5) The final option would be to leave the situation "as is" and perform the repairs as failures occur.

ROADS

A report was presented to Council in 1998 on the status of the road system. this report will not go into a detailed analysis. The 1998 report (see Appendix C) stated that there was an annual funding shortfall of $1,876,000 in order to maintain the road system. At that time Council approved a gradual increase over 6 years to close that gap. In 2004, the annual funding will meet the required need, assuming the annual increases occur to the base budgets. It should be noted that although the gap is being closed, a backlog of deteriorated roads of approximately $12M will be accumulated between 1998 and 2004.

The 1998 report was based on general assumptions as to the life expectancy of a road. These general assumptions were then used for the whole road system to estimate the funding required. Currently, staff are developing a pavement management system that will analyze each road separately, based on the specific conditions for that road (i.e. traffic volume, age of road, thickness of pavement). This will provide the City with the ability to repair or replace the road at the optimal time. This will also provide a more exact annual dollar figure required to maintain our road system. Once this system is in place, staff will be able to refine the cost of the backlog of deteriorated roads (the estimated $12M) and make recommendations on how to deal with this situation.

FINANCIAL IMPACT

It is clear from our preliminary analysis, which based on optimized replacement schedules, and our current funding sources, there will be a long-term shortfall of funding for these service areas. In order to replace our infrastructure in the most cost-effective way possible, a long-term funding strategy that recognizes the need for additional funding and fund stabilization, is essential.

CONCLUSION

Based on the estimated design lives for each of the service areas, and available life-cycle and funding information, it is apparent that the current funding for all the infrastructure programs will not meet the predicted needs for infrastructure replacement.

Additional annual funding needs, required starting in 2002 are:

Water	$8.21M
Sanitary	$5.75M
Drainage	$4.85M

In addition, the roads infrastructure will require a total of approximately $12 M overall to rehabilitate and reconstruct to acceptable service levels. The strategy for determining the annual expenditures will be identified once the pavement management system is in place.

The increase required to replace the water, sanitary and drainage systems may be implemented immediately or phased in over a period of time, for example 10 years. A level of risk is associated with implementing the rates over a ten year period, as the rate of failure in any one of these systems may exceed the funding available. This would necessitate the immediate borrowing of funds. To address the subtleties of long-term financing options, it is recommended that detailed financing options be further reviewed by the Finance staff and/or Finance Select Committee.

The costs used in this report are based on typical City of Richmond unit replacement rates, in average conditions, to completely replace the pipe. Since this report deals with the long-range horizon (i.e. 100 years), there exists the possibility that new technologies will be developed that may eliminate the need to completely replace the infrastructure, thereby significantly reducing the costs. This analysis should be reviewed every 3 to 10 years to incorporate the new information from infrastructure studies, more detailed infrastructure assessments, growth and development.

Siu Tse, M.Eng., P.Eng.
Project Engineer, Engineering Planning

Mark Minson, P.Eng.
Project Engineer, Engineering Planning

Reviewed by: Paul H. Lee, P.Eng.
Manager, Engineering Planning

MM:mm

APPENDIX A – FIGURES

Figure 1: Summary of Water Infrastructure Installation Dates

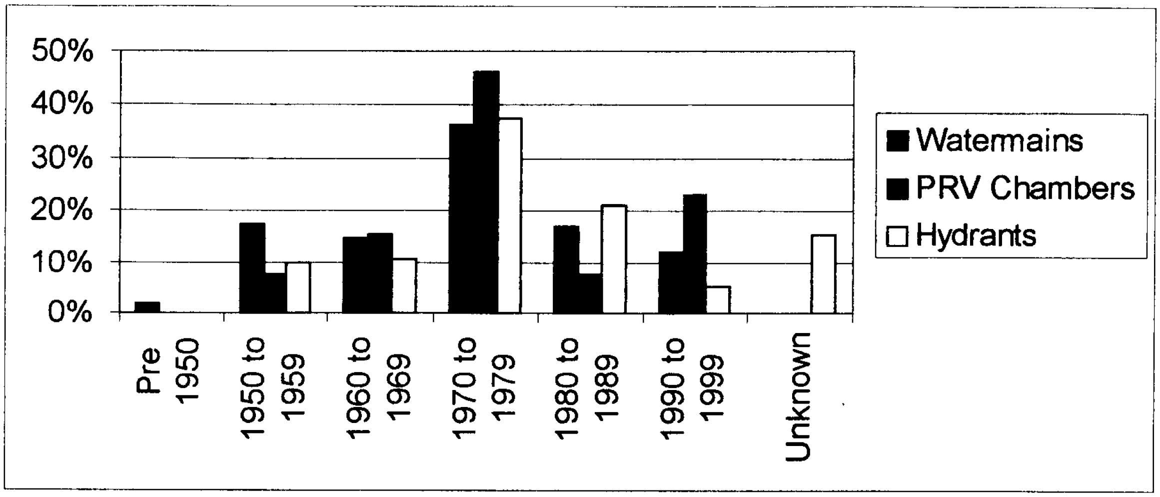


Figure 2: Summary of Water Pipe Materials (By Length)

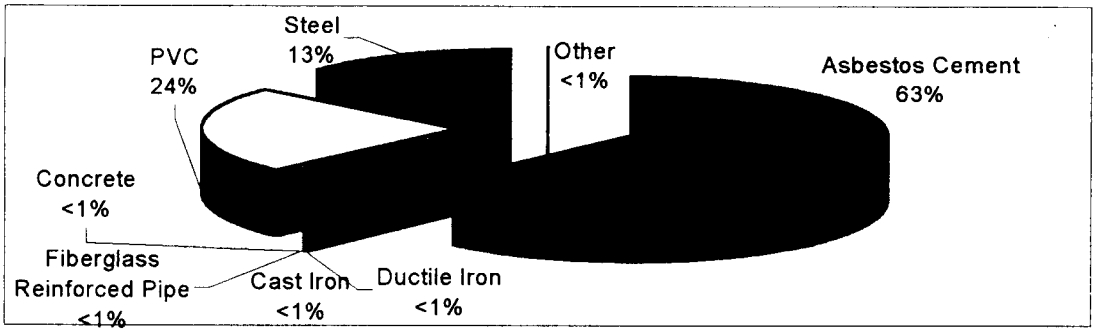


Figure 3: Projected Annual Replacement Costs for Water

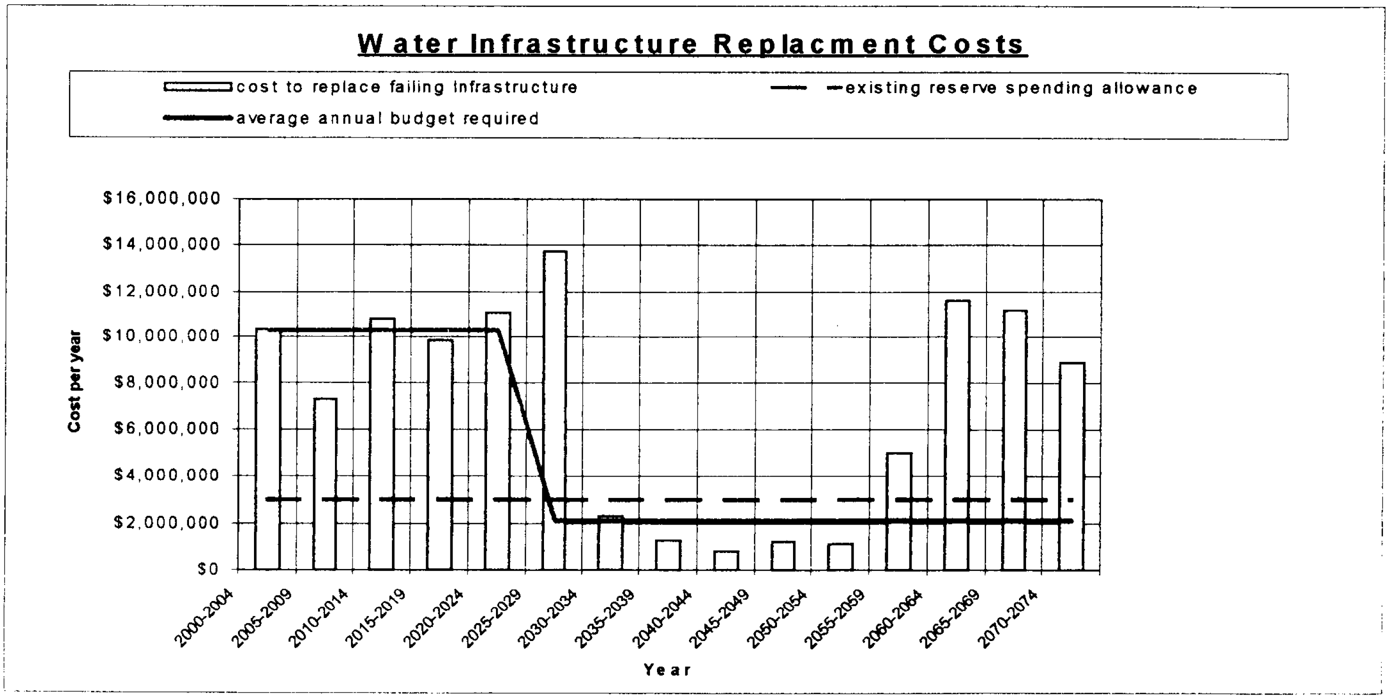


Figure 4: Summary of Sanitary Sewer Infrastructure Installation Dates

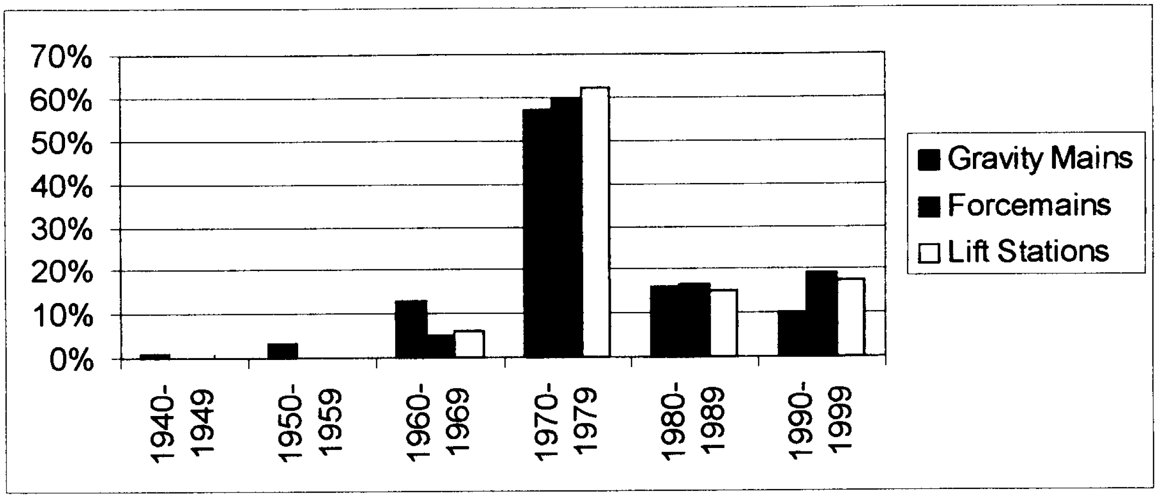


Figure 5: Summary of Gravity Sanitary Sewer Pipe Materials (By Length)

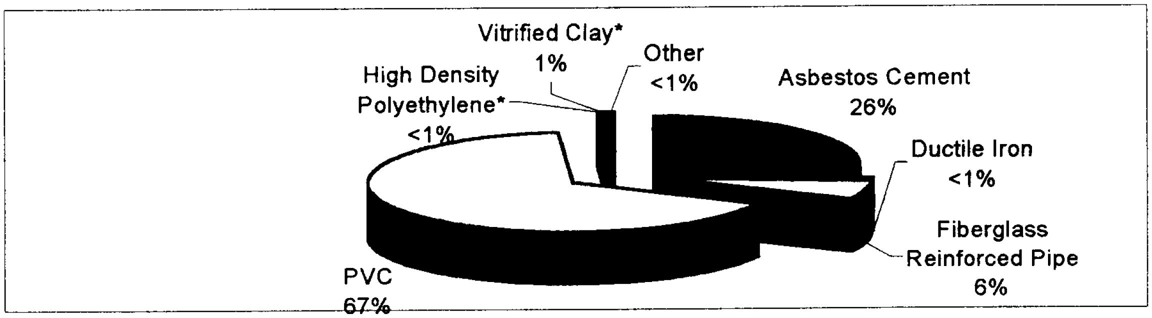


Figure 6: Projected Annual Replacement Costs for Sewer

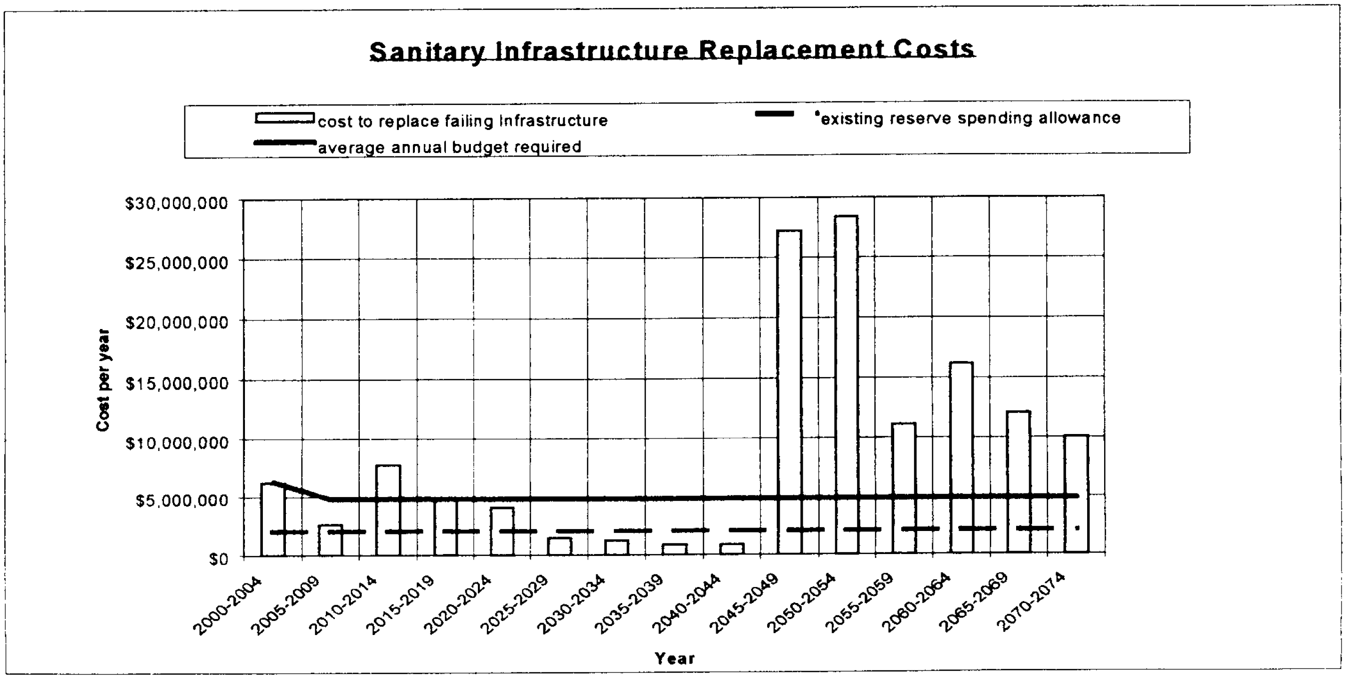


Figure 7: Summary of Storm Sewer Materials (By Length)

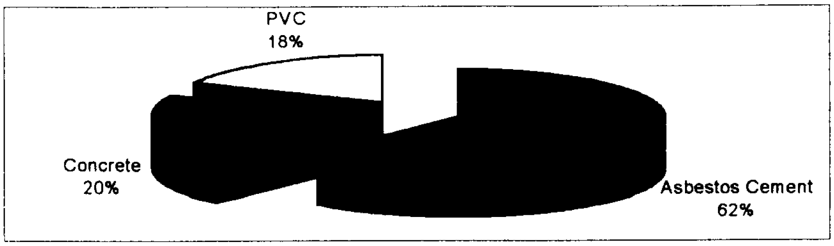


Figure 8: Summary of Drainage Infrastructure Installation Dates

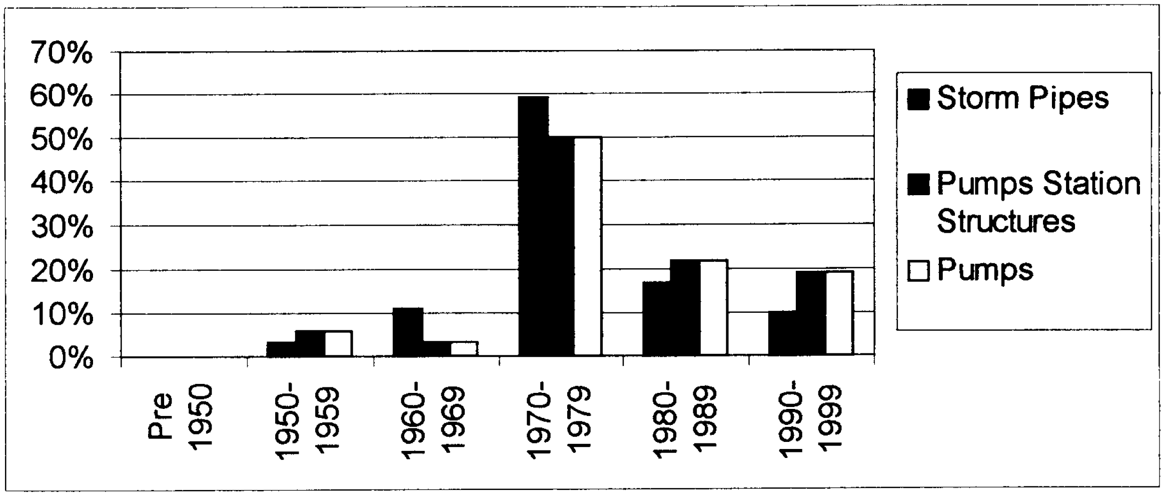
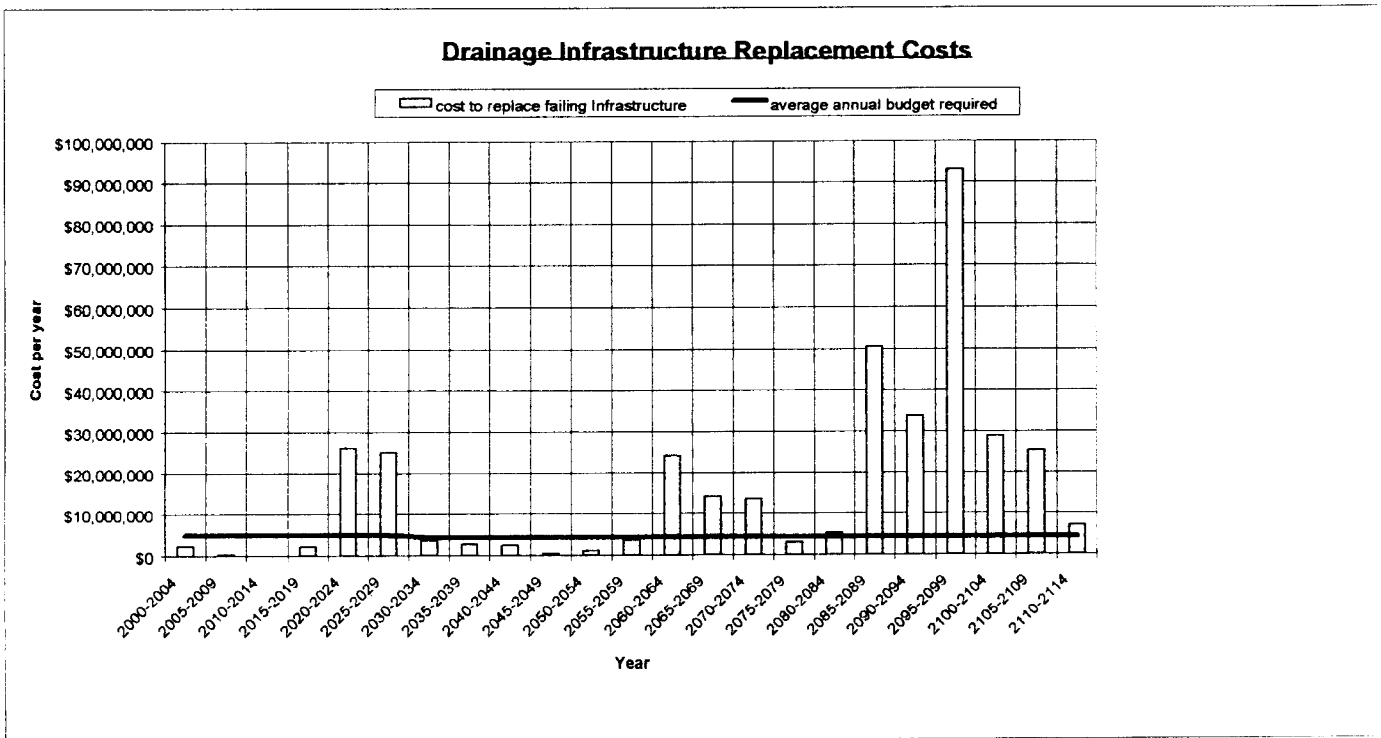


Figure 9: Projected Annual Replacement Costs for Drainage



APPENDIX B – TABLES

Table 1: Estimated Pipe Design Life for Water

Pipe Material	Estimated Design Life (years)
Asbestos Cement	45
Cast Iron	30
Concrete	75
Ductile Iron	40
Fiberglass Reinforced Pipe	50
PVC	75
Steel	50

Table 2: Unit Replacement Rates for Water

Pipe Size (mm)	Unit Rate* (per metre)
100	$230
150	$250
200	$290
250 & 300	$335
350	$430
400	$510
450	$700
500	$900
550	$1,200
600	$1,500
650	$1,700
750	$1,900
800	$2,100
900	$2,400
975 & 1050	$2,700
1200	$3,000
1350	$3,400

- Based on 2000 construction rates for the City of Richmond and GVRD.
- The unit rates include appurtenances such as valves, hydrants, laterals and the restoration to the surface.

Table 3: Estimated Pipe Design Life for Sewer

Pipe Material	Estimated Design Life for Gravity Mains (years)	Estimated Design Life for Forcemains (years)
Asbestos Cement	45	45
Ductile Iron	30	-
Fiberglass Reinforced Pipe	50	50
PVC	75	75
High Density Polyethylene	75	75
Vitrified Clay	75	-
Reinforced Concrete	-	75

Table 4: Unit Replacement Rates for Sewer

Pipe Size (mm)	Unit Rate* for Gravity Mains (per metre)	Unit Rate* for Forcemains (per metre)
100	$400	$200
150	$450	$200
200	$500	$230
250	$550	$275
300	$600	$275
350	$675	$320
400	$775	$400
450	$850	$550
500	$900	-
525	-	$900

* Based on 2000 construction rates for the City of Richmond and GVRD

Table 5: Estimated Pipe Design Life for Drainage

Pipe Material	Estimated Design Life (years)
Asbestos Cement	50
Concrete Pipe	100
Concrete Box Culvert	120
PVC	75

Table 6: Unit Replacement Rates for Drainage

Pipe Size (mm)	Unit Rate* (per metre)
150-250	$400
300-450	$650
525-675	$825
750-900	$975
>900	$1,200
u-shape	$3,200
box culverts	$4,400

- Based on 2000 construction rates for the City of Richmond.
- Included in the unit cost used is the cost to replace the pipe itself along with manholes, inspections chambers, catch basins, laterals and the restoration to the surface.

General Notes

- The water graph shows that from January 2000 to December 2004, the estimated replacement cost will be approximately $5.7M each year for that period. The total cost for the entire 5 year period will be 5 times $5.7M or $28.5M. It is important to note that this graph should be used as an indicator of replacement costs as it is only an estimate based on non-site specific information. Actual failures are unpredictable and require detailed investigations. It is also important to note that these replacement costs do not take into account capacity restrictions due to development and population growth, and are based on current unit rates with a 2% annual inflation rate.

- Research indicates that the design life for the asbestos cement and steel pressure pipes range from 25 to 50 years and varies due to the soil conditions, groundwater table, and chemical characteristics of the potable water. Due to Richmond's unique island setting, a majority of the pipe network resides below the water table in aggressive soil conditions. In addition, the water from the lower mainland watersheds has chemical characteristics that further compound the problem.

- The analysis of the drainage system did not include the ditch or dyking system, since a ditch or dyke will only require regular maintenance. Furthermore, this analysis does not take into consideration the replacement cost of any new infrastructure that may be installed in the future due to ditch infills.

- A majority of the infrastructure is located in the densely populated, western half of the City. Typically, unpredicted failures in the populated areas such as the City Centre will have significant social and economic implications to the surrounding businesses as well as traffic congestion. Emergency repairs in these areas are generally more expensive due to the traffic control required, commercial disruptions and reduced productivity due to the limited working area.

- The accuracy of this report is largely dependent on the assumptions for life expectancies of the different pipe materials, unit replacement costs, and interest and inflation rate. The assumed life expectancies can vary depending on the soil conditions, water table, chemical composition of fluid being transported, pipe installation method, nearby construction activity, etc. The infrastructure life expectancies used in this report are based on information provided by other municipalities taking into account Richmond's unique conditions.

- It should be noted that the results of this report of fairly sensitive to a number of variables used. For example, a change of 1% in the interest rate has a $450,000 impact on the annual budget required for drainage. A 1% change in the inflation rate has a $1,100,000 impact on the annual budget required for drainage.

APPENDIX C – 1998 ROAD SURFACE REHABILITATION REPORT

CITY OF RICHMOND

REPORT TO COMMITTEE

PW + Trans Ctte - Aug 19/98

TO: Public Works and Transportation Committee

DATE: August 12, 1998

FROM: Eric Gilfillan
Director of Operations

FILE: 6360 - 18 - 01

RE: ROAD SURFACE REHABILITATION PROGRAM

STAFF RECOMMENDATION

That Committee support the process to enable automatic annual adjustment to the asphalt overlay rehabilitation base budget which reflects the additional lane kilometres of newly acquired road, and that the formula be based on the life cycle expectancy of the surface asphalt:

Arterial Roads:	Number of lane kilometres x cost ÷ 15 years = increase to budget
Local Roads:	Number of lane kilometres x cost ÷ 25 years = increase to budget

And that the annual asphalt overlay rehabilitation base budget be increased by the cost of 10 lane kilometres per year over the next 6 years (1999 - 2004) to fund the outstanding shortfall.

Eric Gilfillan
Director of Operations

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ROUTED TO:	CONCURRENCE	SIGNATURE OF DIVISION ADMINISTRATOR
Budget	Y ☑ N ☐	

22 July 1998

STAFF REPORT

ORIGIN

During the 1993 budget process Council acknowledged the need to implement a program to deal with our deteriorating road network and supported the concept of increasing the annual maintenance budget for our asphalt overlay program. The original program was to be 10 years in length with annual increases to the base budget of $175,000 based on 1992 dollars. In June of 1997, the Public Works & Transportation Committee supported the concept of a revised 8 year additional level program of $227,500 annually to be considered with the 1998 budget submissions.

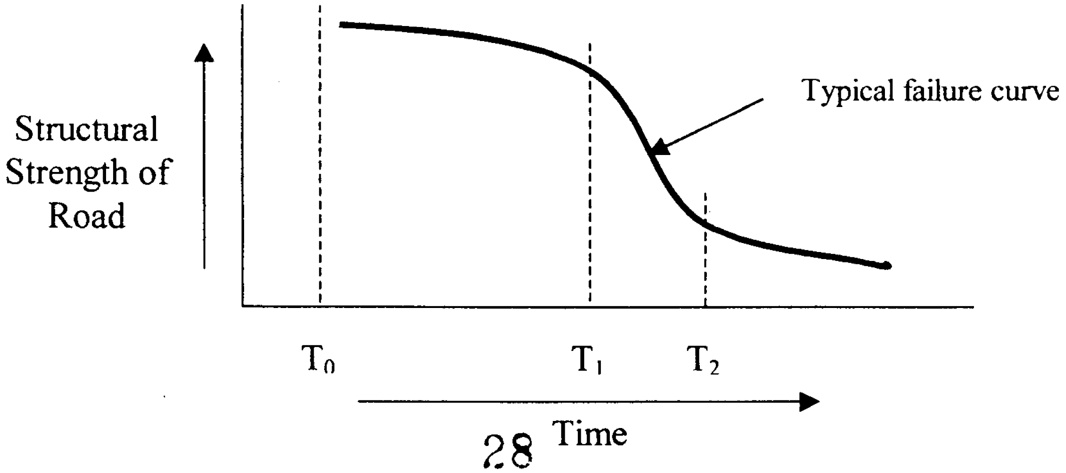
During the 1998 budget review, the Public Works Administrator committed to undertaking a review of our road maintenance funding. The importance of establishing a policy basis for funding infrastructure maintenance was stressed. This report addresses the administrator's commitment to the process.

ANALYSIS

Richmond's road network over the last 30 plus years has grown tremendously due to commercial, industrial and residential development. These roadways require annual maintenance expenditures for crack sealing and replacement of the asphalt surface layer which is failing due to "LIFE CYCLE" fatigue.

The American Asphalt Institute studies and the Greater Vancouver Transportation Authority (GVTA), MRTAC indicate that the average surface life of an asphalt road is approximately ten years, dependent on traffic volume and loading. In Richmond, our experience has shown that arterial roads have a surface life of 12-15 years when not disturbed by utility trenching. Local or subdivision roads have a life expectancy of approximately 25 years. Richmond has achieved longer life expectancy of some of our roads by introducing managed maintenance and new technology, such as a more intensive crack sealing program and application of geo-textiles, when resurfacing.

It is well known in the industry that road structures fail according to a predictable curve. This failure pattern is reflected in the following schematic:



The time between T_0 and T_1 reflects the 12 – 15 year period during which our roads perform well. At t_1 the road structure begins to deteriorate with a consequent loss of strength. t_2 represents failure of the road structure. Once T_1 is reached, failure occurs rapidly with $T_2 - T_1$ representing a period of 3 – 5 years.

It is also well documented that maintenance work performed at T_1 can effectively restore the road structure to a "like new" condition represented by T_0. Failure to perform this timely maintenance leads to rapid failure and a loss of strength. at T_2, the only option is a complete rebuild of the road structure.

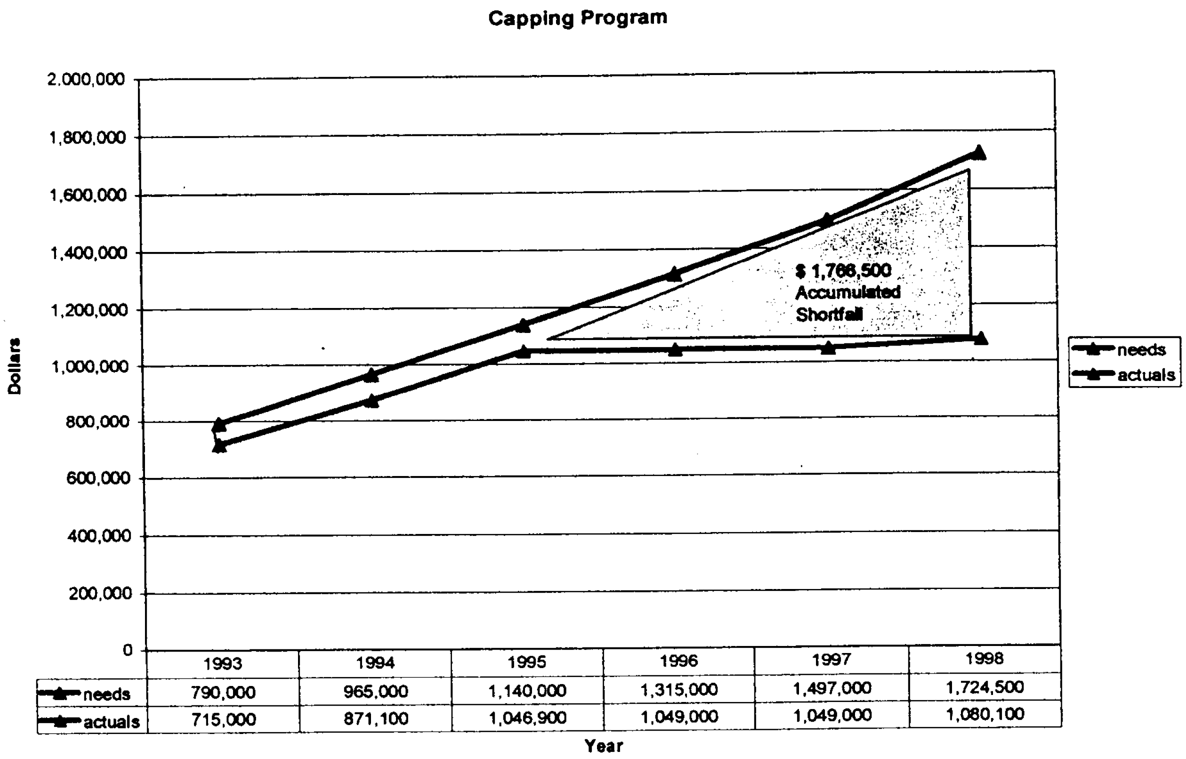
The objective of a managed maintenance program is to ensure road structures are rehabilitated at t_1 and don't reach failure. The cost to reconstruct a road that has reached T_2 is 3 – 4 times the cost of rehabilitating it at T_1. For example, spending \$225,000 at T_1 provides a 12 – 15 year surface. To achieve the same surface after T_2 would cost over \$1,000,000. Deferring expenditure between T_1 and T_2, (3 – 5 years), would cost approximately \$750,000 … a very expensive proposition.

Prior to 1993, the overlay program included a percentage of subdivision roadways along with arterial roads. This was possible because most arterial roads were being upgraded through DCCs. The upgraded roads have now reached the point where they require resurfacing along with all the subdivision roads built between 1960 - 1975. The current program, based on 1998 dollars of \$1,080,100, allows for 32 lane km per annum which includes arterial roads, subdivision roads, and City parking lots at community facilities. The required annual program is 88 lane km (55 km arterial and 33 km residential) leaving an annual shortfall of 88-32 = 56 lane km.

The unit cost of paving 1 lane km has risen since 1992 due to inflation and the fact that most roads currently being resurfaced have curb & gutter. This necessitates grinding of the surface layer and application of a geo-textile to reduce reflective cracking where required. The cost of paving rose by 3% for 1998 over 1997 as determined through our tender process.

- The cost of paving 1 lane km in: 1992 = \$21,400
  1997 = \$32,500
  1998 = \$33,500

Since 1992, the funding required to meet the needs of our asphalt rehabilitation program has fallen below the level required. The following chart indicates the annual shortfall since 1992.



The City has recently installed a Pavement Management System which provides management data necessary to establish which of our roads should be rehabilitated in any specific year. We will always ensure the most needy roads are done first so as to take advantage of the failure cure explained above.

The lowest cost long-term rehabilitation program depends upon a commitment to fund rehabilitation projects before road failure is reached. The recommendations of this report support this concept.

FINANCIAL IMPACT

Cost per lane km for surface rehabilitation is $33,500 (1998 dollars). Given we have a funding shortfall as shown in the chart above, two "catch-up options are suggested.

Option 1:

(a) Increase the base budget annually to reflect the additional lane kilometres of newly acquired road, based on the life cycle expectancy of the surface asphalt:

Arterial Roads: Number of lane kilometres x cost ÷ 15 years = increase to budget
Local Roads: Number of lane kilometres x cost ÷ 25 years = increase to budget

(b) Increase the base funding level in the maintenance budget to reflect the 56 lane km short fall in one step

Option 2:

(a) Increase the base budget annually to reflect the additional lane kilometres of newly acquired road, based on the life cycle expectancy of the surface asphalt:

Arterial Roads: Number of lane kilometres x cost ÷ 15 years = increase to budget
Local Roads: Number of lane kilometres x cost ÷ 25 years = increase to budget

(b) Increase the base budget by the cost of 10 lane km per year over the next 6 years to "catch up" with the outstanding shortfall.

The cost of Option 1(b) would be $1,876,000 in 1999.

The cost of Option 2(b) would be $335,000 each year for the next 6 years (1999 – 2004).

CONCLUSION

The rehabilitation work for roads cannot be deferred without consequence. The consequence is higher costs. The proposed option seeks to minimize our long term pavement rehabilitation costs.

Staff continually seek new efficiencies and technologies that will reduce costs. However, increases in infrastructure maintenance spending are required annually if current levels of service are to be maintained. The consequences of not expanding the annual overlay program will result in higher costs to repair the roads when funding is available, due to increased deterioration to the asphalt and subbase. This inaction will also result in the requirement to expand the funding for the annual crack sealing program to stop water from penetrating into the subbase. Staff recommend that committee support option 2 to enable automatic annual adjustment to the asphalt overlay base budget, and a 6 year catch-up program.

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