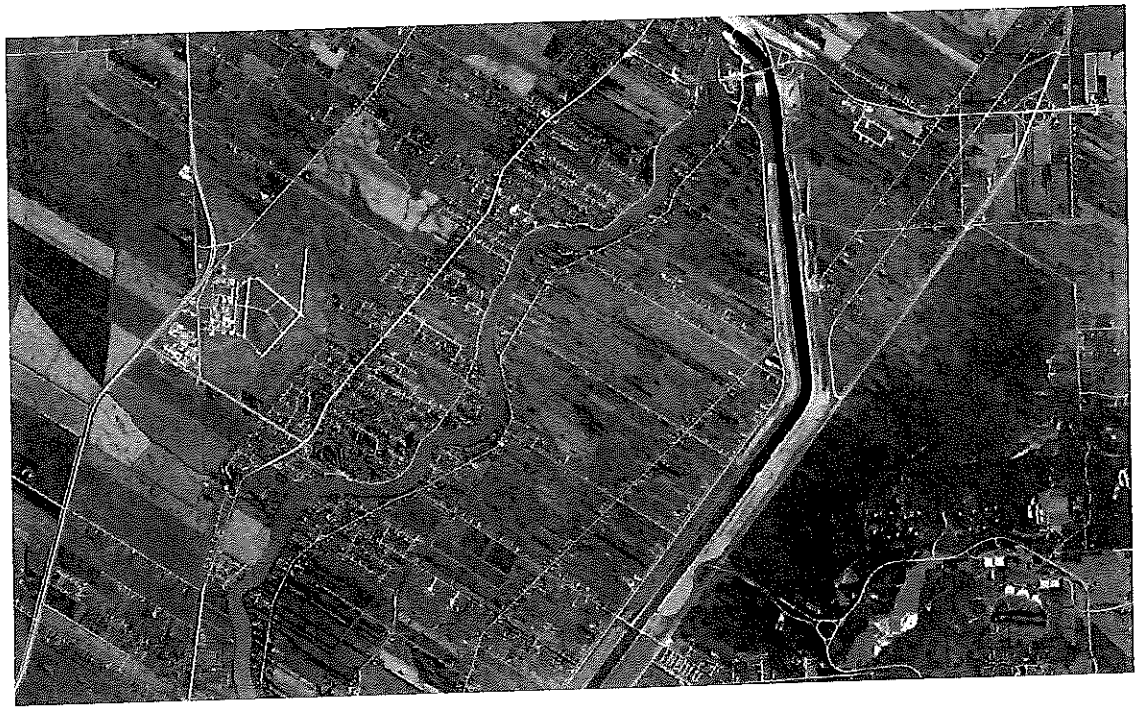
RM of St Clements

Gunns Creek
Hydrologic and Hydraulic Assessment
Drain and Crossing Upgrades



November 2016

Bruce Harding Consulting Ltd

RM of St Clements

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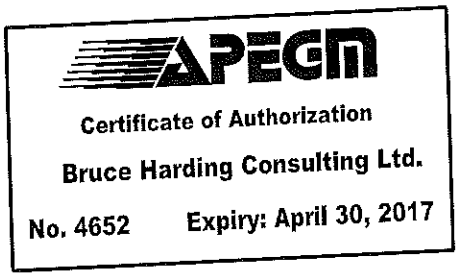

Prepared by: Bruce Harding, P.Eng.

November 2016

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1 Introduction

This report summarizes the hydraulic and hydrologic assessment of Gunns Creek within the Rural Municipality of St Clements reach. Concerns with respect to localized flooding and ineffective drainage have been identified warranting the assessment of the existing area drainage. The project area is shown on Figure 1.

Options for drainage upgrades for Gunns Creek have been developed, which include crossing replacements at PR 202 and the railway embankment alone or in combination with drain cleanout or regrading and municipal road crossing replacements from the railway embankment upstream to the RM boundary. The two major downstream culverts crossing at PR 202 and the railway embankment have the greatest impact on water surface profiles resulting in considerable and unnecessary flooding. Replacement of these two crossings will provide significant benefits to the area drainage. Overall, all the proposed improvements to the creek will provide a lower water surface profile within the creek itself in addition to improving runoff from tributary drains. Additionally, the proposed upgrades will ensure the long term function and integrity of the drain itself.

Pertinent features of project area are as follows:

- Municipality - St Clements
- Stream Order - Third order drain
- Flow Direction - north-northeast
- Designation of Drain Map - No. 11
- Total Drainage Area - 23.5 km^2
- UTM Coordinates of Study reach - Downstream 647880E, 5549950N
  - Upstream 643570E, 5542170N

The following sections summarize: 1) the hydrological assessment, 2) the hydraulic assessment of the existing drain, 3) the proposed drainage upgrade options and 4) the estimated costs for implementation.

2 Flood Hydrology

As shown on Figure 2, the runoff to Gunns Creek starts near the town of Birdshill, with the creek flowing northeastly between Rebeck Road and Henderson Highway before discharging into the Red River at Lockport. The total contributing drainage area at the downstream end near the Red River of approximately 23.5 km^2. The incremental contributing drainage areas have been identified and delineated at key locations. The local drainage is ungauged; therefore the flood hydrology was derived using standard hydrological techniques. Table 1 summarizes the area hydrology.

Table 1
Hydrology – Gunns Creek

Location	Drainage Area (km^2)	50% Discharge (m^3/s)	20% Discharge (m^3/s)	5% Discharge (m^3/s)	3% Discharge (m^3/s)	3DQ10 Discharge (m^3/s)
McKay Road (US)	6.2	1.3	2.3	3.6	4.1	2.3
Dunning Road (DS)	8.6	1.9	3.3	5.0	5.7	3.2
Donald Road (US)	12.5	2.7	4.7	7.3	8.3	4.7
Ludwick Road - old PR 407 (DS)	16.2	2.9	5.1	8.0	9.2	5.0
Church Road (DS)	19.4	3.0	5.2	8.4	9.7	5.2
Hay Road (US)	22.0	3.0	5.4	8.8	10.2	5.4
Railway Crossing (US)	22.5	3.0	5.4	8.9	10.3	5.4
PR 202 (US)	23.0	3.0	5.4	9.0	10.4	5.4
Henderson Highway/Red River	23.5	3.1	5.5	9.0	10.5	5.4

3 Hydraulic Assessment - Existing Conditions

The efficiency of drainage within Gunns Creek was assessed in detail to identify the areas of deficiency that warrant consideration for upgrade. The study area is as shown on Figure 1.

3.1 Assessment Standards and Requirements

Drains

The following hydraulic criteria were applied for creeks/drains:

- Assessment discharge – 5% (1:20 year)
- Water surface profile to remain at or below prairie level
- Maximum channel velocity of 0.9 m/s at assessment discharge

Culvert Crossings

The following hydraulic criteria were applied for culvert crossings:

- Design discharge
  - 5% - Municipal Roads, Field Crossings and Residential Crossings
  - 3% - Railway Embankment, PR 202 and Henderson Highway (PR 204)
- Maximum headloss of 0.3 m during the passage of the assessment discharge

3.2 Gunns Creek

A detailed steady-state hydraulic backwater model of Gunns Creek was developed to assess the hydraulic conditions of the existing creek and culvert crossings. Approximately 11.7 km of the creek was modeled starting at the Red River extending upstream (south) of McKay Road to the RM boundary. The hydraulic analysis for the creek was undertaken using the US Army Corps of Engineers River Analysis System HEC-RAS model. The HEC-RAS model is a one-dimensional backwater model, which is considered to be the universal standard for computing steady-state water surface profiles. The backwater model for the creek was developed using cross-sections, channel profiles and details of the crossings surveyed by GDS Surveys in October 2016.

The model has not been calibrated to observed water levels during periods of high flow, and hydraulic parameters such as channel roughness have been selected based on observations, judgement and experience gained from similar projects

Figure 3 presents the computed water surface profiles for the existing creek for a range of discharges up to a 5% flood event. Table 2 summarizes the hydraulic assessment of the existing culvert crossings.

In general the creek is incapable of conveying flood runoff within prairie level for anything in excess of a 20% event (1 in 5 year). Drainage efficiency would be enhanced through either vegetation cleanout, drain cleanout or regrading to improve the geometric template of the creek in addition to the replacement of the culvert crossings. It was noted that the grade of the drain upstream of Hay Road is very flat (estimated as 0.022%) which reduces drainage efficiency and also renders the creek highly susceptible to downstream backwater affects from elevated water levels from undersized culvert crossings.

The two major downstream culverts crossing at PR 202 and the railway embankment have the greatest impact on water surface profiles resulting in considerable and unnecessary flooding as headlosses well exceed typically accepted standards. Upgrade and replacement of these two crossings would provide significant benefits to the drain even without undertaking drainage improvements within the drain upstream of the railway embankment.

Overall, the majority of the other crossings are acceptable hydraulically without change with the exception of the upstream crossing at McKay Road which has headlosses that are higher than typically accepted. The condition however of these other crossings may warrant upgrade as a large number consist of a standard corrugated steel culvert paired with an older steel boiler pipe for a culvert. These steel boiler pipes are generally too short for these locations and appear to be in a deteriorated condition and could warrant replacement. The three span timber bridge at Ludwick Road (old PR 407) is hydraulically acceptable and appears serviceable. however the structure should be evaluated by a bridge engineer to ensure the structure remains safe for use.

Table 2

Gunns Creek

Hydraulic Summary - Existing Crossings

Location	Station	Existing Crossing	Assessment (Design) Discharge		Headloss at Assessment Discharge (m)	Culvert/Bridge Velocities at Assessment Discharge (m)	Hydraulic Requirements Satisfied
			Probability	(m^3/s)			
Henderson Highway	551	Double 2440 x 2440 x 23.5 L reinforced concrete box culvert	3% *	10.5	0.13	1.15 -1.35	Yes
PR 202	1351	1800 dia x 56 long CSP	3% *	10.4	3.65	4.1 - 4.4	No
Driveway	1853	1500 dia x 9.5 long CSP & 2500 dia x 12.4 long steel boiler pipe	5%	8.8	0.0 **	0.3 **	No
Railway Embankment	2129	1000 dia x 22.6 long CSP & 1800 dia x 20.5 long CSP	3%	10.3	1.31	2.75 - 3.15	No
Hay Road	3184	1500 dia x 12.6 long CSP & 2700 dia x 12.7 long steel boiler pipe	5%	8.8	0.14 **	1.05 - 1.2 **	Yes
Waille Road	4635	1500 dia x 37.6 long CSP & 2500 dia x 15.6 long steel boiler pipe	5%	8.4	0.17	1.05 -1.35	Yes
Church Road	4961	1700 dia x 17.7 long CSP & 2500 dia x 12.7 long steel boiler pipe	5%	8.0	0.13	1.0 - 1.15	Yes
Ludwick Road (old PR 407)	6834	3 span 19m long timber bridge	5%	7.3	<0.05	0.3	Yes
Donald Road	8430	1500 dia x 12.7 long CSP & 2600 dia x 12.7 long steel boiler pipe	5%	7.3	0.10	0.95 - 1.1	Yes
Dunning Road	10351	1400 dia x 14.5 long CSP & 2500 dia x 12.7 long steel boiler pipe	5%	3.6	0.30	0.6	Yes
McKay Road	11357	750 dia x 18.6 long CSP & 900 dia x 18 long CSP	5%	3.6	0.87 **	2.2 - 2.3 **	No

* - MIT Standard

** - road overtopped at design discharge

3.3 Lateral Drains

There are numerous lateral drains which outlet into Gunns Creek, following the road right-of ways. Profile data for the McKay, Dunning, Donald, Ludwick, Church and Waille Road drains was available to allow for a preliminary assessment of the drain grades. Survey data was not available for Hay Road however. Overall there appears to sufficient grade and depth within these drains along with sufficient elevation drop at the outlet into Gunns Creek to provide effective drainage. It would be beneficial to assess the hydrology and hydraulics of each of these drains to confirm drainage efficiency and to allow for recommendations for upgrade. The drainage assessment would require that detailed surveys be completed which would include the collection of profiles of the drain invert, road and prairie, along with all culverts and would include typical sections of the drains.

4 Drainage Upgrades

The following sections present the proposed upgrades to the local drainage. Options for drainage upgrades for Gunns Creek have been developed, which include crossing replacements at PR 202 and the railway embankment alone or in combination with drain cleanout or regrading and municipal road crossing replacements from the railway embankment upstream to the RM boundary. The design criteria for the proposed upgrades are also presented. Three options for upgrade are presented for Gunns Creek including downstream crossing replacement only (PR 202 and railway embankment), drain cleanout with crossing replacements and drain regrading with crossing replacements. Preliminary plan-profile drawings are appended for all three options..

4.1 Design Standards and Requirements

Drains

The following hydraulic criteria were applied for the drain design:

- Design discharge – 5%.
- Water surface profile to remain at or below prairie level
- Maximum channel velocity of 0.9 m/s at design discharge

Culvert Crossings

The following hydraulic criteria were applied for culvert crossings:

- Design discharge
  - 5% - Municipal Roads, Field Crossings and Residential Crossings
  - 3% - Railway Embankment, PR 202 and Henderson Highway (PR 204)
- Maximum headloss of 0.3 m during the passage of the assessment discharge
- Culvert soffit to remain clear at design discharge
- Culvert velocity less than 2.0 m./s at design discharge
- The drain is classified as Type A (complex habitat with indicator species) downstream of the railway embankment to the Red River by Fisheries and Oceans Canada (habitat classification map appended). Any work within this Type A reach (which would include PR 202 crossing) would have specific design requirements (limiting culvert velocities) to permit fish passage. Upstream of the railway embankment, the drain is classified as Type E (indirect habitat) and as such would not have specific design requirements for accommodating fish passage.

4.2 Upgrade Options

Option 1 - Downstream Crossings

The two major downstream culvert crossings at PR 202 and the railway embankment have the greatest impact on water surface profiles resulting in considerable and unnecessary flooding as headlosses well exceed typically accepted standards. Upgrade and replacement of these two crossings with suitably sized culverts would provide significant benefits to the drain even without undertaking drainage improvements within the drain upstream of the railway embankment. Drain cleanout has not been proposed for this option, however it is recommended that the vegetation within the drain should be cut and removed to improve flow. This option presents the drainage improvements whereby these two downstream crossings are replaced. The upstream crossing at McKay Road was also upgraded as headlosses at that location were also higher than typically accepted. The remaining culvert crossings would remain unchanged as would the timber bridge at Ludwick Road. The proposed crossing upgrades for this option are summarized in Table 3. The water surface profiles with all three crossings upgraded are presented in Figure 4.

For comparison, Figure 5 presents the 5% design discharge water surface profiles for existing conditions, with both the PR 202 and railway embankment crossings replaced, in addition to conditions where only the railway embankment crossing was replaced without undertaking the replacement of PR 202. It is apparent that although the replacement of the railway embankment crossing alone does result in a lower water surface profile (approximately 0.7 m upstream of the railway embankment), the full benefit isn't realized without the replacement of the PR 202 crossing which lowers the water surface profile by 1.7 m upstream of the railway embankment.

It is uncertain whether Manitoba Infrastructure (MI) would consider the replacement of the PR 202 culvert crossing in conjunction with this project, even though the culvert itself is in poor condition and warrants replacement. The cost for replacement would be high as the culverts would likely require installation by jacking, and therefore would be cost-prohibitive for the municipality to undertake independent of MI. It would be recommended that the municipality engage MI in discussions for the replacement of this crossing to ensure that the drainage benefits for the area are realized. In addition, it is recommended that the railway be engaged as well to discuss culvert replacement through their railway grade.

Table 3

Gunns Creek

Hydraulic Summary - Proposed Crossings for Option 1 - Downstream Crossing Upgrade

Location	Station	Proposed Crossing	Assessment (Design) Discharge		Proposed Culvert Invert Elevations			Headloss at Assessment Discharge (m)	Culvert/Bridge Velocities at Assessment Discharge (m)	Hydraulic Requirements Satisfied
			Probability	(m^3/s)	Embedment (m)	US (m)	DS (m)			
Henderson Highway	551	No Change - retain Double 2440 x 2440 x 23.5 L reinforced concrete box culvert	3% *	10.5	NA	NA	NA	0.13	1.15 -1.35	Yes
PR 202	1351	3-2400 dia x 56 long PCC **	3% *	10.4	0.50	224.40	224.40	0.07	1.0	Yes
Driveway	1853	No Change - 1500 dia x 9.5 long CSP & 2500 dia x 12.4 long steel boiler pipe	5%	8.8	NA	NA	NA	0.17	1.45-1.8	Yes
Railway Embankment	2129	2-2000 dia x 28 long CSP	3%	10.3	0.10	226.40	226.40	0.30	1.75-1.85	Yes
Hay Road	3184	No Change - 500 dia x 12.6 long CSP & 2700 dia x 12.7 long steel boiler pipe	5%	8.8	NA	NA	NA	0.29	1.6-1.85	Yes
Waille Road	4635	No Change - 1500 dia x 37.6 long CSP & 2500 dia x 15.6 long steel boiler pipe	5%	8.4	NA	NA	NA	0.26	1.3-1.8	Yes
Church Road	4961	No Change - 1700 dia x 17.7 long CSP & 2500 dia x 12.7 long steel boiler pipe	5%	8.0	NA	NA	NA	0.16	1.15-1.3	Yes
Ludwick Road (old PR 407)	6834	No Change - 3 span 19m long timber bridge	5%	7.3	NA	NA	NA	<0.05	0.4	Yes
Donald Road	8430	No Change - 1500 dia x 12.7 long CSP & 2600 dia x 12.7 long steel boiler pipe	5%	7.3	NA	NA	NA	0.14	1.05-1.2	Yes
Dunning Road	10351	No Change - 1400 dia x 14.5 long CSP & 2500 dia x 12.7 long steel boiler pipe	5%	3.6	NA	NA	NA	<0.05	0.55-0.65	Yes
McKay Road	11357	1800 dia x 19 long CSP	5%	3.6	0.10	228.95	228.95	0.22	1.4	Yes

* - MIT Standard

** - sized for fish passage as reach is Type A - velocity <0.6 m/s at 3DQ10

Option 2 - Drain Cleanout/Crossing Upgrades

This option involves the cleanout of the creek upstream from the railway embankment to McKay Road, closely following the existing drain grade. The drain cleanout would involve minimal excavation and reshaping of the drain to the proposed geometric template. The geometric template proposed for the drain is as follows:

- Base width = 3.0 m
- Side Slopes = 4:1
- The proposed channel grades are:
  - Railway Embankment (Sta 21+29) upstream to Hay Road (Sta 31+84) - 0.07%
  - Hay Road (Sta 31+84) upstream to the RM boundary (south of McKay Road - Sta 117+20) - 0.022%

With this option, all of the crossings from the railway embankment upstream, with the exception of the Ludwick Road Bridge, would be upgraded including the railway embankment crossing and PR 202 (as per Option 1). It has been assumed that the municipal road crossing culverts would be replaced as it is unlikely that the existing culverts could be excavated and reset to grade without damage. Additionally it is likely that the existing culverts, particularly the steel boiler pipes, have reached the end of their service life and require replacement. The Ludwick Road bridge would also require reshaping of the bridge opening and placement of rock riprap. The proposed crossing upgrades for this option are summarized in Table 4.

Water surface profiles with the Option 2 improvements are presented in Figure 6. It was noted that although the water surface profile is lower than what would occur under existing conditions, the water surface profile still exceeds prairie level upstream of Ludwick Road at the design discharge. As such, this options does not entirely satisfy the design requirements. Larger culverts and a wider channel base width were assessed, however the water surface profile doesn't recede sufficiently to meet the requirements. The flat channel grade (0.022%) as discussed is the primary cause of the high water surface profile. A steeper channel grade in combination with a lower drain invert, requiring channel regrading, would result in a lower water surface profile and is reflected in the Option 3 improvements presented in the following section.

Plan Profile drawings for this option have been prepared and are appended for reference.

Table 4

Gunns Creek

Hydraulic Summary - Proposed Crossings for Option 2 - Drain Cleanout and Crossing Upgrade

Location	Station	Proposed Crossing	Assessment (Design) Discharge		Proposed Culvert Invert Elevations			Headloss at Assessment Discharge	Culvert/Bridge Velocities at Assessment Discharge	Hydraulic Requirements Satisfied
			Probability	(m^3/s)	Embedment (m)	US (m)	DS (m)	(m)	(m)	
Henderson Highway	551	No Change - retain Double 2440 x 2440 x 23.5 L reinforced concrete box culvert	3% *	10.5	NA	NA	NA	0.13	1.15 -1.35	Yes
PR 202	1351	3-2400 dia x 56 long PCC **	3% *	10.4	0.50	224.40	224.40	0.07	1.0	Yes
Driveway	1853	No Change - 1500 dia x 9.5 long CSP & 2500 dia x 12.4 long steel boiler pipe	5%	8.8	NA	NA	NA	0.17	1.45-1.8	Yes
Railway Embankment	2129	2-2000 dia x 28 long CSP	3%	10.3	0.10	226.40	226.40	0.30	1.75-1.85	Yes
Hay Road	3184	2-2000 dia x 20 long CSP	5%	8.8	0.10	227.14	227.14	0.27	1.6	Yes
Wallie Road	4635	2-2000 dia x 21 long CSP	5%	8.4	0.10	227.46	227.46	0.20	1.4	Yes
Church Road	4961	2-2000 dia x 21 long CSP	5%	8.0	0.10	227.53	227.53	0.19	1.3	Yes
Ludwick Road (old PR 407)	6834	No Change - 3 span 19m long timber bridge	5%	7.3	NA	NA	NA	<0.05	0.3	Yes
Donald Road	8430	2-2000 dia x 19 long CSP	5%	7.3	0.10	228.29	228.29	0.15	1.2	Yes
Dunning Road	10351	2-1800 dia x 18 long CSP	5%	3.6	0.10	228.72	228.72	0.06	0.7	Yes
McKay Road	11357	1800 dia x 19 long CSP	5%	3.6	0.10	228.94	228.94	0.22	1.5	Yes

* - MIT Standard

** - sized for fish passage as reach is Type A - velocity <0.6 m/s at 3DQ10

Option 3 - Drain Regrading/Crossing Upgrades

This option involves the regrading of the creek upstream from the railway embankment to McKay Road, to a lower drain grade to achieve a lower water surface profile. The drain regrade would involve the lowering (maximum 0.5 m) and reshaping of the drain to the proposed geometric template. The geometric template proposed for the drain is as follows:

- Base width = 3.0 m
- Side Slopes = 4:1
- The proposed channel would have a consistent grade of 0.025% from the Railway Embankment (Sta 21+29) upstream to the RM boundary (south of McKay Road - Sta 117+20)

With this option, all of the crossings from the railway embankment upstream would be upgraded including the railway embankment crossing and PR 202 (as per Option 1). It has been assumed that the municipal road crossing culverts would be replaced as it is unlikely that the existing culverts could be excavated and reset to grade without damage. Additionally it is likely that the existing culverts, particularly the steel boiler pipes, have reached the end of their service life and require replacement. The Ludwick Road bridge would also require reshaping of the bridge opening and placement of rock riprap. The proposed crossing upgrades for this option are summarized in Table 5.

Water surface profiles with the Option 3 improvements are presented in Figure 7. The resultant water surface profile is overall lower and within prairie level with the exception of a short length (500 m) of the creek upstream of Dunning Road. This short length of the creek could be provided with a spoil berm dike to contain the water surface profile.

Plan Profile drawings for this option have been prepared and are appended for reference.

Water surface profiles comparing all three proposed drain improvement options are presented against existing conditions in Figure 8. It is evident that Option 3 with the drain regrading provides the greatest reduction in water surface profile.

Table 5

Gunns Creek

Hydraulic Summary - Proposed Crossings for Option 3 - Drain Regrade and Crossing Upgrade

Location	Station	Proposed Crossing	Assessment (Design) Discharge		Proposed Culvert Invert Elevations			Headloss at Assessment Discharge (m)	Culvert/Bridge Velocities at Assessment Discharge (m)	Hydraulic Requirements Satisfied
			Probability	(m^3/s)	Embedment (m)	US (m)	DS (m)			
Henderson Highway	551	No Change - retain Double 2440 x 2440 x 23.5 L reinforced concrete box culvert	3% *	10.5	NA	NA	NA	0.13	1.15 -1.35	Yes
PR 202	1351	3-2400 dia x 56 long PCC **	3% *	10.4	0.50	224.40	224.40	0.07	1.0	Yes
Driveway	1853	No Change - 1500 dia x 9.5 long CSP & 2500 dia x 12.4 long steel boiler pipe	5%	8.8	NA	NA	NA	0.17	1.45-1.8	Yes
Railway Embankment	2129	2-2000 dia x 28 long CSP	3%	10.3	0.10	226.40	226.40	0.30	1.75-1.85	Yes
Hay Road	3184	2-2000 dia x 21 long CSP	5%	8.8	0.10	226.66	226.66	0.21	1.6	Yes
Waille Road	4635	2-2000 dia x 22 long CSP	5%	8.4	0.10	227.03	227.03	0.21	1.4	Yes
Church Road	4961	2-2000 dia x 22 long CSP	5%	8.0	0.10	227.11	227.11	0.18	1.3	Yes
Ludwick Road (old PR 407)	6834	No Change - 3 span 19m long timber bridge	5%	7.3	NA	NA	NA	<0.05	0.3	Yes
Donald Road	8430	2-2000 dia x 20 long CSP	5%	7.3	0.10	227.98	227.98	0.15	1.2	Yes
Dunning Road	10351	2-1800 dia x 19 long CSP	5%	3.6	0.10	228.46	228.46	0.06	0.7	Yes
McKay Road	11357	1800 dia x 19 long CSP	5%	3.6	0.10	228.71	228.71	0.22	1.5	Yes

* - MIT Standard

** - sized for fish passage as reach is Type A - velocity <0.6 m/s at 3DQ10

4.3 Cost Estimates

Feasibility level capital costs estimates for the proposed drainage improvements have been prepared for each option. The capital cost estimates, are summarized in Table 6 and include the following where applicable:

- Material costs – culverts, riprap, etc.
- Installation – cost for riprap placement, drain excavation and reshaping, culvert installation, gradient control structure reconstruction, etc.
- Land purchase and Utilities
- Mobilization and Demobilization – costs incurred by contractor to bring equipment to site
- Erosion and Sediment Control
- Site Supervision
- Contingency – 25%
- Exclusive of applicable taxes

Table 6
Gunns Creek - Drainage Upgrades
Summary of Capital Cost Estimates

Drainage Improvements	Estimated Cost ($)
Option 1 - Downstream Crossings	
• Channel Excavation	$0
• Municipal Crossings	$21,000
• PR 202 Crossing *	$0
• Railway Crossing	$180,000
• Land, Miscellaneous and Construction Management	$8000
• Contingency	$50,000
Total - Option 1	**$259,000**
Option 2 - Drain Cleanout and Crossing Upgrades	
• Channel Excavation	$200,000
• Municipal Crossings	$350,000
• PR 202 Crossing *	$0
• Railway Crossing	$180,000
• Land, Miscellaneous and Construction Management	$60,000
• Contingency	$198,000
Total - Option 2	**$988,000**
Option 3 - Drain Regrading and Crossing Upgrades	
• Channel Excavation	$600,000
• Municipal Crossings	$360,000
• PR 202 Crossing *	$0
• Railway Crossing	$180,000
• Land, Miscellaneous and Construction Management	$60,000
• Contingency	$300,000
Total - Option 3	**$1,500,000**

* - The PR 202 crossing replacement assumes installation by jacking (not open cut), with costs borne by Manitoba Infrastructure as the culvert is in poor condition. Culvert sized to meet strict fish passage requirements at that location. Estimated replacement cost of $750,000

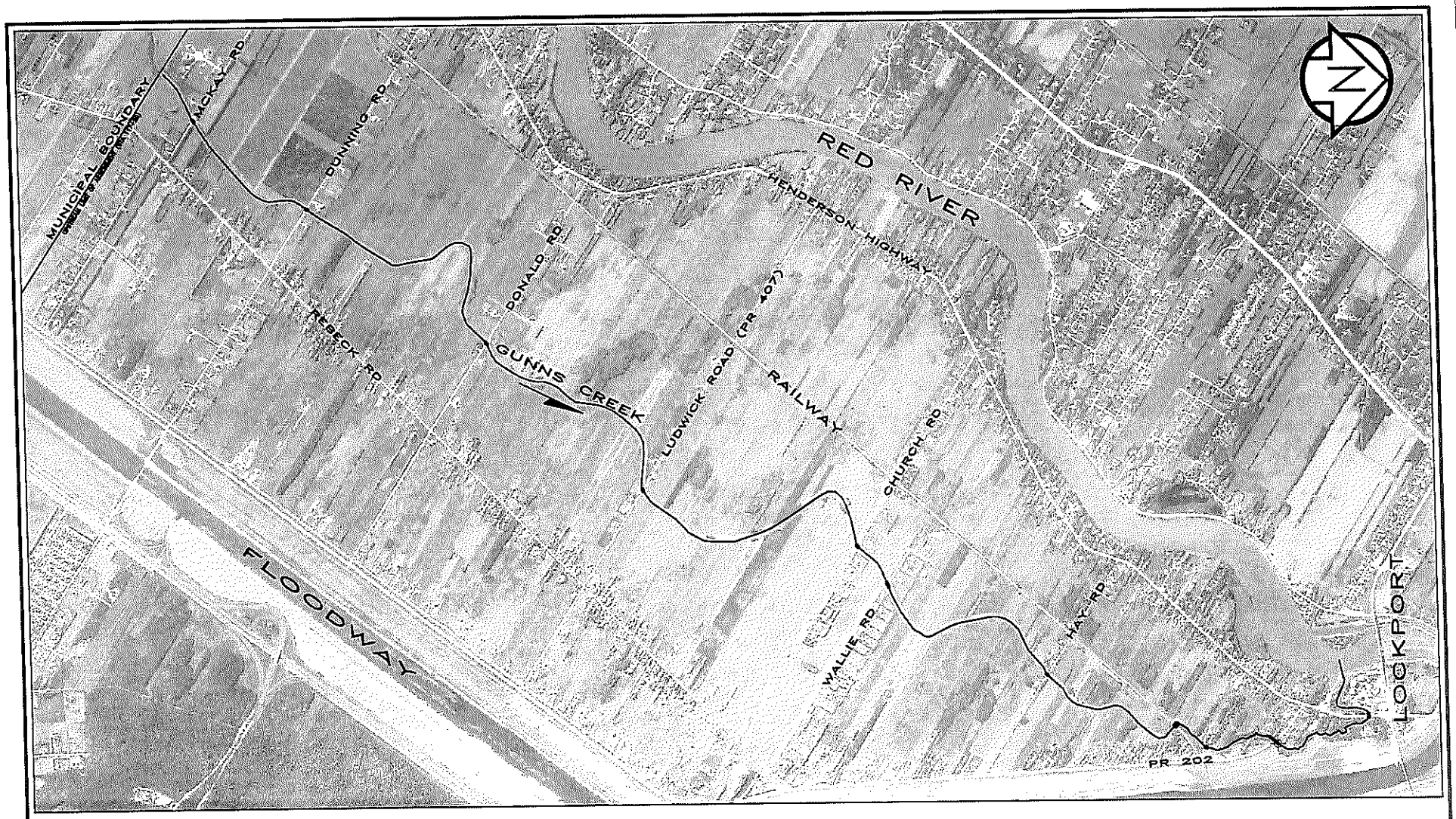
5 Conclusions and Recommendations

The existing drainage within Gunns Creek, although reasonably effective, could be improved either through downstream crossing replacements, drain cleanout combined with crossing replacements or drain regrading combined with crossing replacements. Three options for drainage improvements have been proposed for Gunns Creek, however it is recommended that as a minimum that Option 1 be considered which includes the replacement of the PR 202 crossing, the railway embankment crossing and the McKay Road crossing. Option 3 however is the preferred and recommended overall option as this provides the greatest overall benefit in terms of drainage, however also at the greatest cost. It must be emphasized that any upstream improvements (drain regrading, municipal road culvert replacements, etc.) without the replacement of the downstream crossings (as per Option 1) would provide little benefit. Detailed plan-profile drawings for all three options, complete with the proposed drain design and crossing upgrades, are appended for reference.

It is uncertain whether Manitoba Infrastructure (MI) would consider the replacement of the PR 202 culvert crossing in conjunction with this project, even though the culvert itself is in poor condition and warrants replacement. The cost for replacement would be high as the culverts would likely require installation by jacking, and therefore would be cost-prohibitive for the municipality to undertake independent of MI. It would be recommended that the municipality engage MI in discussions for the replacement of this crossing to ensure that the drainage benefits for the area are realized. In addition, it is recommended that the railway be engaged as well to discuss culvert replacement through their railway grade.

It is further recommended that assessment of the lateral road drains (ie. McKay, Donald, etc.) be undertaken to confirm drainage efficiency and to allow for recommendations for upgrade. The assessments would require detailed surveys be completed.

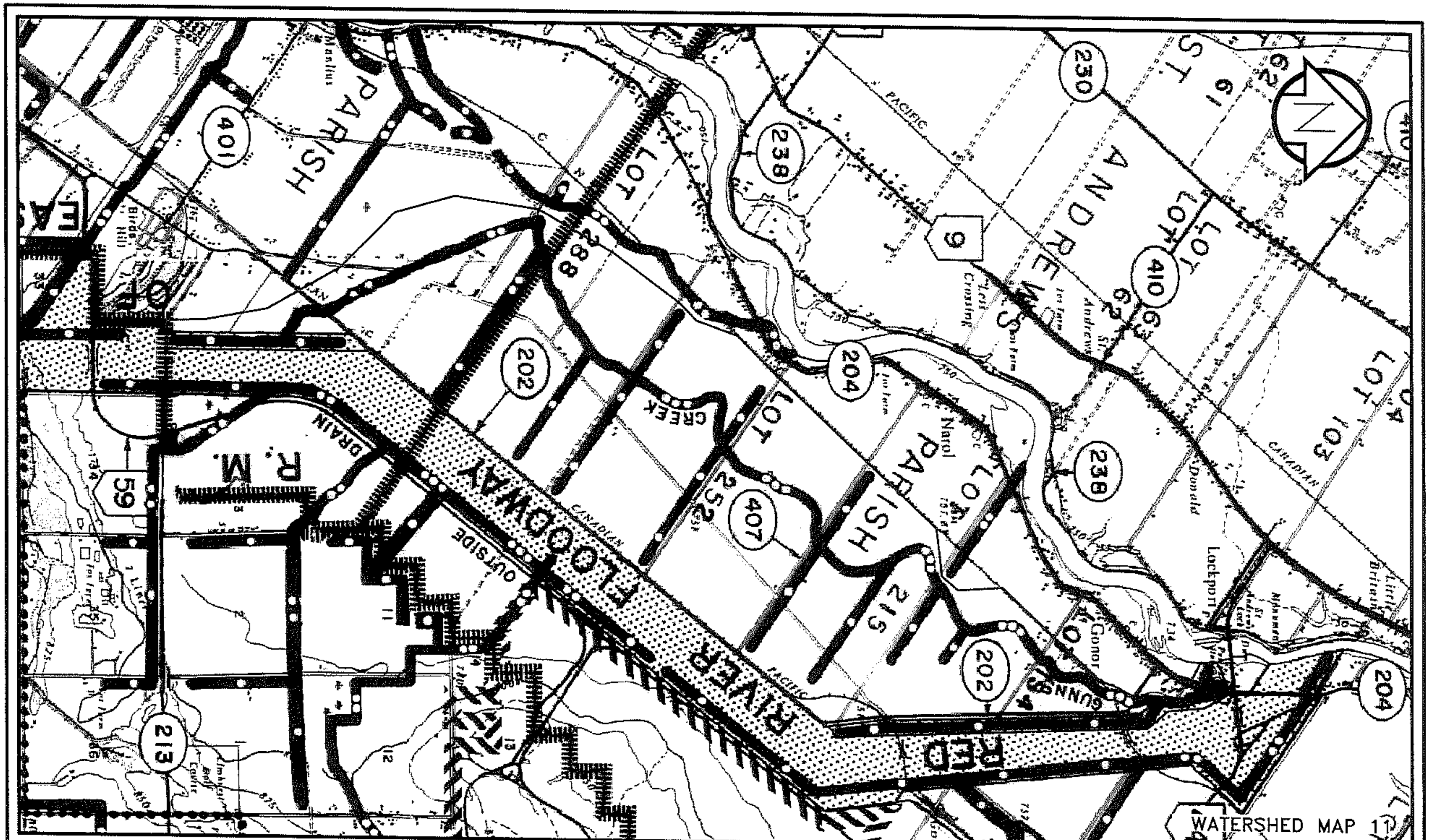
Figures



SCALE (METRES)

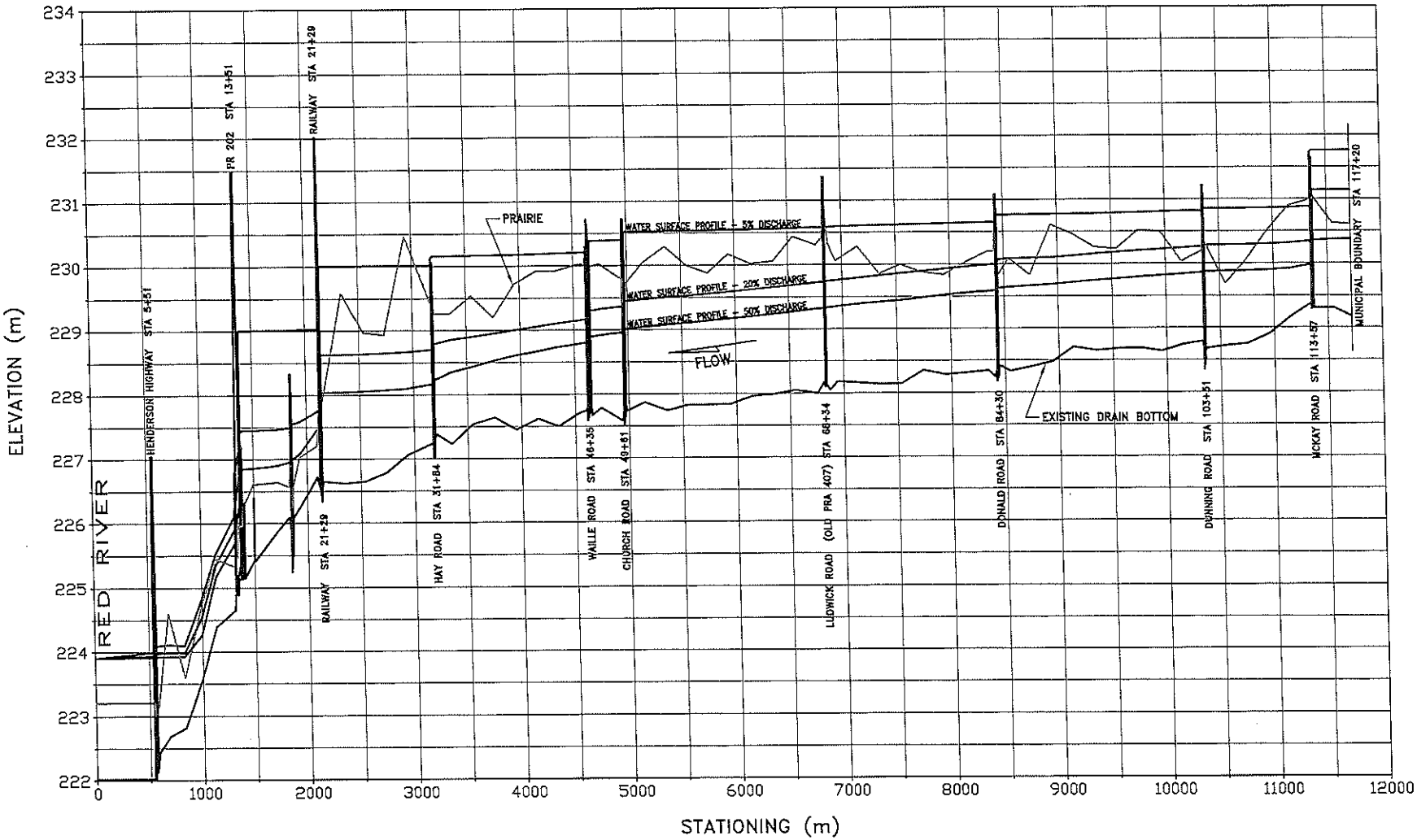
1250 0 1250 2500

GUNNS CREEK DRAINAGE ASSESSMENT
LOCATION PLAN
FIGURE 1



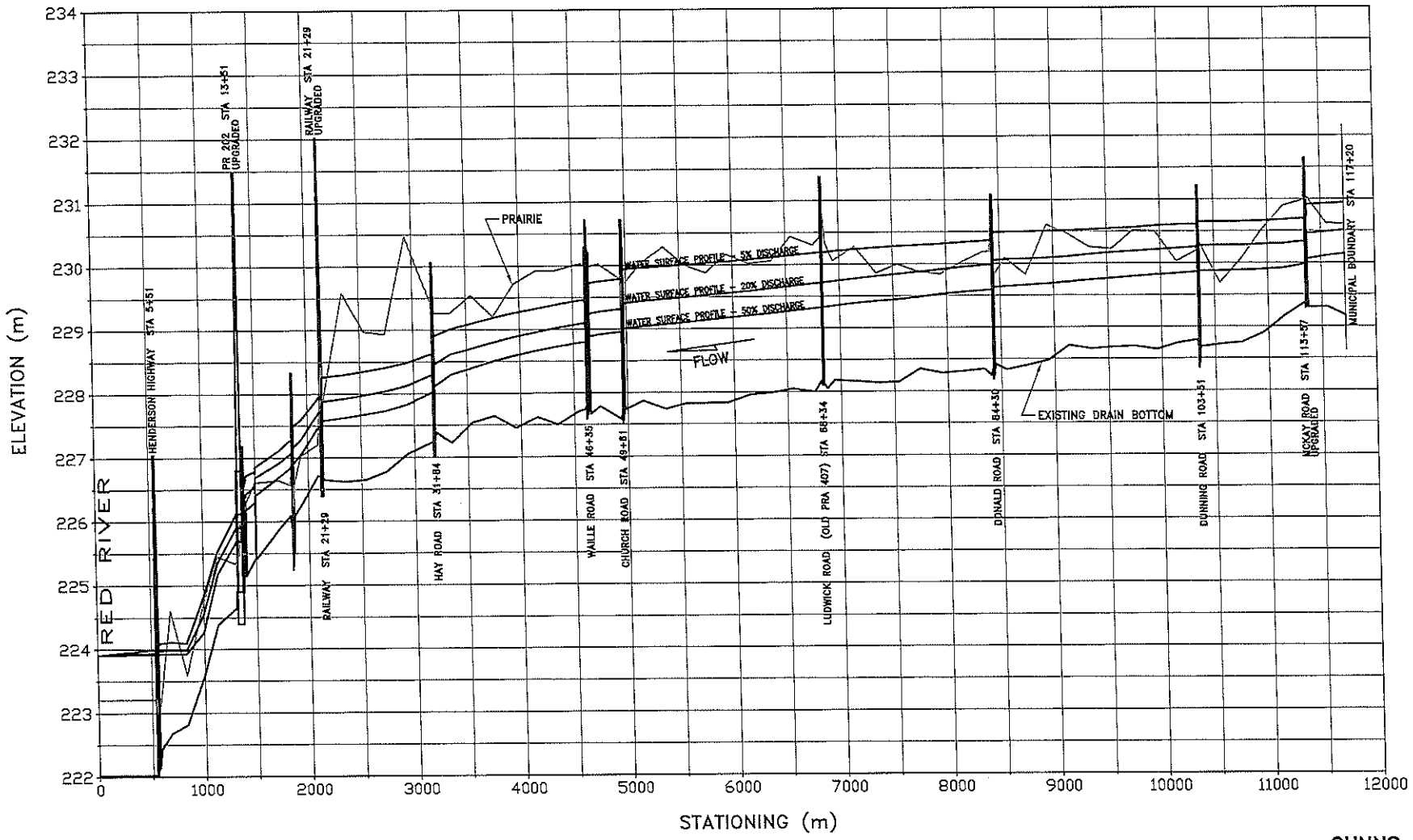
GUNNS CREEK DRAINAGE
DRAINAGE AREA
FIGURE 2

SCALE (METRES)
1000 0 1000 2000



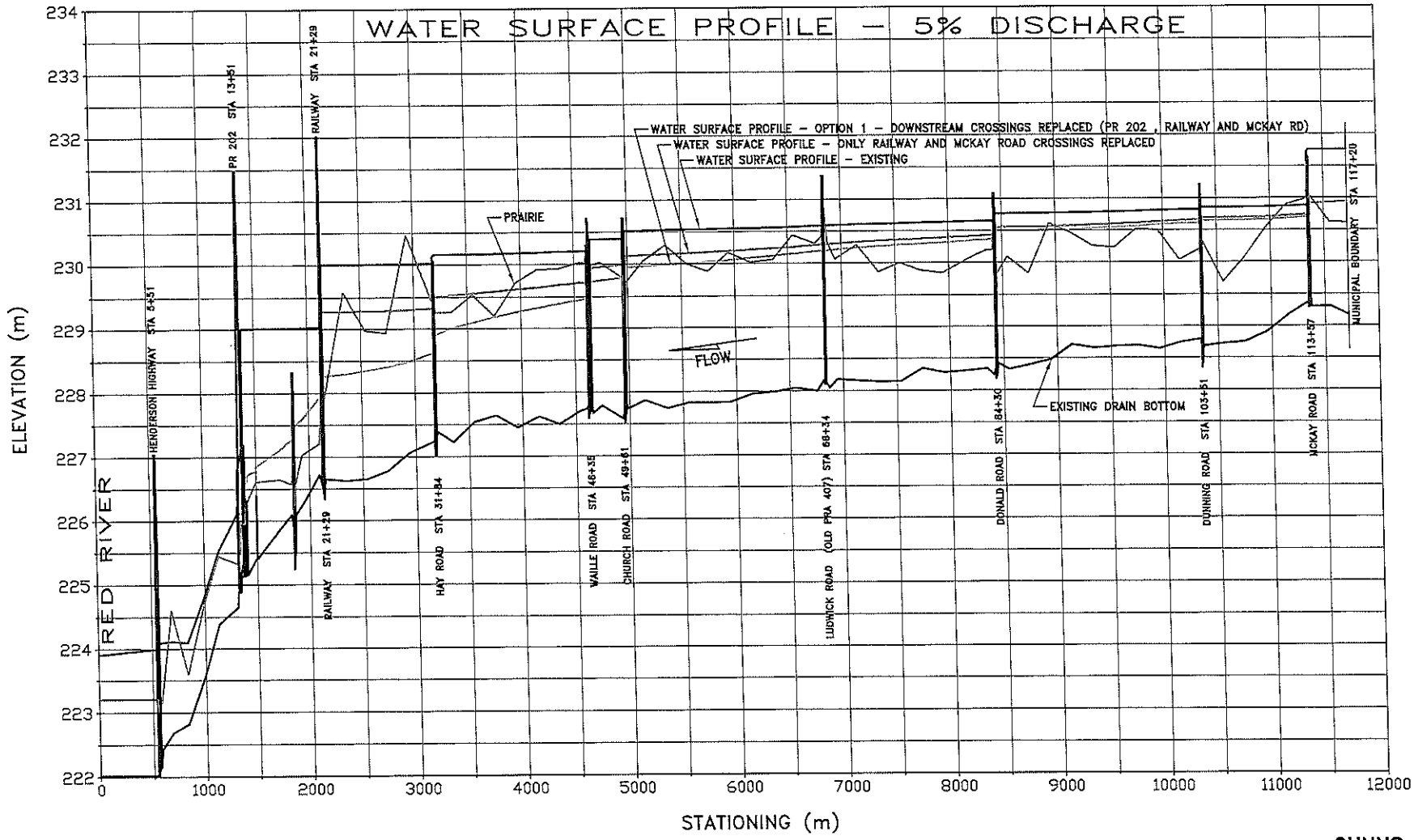
NOTES:
1) SURVEYED OCTOBER 2016 BY GDS SURVEYS
2) WATER SURFACE PROFILES REFLECT EXISTING CONDITIONS (DRAIN, CROSSINGS) – OCTOBER 2016

GUNNS CREEK
WATER SURFACE PROFILES
EXISTING CONDITIONS
FIGURE 3



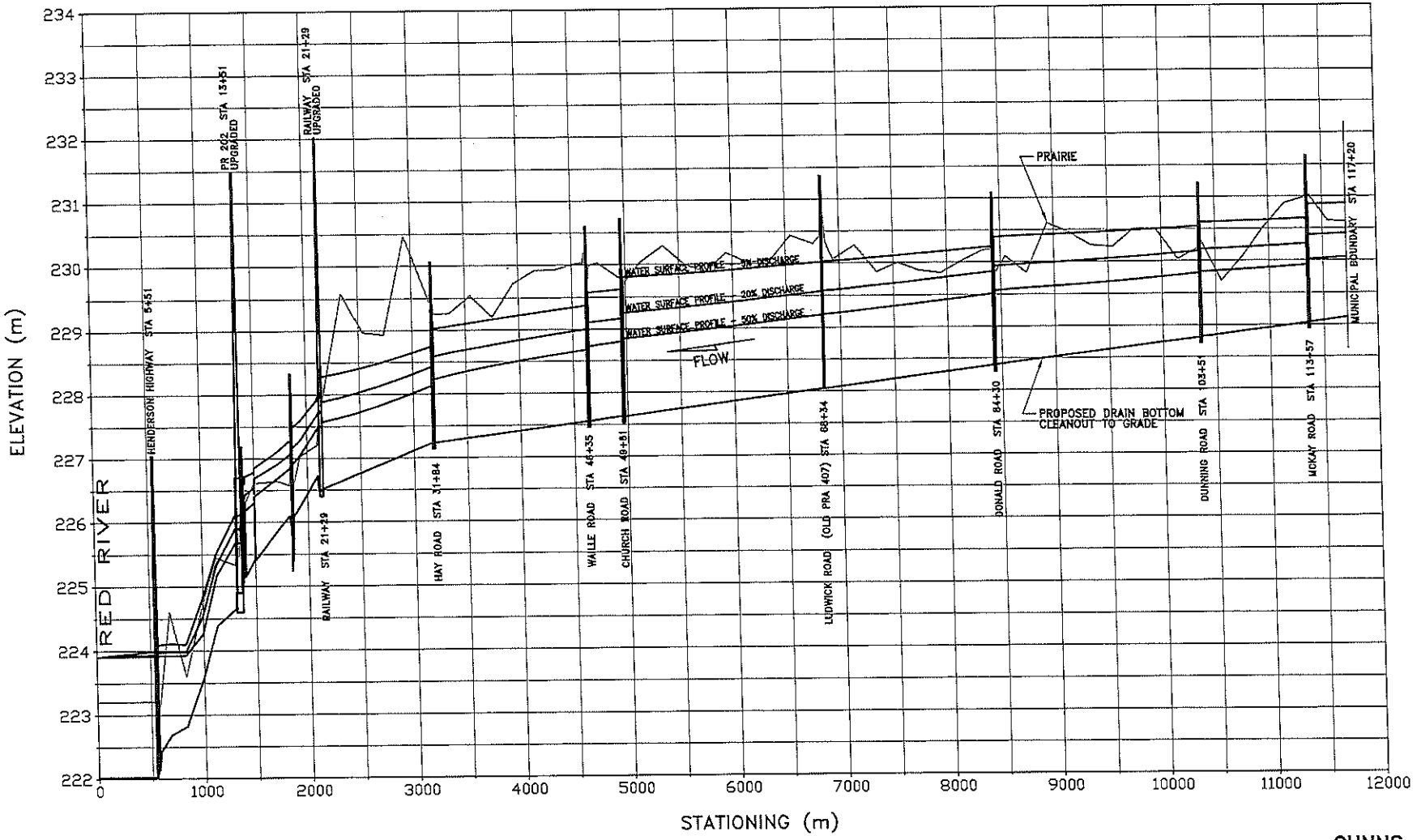
NOTES:
1) SURVEYED OCTOBER 2016 BY GDS SURVEYS
2) WATER SURFACE PROFILES REFLECT OPTION 1 CONDITIONS WHERE THE PR 202, RAILWAY EMBANKMENT AND MCKAY ROAD CROSSINGS WERE UPGRADED. NO DRAIN IMPROVEMENTS WITH THIS OPTION

GUNNS CREEK
WATER SURFACE PROFILES
OPTION 1 – DOWNSTREAM CROSSINGS
FIGURE 4



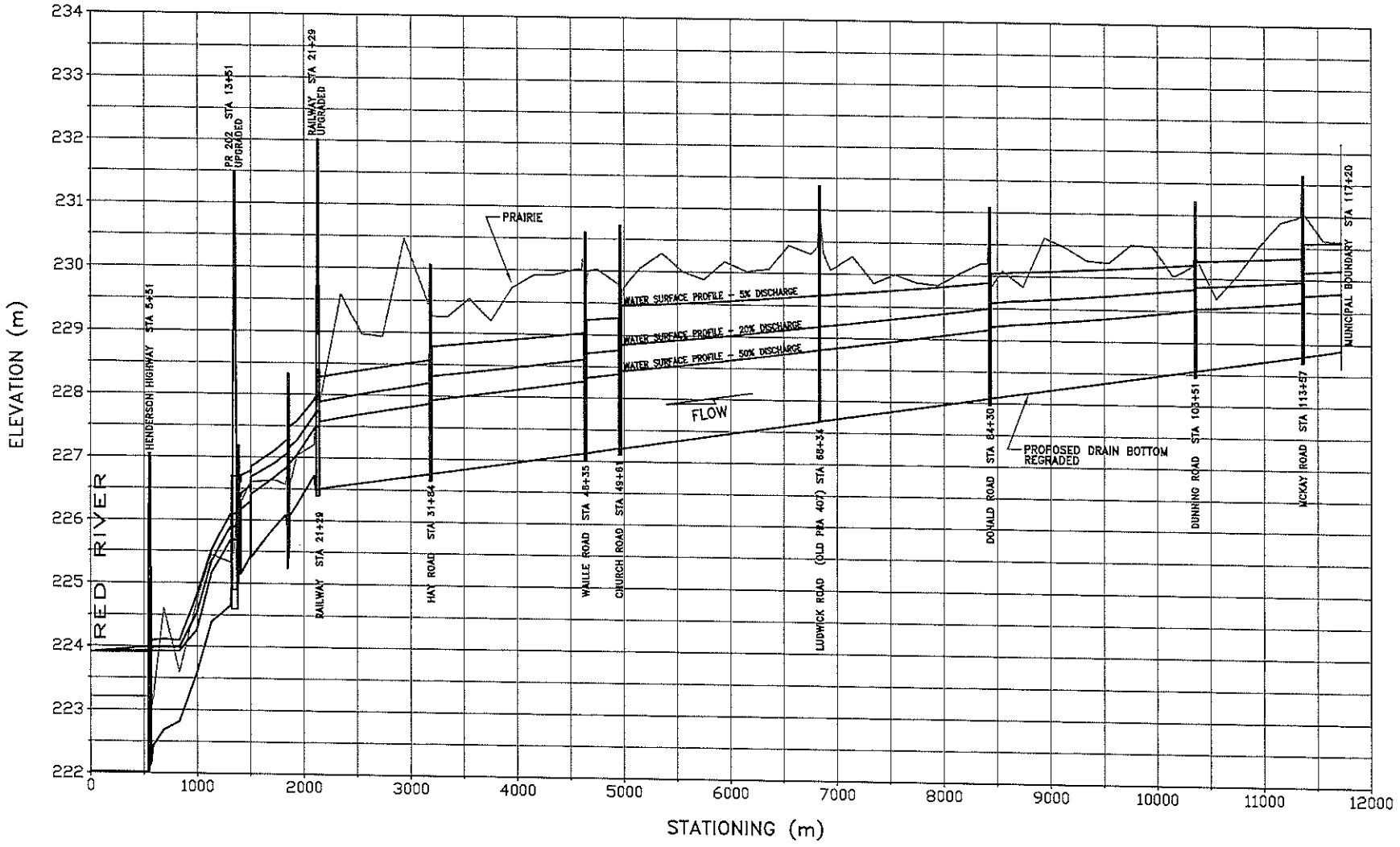
NOTES:
1) SURVEYED OCTOBER 2016 BY GDS SURVEYS
2) WATER SURFACE PROFILES REFLECT EXISTING CONDITIONS, WITH BOTH THE PR 202 AND RAILWAY CROSSINGS REPLACED AND WITH ONLY THE RAILWAY CROSSING REPLACED

GUNNS CREEK
WATER SURFACE PROFILES – COMPARISON
DOWNSTREAM CROSSING REPLACEMENTS TO EXISTING
FIGURE 5



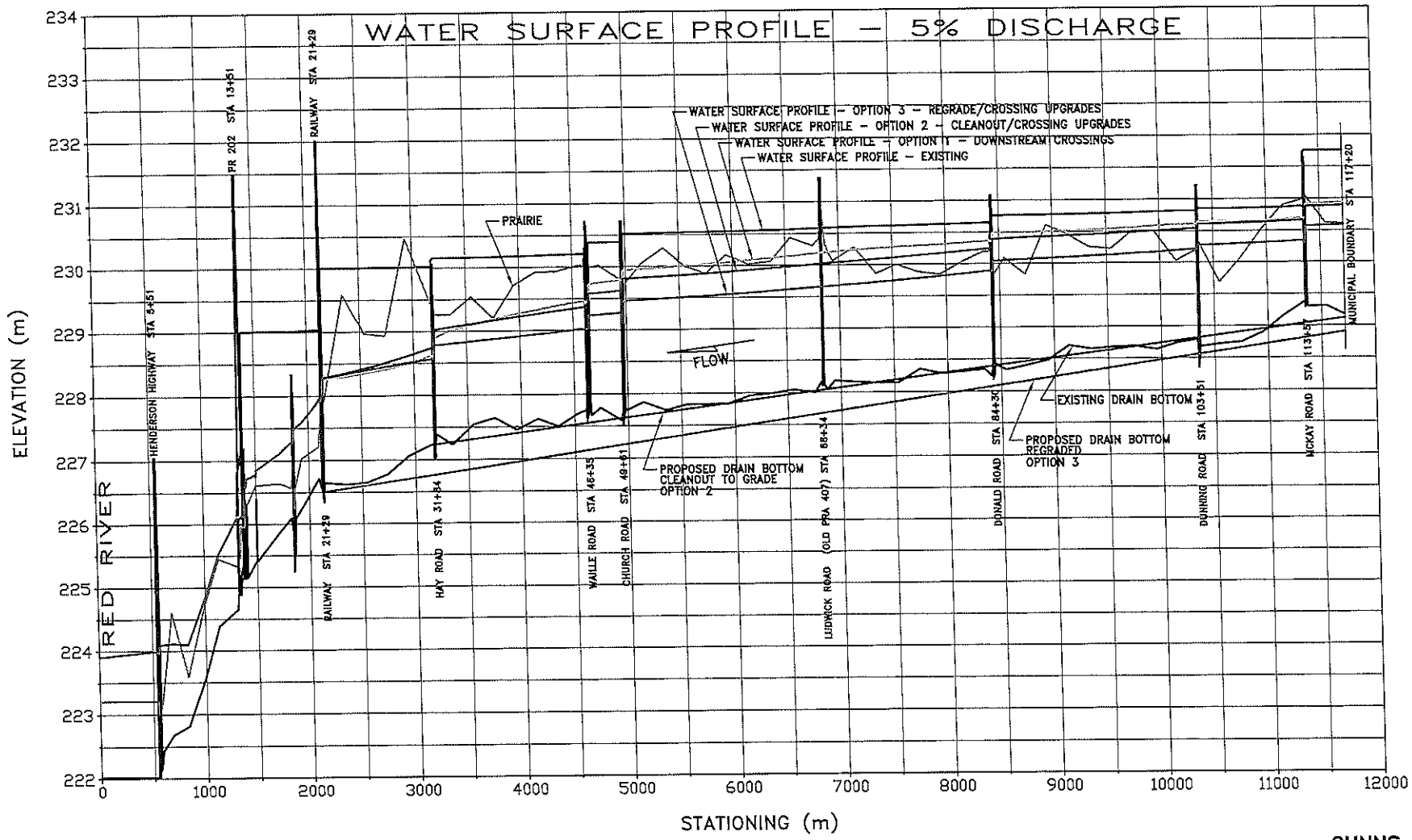
NOTES:
1) SURVEYED OCTOBER 2016 BY GDS SURVEYS
2) WATER SURFACE PROFILES REFLECT OPTION 2 CONDITIONS WHERE THE PR 202 AND RAILWAY EMBANKMENT CROSSINGS, IN ADDITION TO ALL UPSTREAM CROSSINGS ARE UPGRADED. DRAIN UPGRADED WITH CLEANOUT TO GRADE

GUNNS CREEK
WATER SURFACE PROFILES
OPTION 2 – DRAIN CLEANOUT/CROSSING UPGRADES
FIGURE 6



NOTES:
1) SURVEYED OCTOBER 2016 BY GDS SURVEYS
2) WATER SURFACE PROFILES REFLECT OPTION 2 CONDITIONS WHERE THE PR 202 AND RAILWAY EMBANKMENT CROSSINGS, IN ADDITION TO ALL UPSTREAM CROSSINGS ARE UPGRADED. DRAIN REGRADED TO LOWER PROFILE

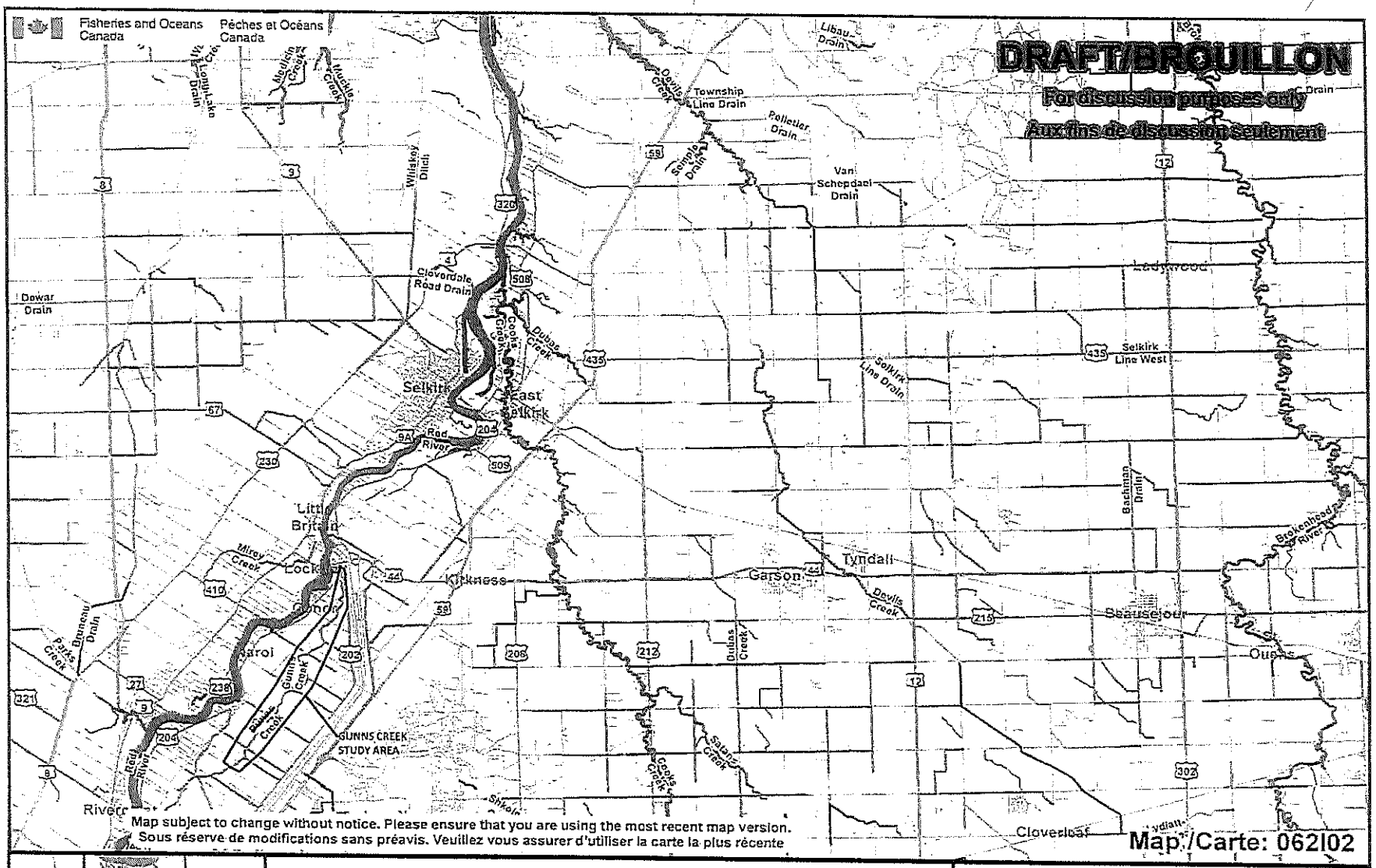
GUNNS CREEK
WATER SURFACE PROFILES
OPTION 3 – REGRADED DRAIN/CROSSING UPGRADES
FIGURE 7



NOTES:
1) SURVEYED OCTOBER 2016 BY GDS SURVEYS
2) WATER SURFACE PROFILES REFLECT EXISTING CONDITIONS AND ALL THREE OPTIONS

GUNNS CREEK
WATER SURFACE PROFILES – COMPARISON
PROPOSED OPTIONS TO EXISTING
FIGURE 8

Appendix A
Fish Habitat Classification Map



062I06	062I07	062I08
062I03	062I02	062I01
062H14	062H15	062H16

Kilometers 0 1 2 4 6 8 10 Kilomètres

Miles 0 1 2 4 6 Milles

Map not to be used for navigation/
Ne pas utiliser pour la navigation

Habitat Type/ Type d'habitat	Color/ Couleur
A	
B	
C	
D	
E	
Unclassified/ Non classifié	

Fish Habitat Classification for Manitoba Agricultural Watersheds/ Classification de l'habitat du poisson par rapport aux bassins hydrographiques agricoles au Manitoba

Version 1.0
Valid until March 31, 2008
Valide jusqu'au 31 mars 2008

Canada