
Appendix D

Technical Memorandum #4 – Development and Evaluation of Alternative Design Concepts – Facility Sizing



New Dundee Water Supply System – Iron and Manganese Upgrades Class Environmental Assessment

Technical Memorandum #4

Development and Evaluation of
Alternative Design Concepts –
Facility Sizing

Final

Prepared for:

Region of Waterloo

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RVA 194591

September 27, 2022



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September 27, 2022

RVA 194591

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Design and Construction Division
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Attention: Kaoru Yajima

Dear Mr. Yajima:

Re: Technical Memorandum #4 – Development and Evaluation of Alternative Design Concepts – Facility Sizing – Draft 2, New Dundee Water Supply Iron and Manganese Upgrades Class Environmental Assessment

Please see enclosed Technical Memorandum #4 as the fourth submittal for the New Dundee Water Supply Iron and Manganese Upgrades Class Environmental Assessment (EA).

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED



Jonathan Rudyk, P.Eng
Process Engineer



Kirk Worounig, P.Eng., PMP
Project Manager

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Technical Memorandum #4

Development and Evaluation of Alternative Design Concepts – Facility Sizing

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1.0 Introduction

The Region of Waterloo has embarked upon a Class Environmental Assessment (EA) for the New Dundee Water Supply System in the Community of New Dundee, in the Township of Wilmot, in accordance with the requirements of the *Municipal Class Environmental Assessment* which is an approved process under the *Ontario Environmental Assessment Act*. The New Dundee Water Supply facility is located on 156 Alderview Dr., Township of Wilmot.

The Region is completing this Class EA to address water treatment upgrades that have been identified based on anticipated changes to the Ontario Drinking Water Standards (ODWS). In June 2019, Health Canada issued the *Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Manganese*, which established an aesthetic objective of 0.02 mg/L. It can be noted that aesthetic objectives are intended to address non-health related items such as odour, taste, and colour. To be in line with Health Canada recommendations, it is anticipated the provincial objective for manganese will be reduced from 0.05 mg/L to 0.02 mg/L, with a design operating objective of 0.015 mg/L. The New Dundee Well Supply System was identified for potential treatment upgrades to consistently meet the anticipated new standard.

In September 2019, the Region retained R.V. Anderson Associates Limited (RVA) to complete the Class Environmental Assessment for the Iron and Manganese Treatment Upgrades.

This technical memorandum (TM) is the fourth of five technical memoranda to be released as part of the Class EA. The first objective of TM #4 is to determine the property size for the preferred treatment alternative as determined in **TM #3 – Development and Evaluation of Alternative Solutions**. This preferred treatment technology was chlorine oxidation and pressure filtration, with a residual management strategy of a backwash equalization tank (BET) for storage of wastewater flows, recycling the supernatant back through the filters, and hauling off any settled solids. The second objective is to identify five suitable sites in the Study Area as possible locations for the new facility, and evaluate their suitability using the criteria identified in **TM #2 – Evaluation Criteria** to reach a preferred location for the preferred treatment technology and residual management strategy.

2.0 Facility Layout

The basis of this design was on the preferred treatment alternative of chlorine oxidation using sodium hypochlorite followed by pressure filtration, and a residual management strategy of a BET for wastewater storage, with supernatant being recycled back into the raw water inlet upstream of oxidation, and settled solids being hauled off. Based on this preferred approach, the new facility requires space for:

- An inground backwash equalization tank with two cells,
- An inground backwash supply tank with two cells,
- An inground sludge holding tank with one cell,
- An electrical room,
- A filter and process room, which would include:
 - Filters and associated piping,
 - Backwash supply pumps,
 - Blowers,
 - Supernatant supply pumps,
 - Sodium hypochlorite dosing and storage system,
- Alterations to the existing water supply facility and system, which could include well pump replacement, and electrical, process piping, and architectural changes.

If the facility is not adjacent to the existing water supply facility, additional spacing would be considered outdoors for an outdoor standby emergency diesel generator, like what is installed currently at the existing facility.

The new site should have additional space for adequate property setbacks, driveways, parking, and landscaping. As discussed in **TM #1 – Existing Conditions Summary and Background Review**, the treatment design capacity for the new facility has been calculated to include population growth for the next ten years.

3.0 Preliminary Equipment and Tankage Size Assumptions

3.1 Design Flows

Based on the proposed treatment design capacity of 8.0 L/s was considered for the facility sizing.

3.2 Tankage Depth and Thickness

For the purposes of property size tankage depth was based on the depth of the existing tanks at the New Dundee facility. This depth may be varied as a detailed geotechnical and hydrogeological investigation is completed in this area. The existing tanks have been shown to be 3 m below grade. Taking this value, and assuming 0.3 m of freeboard, the footprint for the new tanks assumes a wetted depth of 2.7 m. Each new tank was also estimated to have walls that are 0.5 m thick.

3.3 Backwash Equalization Tank (BET)

The BET has been sized such that the tank, which contains two cells, has capacity for one backwash and filter to waste cycle for both filters. A factor of 15% has been added to this capacity as well, to keep with the conservative estimates. The capacity of the BET was therefore 54.7 m³, with dimensions of 8 m long by 5 m wide by 3 m deep. Supporting calculations may be found in Appendix A.

The tank has been split into two cells for increased operational flexibility, such that one cell could be used for one filter, and is accessible through hatches in the roof above the tank.

3.4 Backwash Supply Tank

The backwash supply tank has been sized to provide capacity for one backwash cycle for both filters before requiring refilling. A factor of 15% has been applied to this capacity as a conservative measure at this stage of the design. The capacity of the backwash supply tank was therefore calculated to be 50.8 m³, with dimensions of 8 m long by 5 m wide by 3 m deep. Supporting calculations may be found in Appendix A.

As with the BET, the tank has been split into two cells for increased operational flexibility, and each cell may be accessed via a roof hatch for inspection. Each

backwash supply cell would include one vertical turbine backwash supply pump also for increased operational flexibility. This provision has been included for conservative sizing purposes to cover all locations, and may not be required if the facility location is adjacent to the existing facility.

3.5 Sludge Holding Tank

The sludge holding tank has been sized to hold at least three months of sludge produced from the facility based on the sludge at the bottom of the BET achieving a concentration of 0.1%. A factor of 15% has been applied to this value as well to be conservative at this time in the design stage. Therefore, the tanks capacity has been sized at 8.5 m³, with dimensions of 2.8 m long by 2.8 m wide by 3 m deep.

3.6 Electrical Room

The electrical room for the new facility uses the same footprint as the existing facility's electrical room. The new electrical room would contain a motor control centre, variable frequency drives, control panels, programmable logic controllers, and lighting and distribution panels. The exact scope of equipment to be housed in this room would be determined in detailed design and based on the Region's preferences for motor starters. The footprint of the new electrical room would be 5 m by 4 m.

3.7 Filter Location

3.7.1 Filters and associated piping

The filters housed in the room would be two 1.68 m Ø vertical pressure filters, spaced 1.2 m apart from one another, with 2 m of free space around the outside of each filter, and 3 m of spacing for the face piping off the filters.

3.7.2 Process Equipment

The process equipment that would be in this room includes two vertical turbine backwash supply pumps, two blowers, and the supernatant recycle pump system. For each piece of equipment minimum clearances of 1.2 m have been provided. The backwash supply pumps would be situated above the backwash supply tanks, with one pump drawing water from each cell.

3.7.3 Sodium Hypochlorite Dosing and Storage System

The new sodium hypochlorite dosing and storage system has been sized at approximately the same size as the existing facility's chemical storage and dosing system with space provided in future for an additional storage tank. and spill containment being provided for the storage tank and the pumps. This has been provided at the new facility to suit the new flow routing of the raw water into the filters The existing chemical storage contains one 200 L storage tank, and two chemical dosing pumps feeding sodium hypochlorite into the raw water header. With an average dosing of 2 mg/L, and assuming PTTW flows of 8.0 L/s, the new facility would consume a maximum 11.4 L of sodium hypochlorite solution per day, giving the single storage tank capacity for 17 days. While the MECP states that storage on site should be provided for at least thirty days or 346 L for this facility, at this time the existing facility uses a fraction of that volume, about 57 L per month, from operator records. Therefore, space is given in the new facility for an additional 200 L tank to be added in the future if required for the system. The existing system is 2.5 m by 1.4 m including an eyewash station, and to add value to the new system, it is proposed to have a new room to house the chemical dosing equipment, approximately 4 m by 3 m, with proper ventilation.

3.7.4 Existing System Alterations

Alterations to the existing system (existing pumphouse, process piping, wells, standby outdoor generator, electrical system) are varied and are largely dependent on the location of the future facility. Common among all the options are changes to the raw water yard piping and process piping, such that the well flows are directed to the new new treatment building and through the filters prior to flowing into the existing clearwells to achieve the necessary chlorine contact time. Some of the alternative locations being evaluated may require other alterations such as:

- Standby Generator re-sizing, or new standby generators for Layout No. 4 and 5
- Well Pump re-sizing for each layout
- Existing facility expansion through hallways to new facility, for Layout No. 2.

Specific impacts to the existing site will be further evaluated and quantified as part of TM #5 – Development and Evaluation of Alternative Design Concepts – Facility Sizing, as part of the evaluation process.

3.7.5 Key Site Plan Requirements and Considerations

Additional space requirements include space for building setbacks, parking, and driveways access for deliveries.

The New Dundee water supply facility is in an area zoned as Residential Zone 2. The alternate facility locations are in areas that are either zoned as Zone 1 Agricultural or Zone 2 Residential. The setbacks are given below:

Zone 1 Agricultural

- Front yard setback: 10 m
- Minimum side yard setback: 2 m
- Minimum rear yard setback: 7.5 m

Zone 2 Residential

- Front yard setback: 7.6 m
- Side yard setback: 2 m
- Rear yard setback: 7.5 m

It should also be noted that for the purposes of the facility property sizes shown in Appendix B, no allowance has been given for a septic system. Layouts 1 – 3 are located within 100 m of the existing wells and are rated as WSPA – 1, which does not permit the construction of new individual wastewater treatment systems, per the Region of Waterloo Official Plan, Chapter 8. It is proposed to handle Layouts 4 – 5 in the same fashion as well. Therefore, each facility will need to be designed to have no sanitary wastewater.

3.8 Preliminary Site Layout

The access driveway and parking are unique to every facility location as shown in the facility location sketches in Appendix B, however the facility sizing remains the

same in every case. The treatment building has been sized at 19 m by 14 m, with a 4 m by 4 m sludge holding tank located belowground adjacent to the building.

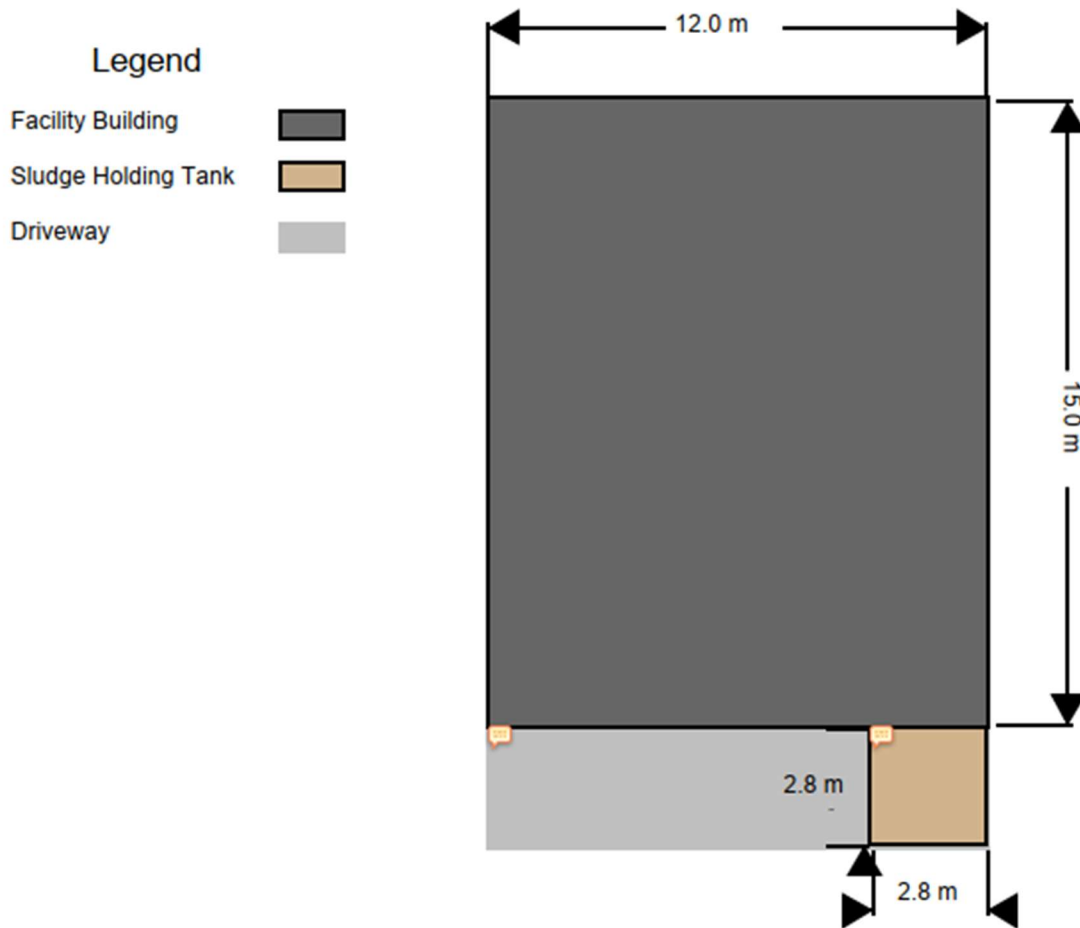


Figure 3.1: Facility Footprint

It should be noted that depending on the location, the driveway orientation and sludge tank location may be different. For access purposes, the sludge holding tank needs to be located on what would be considered the front of the building to allow for easier truck access. Shown in the Figure above, the “front” of the building in this case is the 14 m side, however the layout is flexible to have the 19 m long side as the front of the building, with the sludge holding tank relocated accordingly.

4.0 Discussion and Selection of Facility Location Alternatives

4.1 Facility Location Alternatives

Five preliminary location alternatives for the New Dundee iron and manganese removal facility have been identified and outlined in Appendix B. Potential sites were identified based on considerations for:

- Available land size
- Proximity to the existing water supply facility
- Environmental, cultural heritage, and areas of archaeological potential, based on an Existing Conditions Report and Stage 1 Archaeological Assessment completed in **TM #1 – Existing Conditions Summary and Background Review**, and from Grand River Conservation Authority mapping.
- Existing and potential land uses.

A summary map is shown in Figure 4.1, with the individual site plans on Appendix B. The summary map is also included in Appendix B. Also shown on this drawing is an approximate location of the floodplain elevation, as provided by the GRCA during the virtual PCC #2 review period, in June 2021. The floodplain is approximated to be 319.9 m ASL.

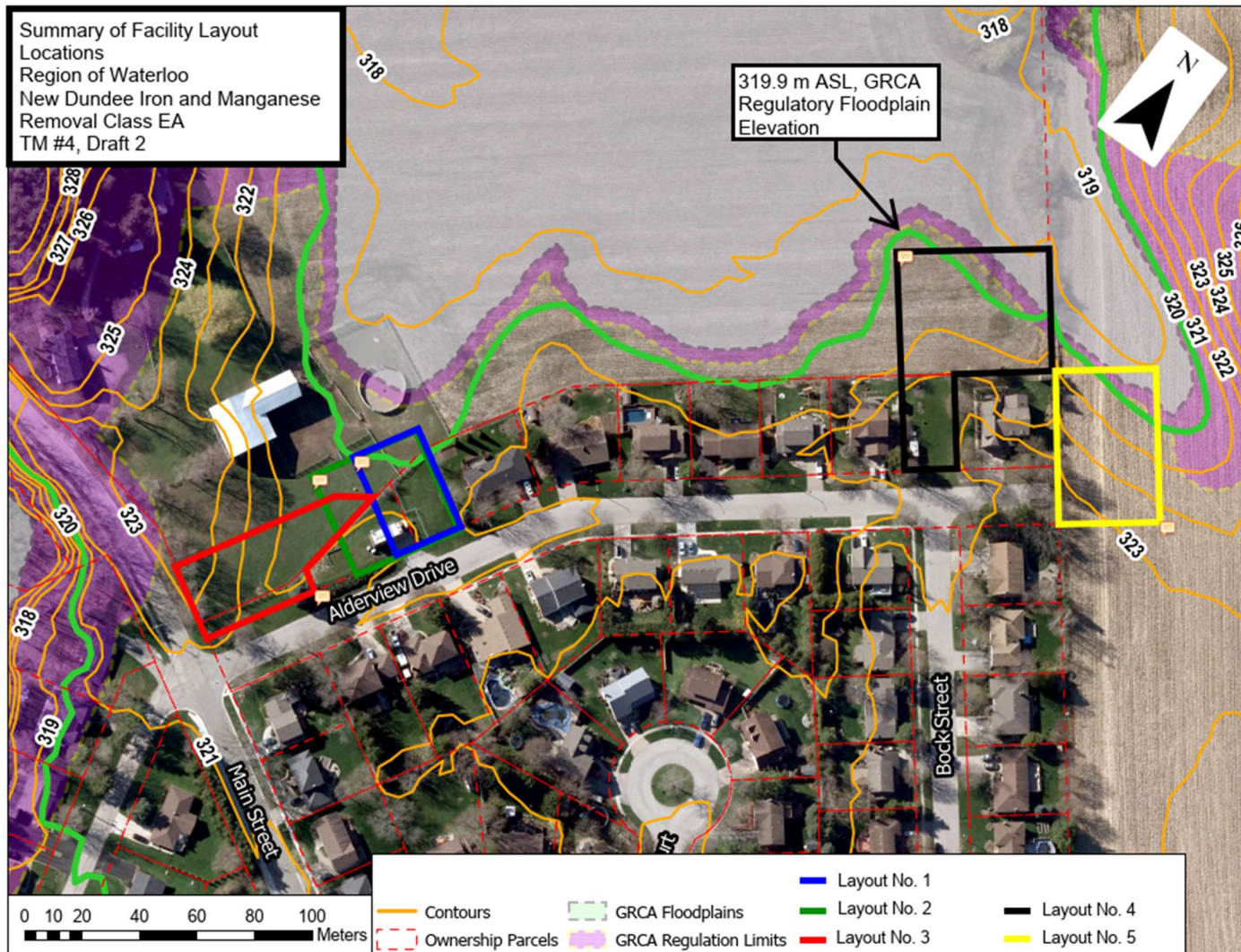


Figure 4.1: Facility Location Summary

Based on a preliminary review, advantages and disadvantages are listed in Table 4.1.

Table 4.1 – Facility Locations Preliminary Evaluation

Location Alternatives	Advantages	Disadvantages
1	<ul style="list-style-type: none"> • Adjacent property to existing facility • Majority of land acquisition is from the Township • Adjacent to Alderview Dr. for vehicle access, relatively short driveway required. • Possibility for interconnection with existing facility 	<ul style="list-style-type: none"> • Requires land acquisition from the Township and a local residential owner.
2	<ul style="list-style-type: none"> • Adjacent to existing facility • Possibility for interconnection with existing facility • New facility is the closest to the existing facility, easiest to interconnect • Building would not be located in the GRCA Regulated Area. 	<ul style="list-style-type: none"> • Requires land acquisition from the Township and a local residential owner.
3	<ul style="list-style-type: none"> • Closer to the facility than Locations 4 and 5. • Adjacent to Alderview Dr. for vehicle access, relatively short driveway required. • Building would not be located in the GRCA Regulated Area. 	<ul style="list-style-type: none"> • Largest land acquisition for the locations adjacent to the existing facility • Largest yard piping and power duct requirements for locations adjacent to the existing facility.
4		<ul style="list-style-type: none"> • Requires land acquisition from the

Location Alternatives	Advantages	Disadvantages
5	Adjacent to Alderview Dr. for vehicle access, relatively short driveway required.	Township and a local residential owner.
		<ul style="list-style-type: none"> • Site is not adjacent to existing facility • Remote site requires additional equipment and utility requirements.
		<ul style="list-style-type: none"> • Site is not adjacent to existing facility • Remote site requires additional equipment and utility requirements.

5.0 Next Steps

The next steps in the Class EA process is an evaluation of the proposed facility locations, to be completed in TM #5. To complete the facility location evaluation, an environmental field investigation of the preferred facility locations is also required, and these field investigations were completed in June and July of 2021.

The findings of TM #5 are to be presented in PCC #3. After TM #5 and PCC #3, the Environmental Study Report is to be completed to document the project information and the decision-making process. The Region of Waterloo would then provide the approval to file the Environmental Study Report to the Ministry of the Environment, Conservation and Parks for a 30-day public review period.

6.0 References

Health Canada, *Guidelines for Canadian Drinking Water Quality: Guideline Technical Document- Manganese*, Health Canada, Ottawa, ON, 2019.

MECP, *Design Guidelines for Drinking-Water Systems*, Ministry of the Environment, accessed January 2021, <https://www.ontario.ca/document/design-guidelines-drinking-water-systems-0>

Regional Municipality of Waterloo, *Regional Official Plan*, Regional Municipality of Waterloo, Kitchener, ON, 2015.

Township of Wilmot, *Township of Wilmot Official Plan*, Township of Wilmot, Development Services Department, Baden, ON, 2019.

Township of Wilmot, *Township of Wilmot Zoning By-law 83-38, as amended by By-law 2020-026*, Township of Wilmot, Development Services Department, Baden, ON, 2020.

Appendix A – Facility Sizing Calculations

Facility Sizing Requirements
194591 - New Dundee Iron and Manganese Removal Class EA
TM #4 - Appendix A, Facility Sizing Calculations
Date: August 20, 2021

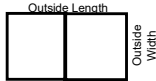
Blue numbers indicate inputted values, black values indicate calculated values.

Key Design Parameters		Comments
Tank Depth	3 m	Tank depth assumed to be equal to depth of existing tanks on site.
Tank Freeboard	0.3 m	
Wall Thickness	0.5 m	

BET Capacity

No. of BET Tanks	1	
No. of Cells/Tank	2	
Filter Backwash Volume	47.56 m ³	From TM #3, Appendix B
Safety Factor (SF)	15%	
Filter Backwash Volume w/ SF Applied	54.69 m ³	
BET Capacity/Cell	27.35 m ³	
Capacity of all Cells	54.69 m ³	
Depth	3.00 m	From existing clearwell tanks on site, 3 m deep
Freeboard	0.30 m	
Wetted Depth	2.70 m	
Width/Cell	3.18 m	Assuming the tank is a 2:1 Length to width ratio
Length/Cell	3.18 m	
Surface Area/Cell	10.13 m ²	

Configuration of BET Cells



Wall thickness	0.50 m	
Outside Width	5.00 m	Rounded up to the nearest meter
Outside Length	8.00 m	Rounded up to the nearest meter

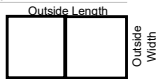
Sludge Holding Tank

Sludge Mass (Dry)	29.52 kg/year	From TM #3, Appendix B.
Sludge Concentration	0.1%	
Sludge Volume	29.52 m ³ /year	
Sludge Volume for Storage	7.38 m ³ in three months	
Safety Factor	15%	
Sludge Volume for Storage w/ SF Applied	8.49 m ³ /three months	
Tank Depth	3.00 m	
Freeboard	0.30 m	
Wetted Depth	2.70 m	
Tank Length and Width	1.77 m	Assuming the tank is 1:1 Length to width ratio
Outside Width	2.80 m	Rounded up to the nearest decimeter
Outside Length	2.80 m	Rounded up to the nearest decimeter

Backwash Supply Tank

No. of Backwash Tanks	1	
Backwash Cells/Tank	2	
Backwash Volume/filter	22.10 m ³	From TM #3, Appendix B
Backwash Volume for all Filters	44.20 m ³	
Safety Factor	15%	
Backwash Volume w/ Safety Factor Applied	50.83 m ³	
Backwash Capacity/Cell	25.42 m ³	
Backwash Capacity of all Cells	50.83 m ³	
Tank Depth	3.00 m	
Tank Freeboard	0.30 m	
Wetted Depth	2.70 m	
Width	3.18 m	Same width as BET cells, for ease of re-configuration
Length	2.96 m	

Configuration of Backwash Supply Tank Cells



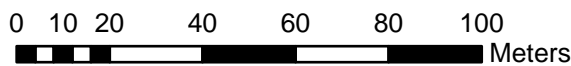
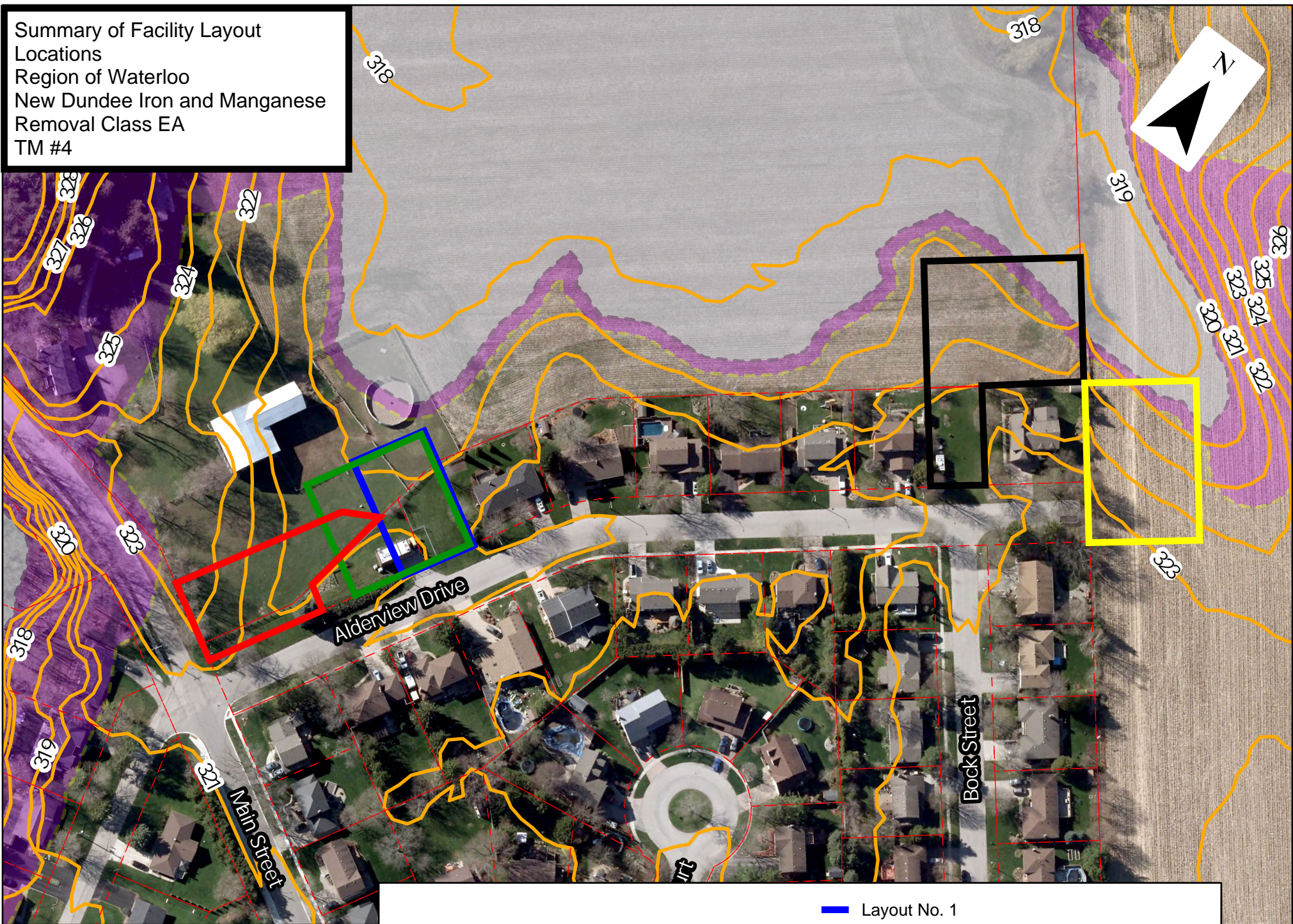
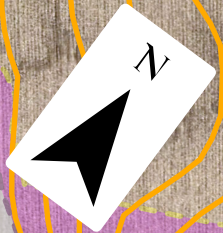
Wall Thickness	0.50 m	
Outside Width	5.00 m	Rounded up to the nearest meter
Outside Length	8.00 m	Rounded up to the nearest meter

Chemical Storage Area

Existing System Length	2.50 m	
Existing System Width	1.40 m	
PTTW Flow	8.00 L/s	
Dosing Concentration	2.00 mg/L	
Concentrated Sodium Hypochlorite concentration	12% by weight	
Hypo used per day at Design Flows	1.38 kg pure hypo	
Hypo volume used at Design Flows	11.52 L	
Thirty Day Capacity Requirement	345.60 L	Per MECP Design Guidelines Drinking Water Systems Section 6.2.1.
Existing Tank	200.00 L capacity	
If the volume of the chlorine tank remains constant, then it has a capacity for	17.00 days	
Future Tank Size (calculated)	200.00 L	Rounded up to the nearest hundred.
Future Tank Diameter	0.60 m	Dimensions for a 70 gallon liquid storage tank.
Future Tank Height	1.27 m	Dimensions for a 70 gallon liquid storage tank.
Additional Spacing Required	1.00 m	For room dimensions
Chemical Room Length	4.00 m	Existing measurements plus spacing for future tankage and allowances for doorways, includes wash station and rounded up
Chemical Room Width	3.00 m	Rounded up to nearest meter from existing measurements and room wall thicknesses, and includes wash station.

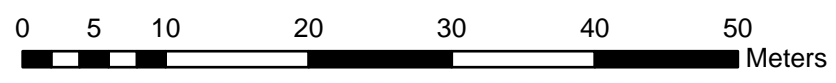
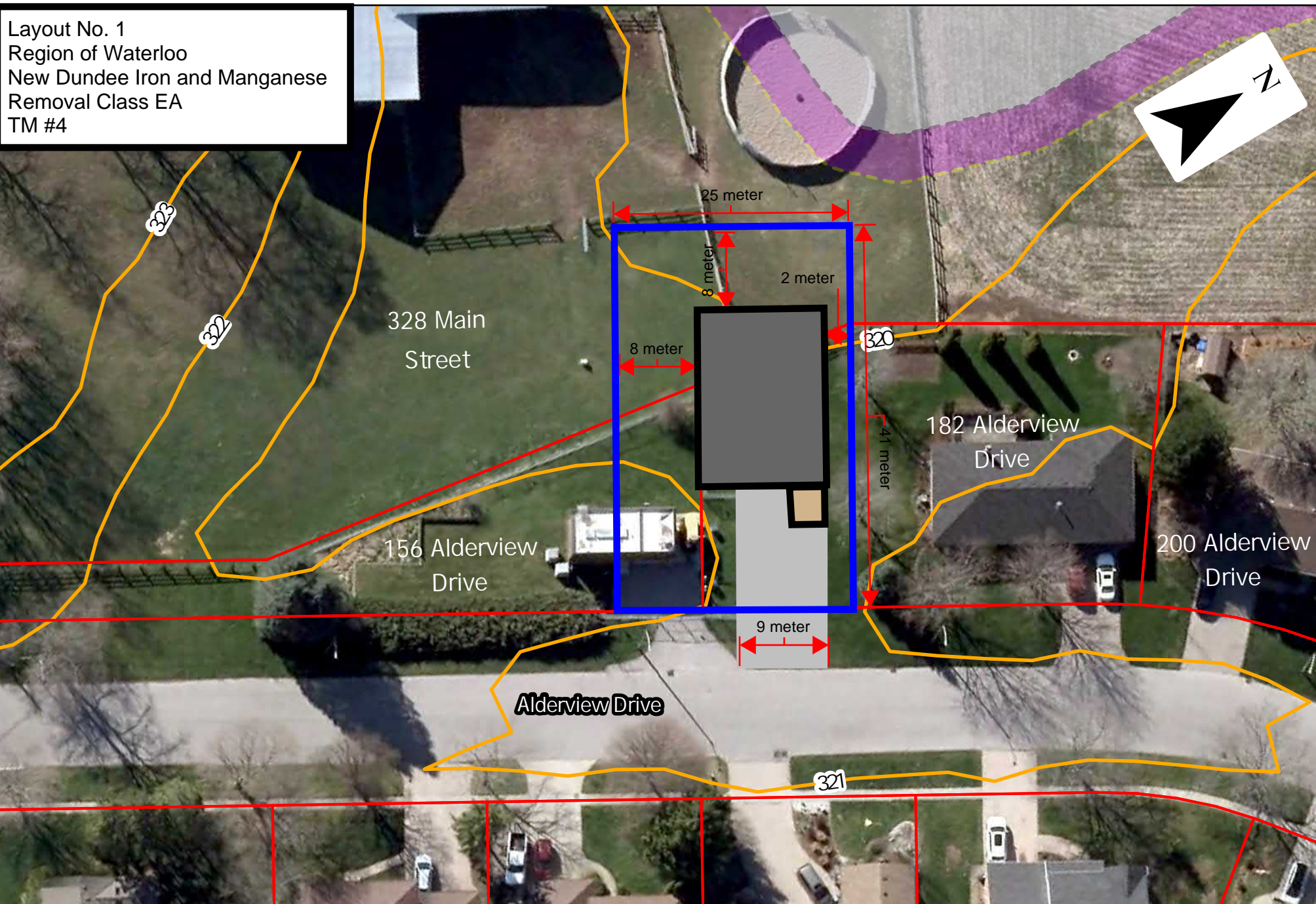
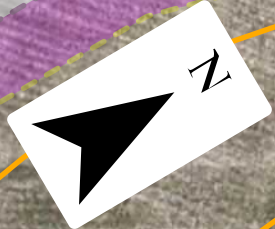
Appendix B – Facility Location Alternatives

Summary of Facility Layout Locations
 Region of Waterloo
 New Dundee Iron and Manganese Removal Class EA
 TM #4



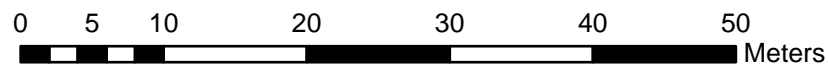
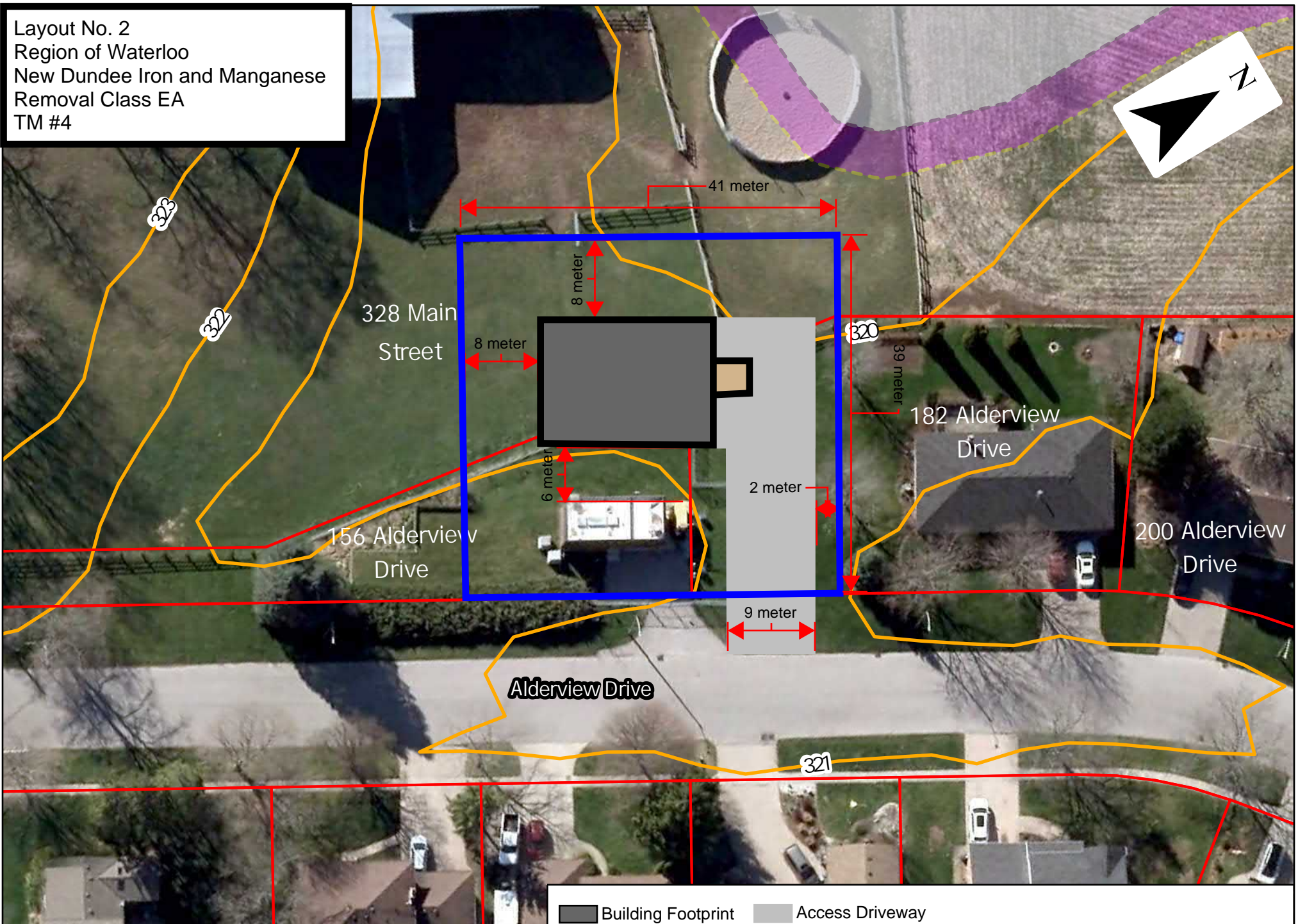
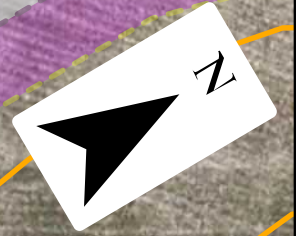
- | | | |
|-------------------|------------------------|--------------|
| Contours | GRCA Floodplains | Layout No. 1 |
| Ownership Parcels | GRCA Regulation Limits | Layout No. 2 |
| | | Layout No. 3 |
| | | Layout No. 4 |
| | | Layout No. 5 |

Layout No. 1
 Region of Waterloo
 New Dundee Iron and Manganese
 Removal Class EA
 TM #4



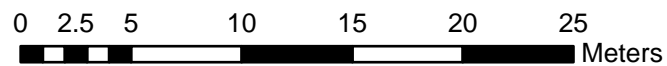
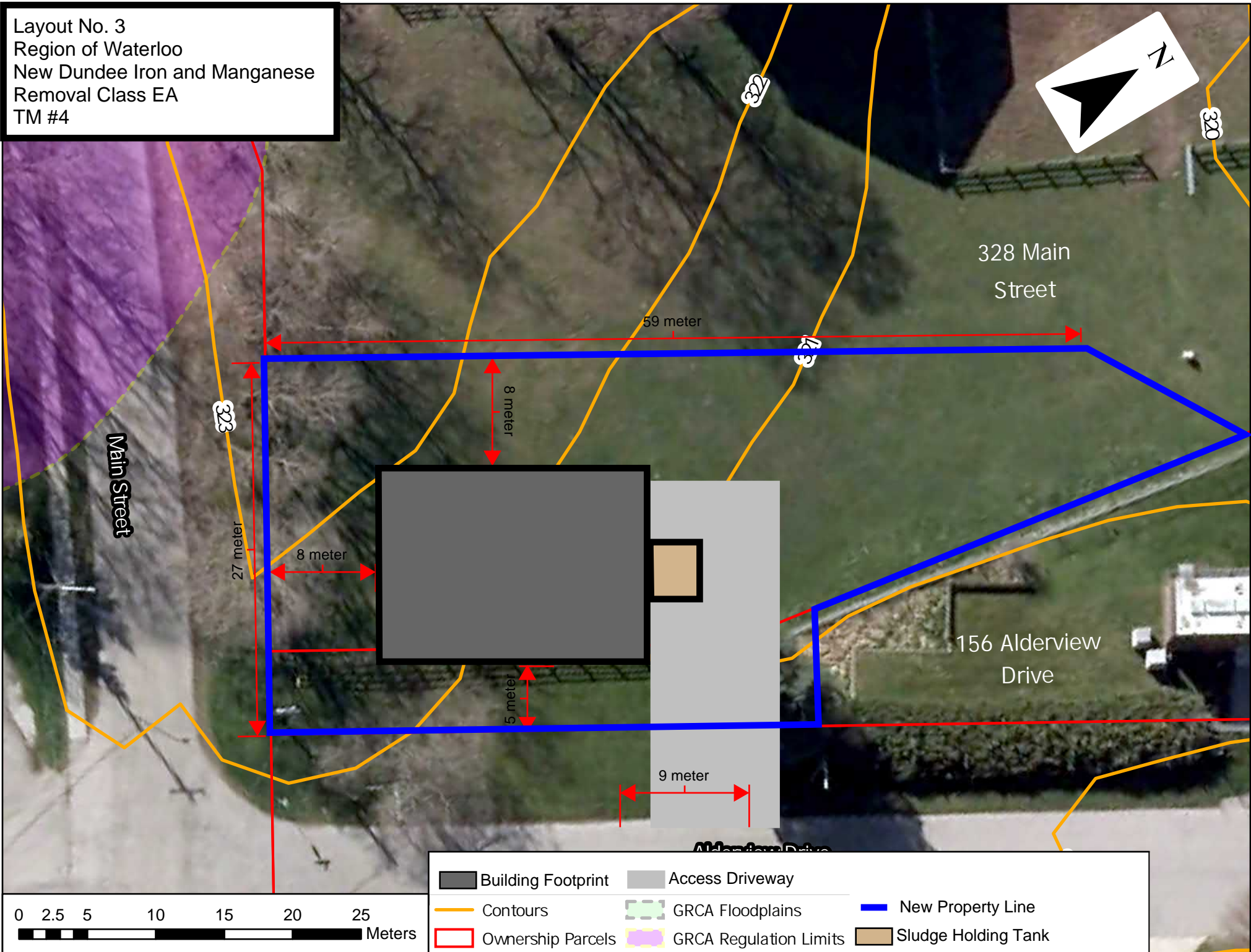
Building Footprint	Access Driveway	New Property Line
Contours	GRCA Floodplains	GRCA Regulation Limits
Ownership Parcels	Sludge Holding Tank	

Layout No. 2
 Region of Waterloo
 New Dundee Iron and Manganese
 Removal Class EA
 TM #4



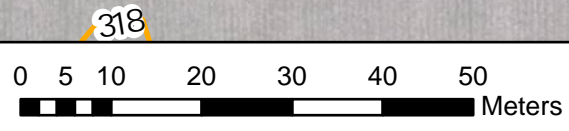
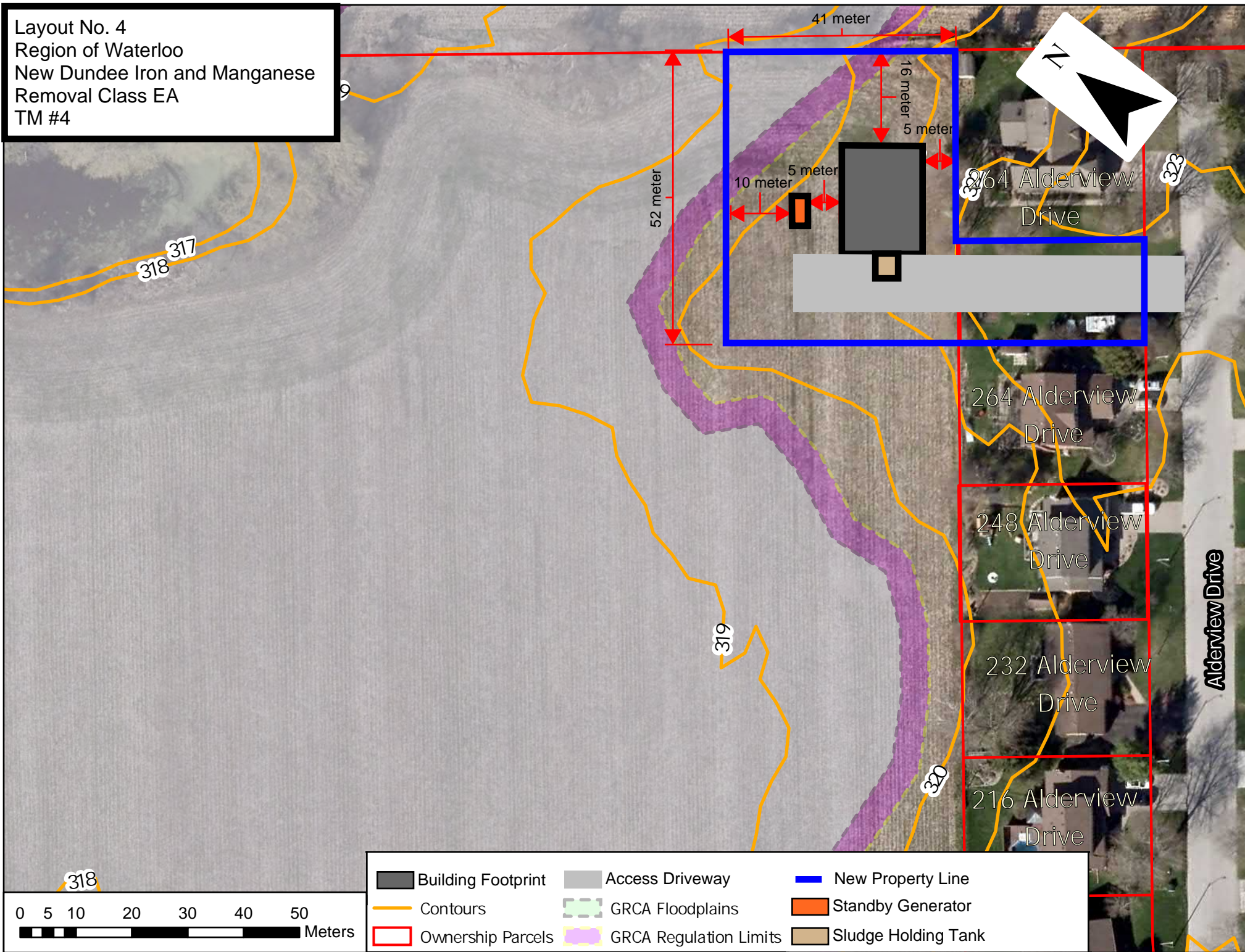
- Building Footprint
- Access Driveway
- Contours
- GRCA Floodplains
- Ownership Parcels
- GRCA Regulation Limits
- New Property Line
- Sludge Holding Tank

Layout No. 3
 Region of Waterloo
 New Dundee Iron and Manganese
 Removal Class EA
 TM #4



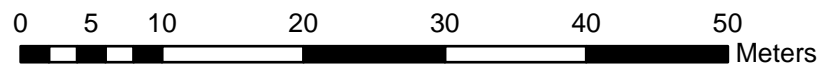
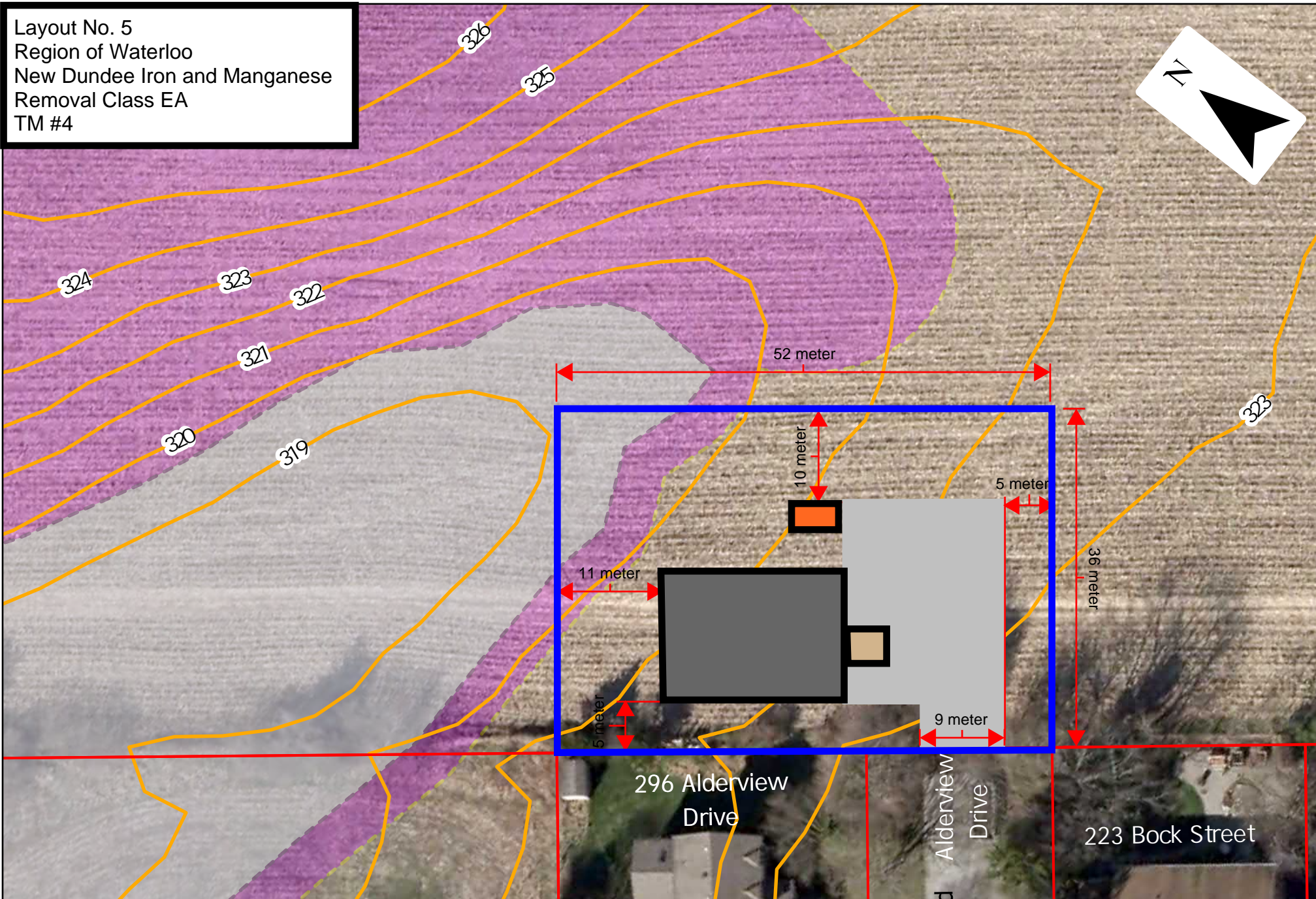
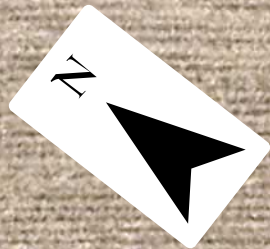
Building Footprint	Access Driveway	New Property Line
Contours	GRCA Floodplains	Sludge Holding Tank
Ownership Parcels	GRCA Regulation Limits	

Layout No. 4
 Region of Waterloo
 New Dundee Iron and Manganese
 Removal Class EA
 TM #4



Building Footprint	Access Driveway	New Property Line
Contours	GRCA Floodplains	Standby Generator
Ownership Parcels	GRCA Regulation Limits	Sludge Holding Tank

Layout No. 5
 Region of Waterloo
 New Dundee Iron and Manganese
 Removal Class EA
 TM #4



- | | | |
|--------------------|------------------------|---------------------|
| Building Footprint | Access Driveway | New Property Line |
| Contours | GRCA Floodplains | Standby Generator |
| Ownership Parcels | GRCA Regulation Limits | Sludge Holding Tank |