APPENDIX E

STORM WATER DESIGN BRIEF

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Design Brief

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To:	**Town of Millet / Select Engineering**	Date:	**March 9, 2020**
Attention:	**Jarrad Elliot, P.Eng, Lisa Novotony, AMAA**	Project No.:	**27542**
Reference:	**Millet Industrial – Stormwater Management Plan**		
From:	**Curtis Hobbs, P.Eng Garnet Dawes, P.Eng**		

1.0 Project Background / Site Information

Millet industrial Development LP is preparing to create a new industrial area within the Town boundaries of Millet, Alberta. Ultimate project boundaries include to quarter sections (S ½ of 33-47-24-4) located east of 48 Street, and north of 45 Avenue comprising approximately 128 hectares (316 acres). The immediate development with land use consists of the westerly quarter section. The first phase of the project consists of approximately 33 hectares within the west quarter section. It is important to highlight that an existing stormwater management facility exists on site, constructed by the previous owners, this existing facility forms the focal point of stormwater management of the initial phases of development. For ease of description, this report refers to the two quarter sections simply as the West Quarter and East Quarter. Phase 1 is within the West Quarter and contains the West Pond.

Onsite construction drawings have been previously sent to the Town for review and approval. The design memo is intended to address a number of relevant questions around the storm drainage of the proposed development from the overall storm system concepts, to a more detailed examination of the current construction drawings, storm pond, and offsite storm outfall. The storm system design will follow Government of Alberta, Town of Millet, and Wetaskiwin County requirements.

A previous Stormwater Management Study was previously completed in September 2006 by A.D. Williams Engineering Inc. This report has been reviewed in the preparation of this design memo. We do note that the current construction drawings have a stormwater design that is based on more current and relevant standards and is described in this memo.

This memo is intended to provide the technical justification for the current capacity of the existing stormwater management facility onsite, and outline the triggers for expansion of this facility as phases of the Millet Industrial Park are constructed.

Site Drainage

Generally, the entire site drainage falls in a southwesterly direction towards the Town of Millet and 48 Street and 45 Avenue. The topography is gently sloping, averaging less than 2%, and generally not exceeding 3.0%. The majority of drainage enters the north ditch along 45 Avenue, which then conveys west towards the Town. From there, drainage follows the existing Town's system of overland drainage.

The West Quarter has been rough graded, but the work is not yet complete. A low area has been excavated in the southwest central area as a storm pond. The pond excavation is not complete, but the full design is included with the current construction drawings.

2.0 Proposed Drainage Systems

The following is a general description of the storm drainage systems and materials to be used on the project site.

2.1 Grading Philosophy

The grading and drainage philosophy of the development is to provide storm drainage by gravity overland means. Roadway ditches are designed to accommodate runoff and direct it to a centrally located storm ponds. A storm pond then will feature a control manhole and underground storm sewer extended offsite, to the surface, and the nearest receiving stream (Pipestone Creek). Industrial development prefers large flat areas, and the proposed grades throughout will not exceed 2%.

Grading of individual parcels will be the responsibility of each site developer based on the needs of the site and location of buildings. This report will recommend surface features, ponding areas, and simple flow controls for each of the sites to ensure that ditch drainage within the public roads does not exceed Alberta Environment's overland flow requirements.

2.2 Downstream Conveyance Systems

The stormwater assessment for these two quarter sections must also consider the routes that are available to convey stormwater. Downstream route options to convey stormwater from the developed lands are limited. Naturally occurring draws or intermittent streams within private lands that are not Provincially recognized or are not within existing easements/right of ways, are not available routes for post development flows. For that reason, the only available routing along existing road rights of way, or public (Town) lands. In this case, an available route is along 45 Avenue to 48 Street, and south down 48 Street to Pipestone Creek. Due to grading constraints, portions of the downstream system must be by underground sewer conveyance.

2.3 Pond Sizing Philosophy

Pond sizing requires the consideration of a number of factors, such as available space, downstream conditions, groundwater, and the type of development. A common philosophy is to size the stormwater pond to attenuate flows to pre-development conditions, or based on the naturally occurring overland flows. This memo will evaluate the pre-development flow condition and make adjustments as necessary based on the downstream system capacity.

3.0 Analysis and Methodology

The computer analysis was performed to understand a number of effects of this proposed development on the lands. This model included an assessment of the 1:100 year pre-development flows from both the east and west quarter sections, an assessment of the west quarter's storm pond and overland drainage characteristics, and an assessment of the ponding requirements for Phase 1. A single event model was undertaken to evaluate these storm characteristics.

3.1 Design Storms

The single event used to evaluate the proposed development was a 1:100 year, 24 hour, Chicago distribution storm event. Characteristics are based on the County of Wetaskiwin published data from their Design Guidelines and Construction Standards for Subdivision Developments calculated from the Rainfall Intensities noted in Table 7.1, page 60 / 61. The IDF curve parameters used to approximate these intensities are a=580.0, b=0.1, c=0.680. The storm event is a statistical approximation of key characteristics of a 1:100 year event namely maximum rainfall intensity (120 mm/hr) and total runoff volume (99.1 mm in 24 hours).

3.2 Computer Models

To aid with the analysis, the SWMHYMO computer model to assess pre and post development overland drainage throughout the site. The model has been developed and distributed by J.F. Sabourin and Associates Inc. This model uses a system approach and allows for quick parameter changes and run times, allowing us to analyze a wide variety of possible drainage scenarios. If good parameters are input into the model, the model is excellent at routing and estimating overland flows and ponding areas. The parameters for the existing site condition were assessed using the CALIB NASHYD command and the catchments physical characteristics. For those catchments that are affected by the development, the DESIGN STANDHYD command was used.

3.3 Catchment Areas

The drainage catchment areas were simply taken from the catchment boundaries from the Phase construction drawings, and include the entire easterly quarter section boundary. Surface runoff is computed using the appropriate hydrologic commands. For pre-development flows, the time of concentration was evaluated in terms of a drop of water flowing from the far northeast corner of the east quarter section to the corner of 45 Avenue and 48 Street. At 1800m in length, the time of concentration is long.

A geotechnical analysis has been completed for the development. The analysis noted a number of different type of soils through the site from clay to sand to weathered siltstone. All classified soils contain a mixture of soil types with the soils being generally described as clay or silty till. Table 3.1 provides a listing of the runoff input characteristics for the site soils.

Table 3.1 Runoff Input Parameters

Runoff Calculation Parameter		Pre-development Values	Developed Values
Depression Storage	Impervious Area	2.5 mm	0.8 mm
	Pervious Area	7.5 mm	1.2 mm
Manning ‘n’	Impervious Area	0.025	0.015
	Pervious Area	0.25	0.025
Soil Characteristic		Clay or Silty Till	Clay or Silty Till
Rainfall loss	SCS Curve Number (CN)	67	72

3.4 Stormwater Ponding

The storm ponds were evaluated using SWMHYMO’s ROUTE RESERVIOR command. Runoff of the various areas of interest were assessed through a trial and error approach to achieve the most efficient ponding systems. As noted above, ponding requirements were assed for post development conditions of the east and west quarter sections (ultimate Pond 1), and for the capacity required for the Phase 1 development lands. From this analysis, a common unit area release rate was derived from the pond for all the areas.

4.0 Results

4.1 Pre-Development Runoff Assessment

Given that the pre-developed sites are relatively flat, and impervious ratios are low or non-existent, overland drainage generated in the 1:100 year event is typical for a rural setting. The results do not necessarily capture all the hydrologic features within the two quarter sections. Features such as low spots or infiltration areas are not captured. The maximum flow generated in the 1:100 year event was assessed at **1.21 m^3/s** for the 128 hectare areas. This equates to a unit area release rate of roughly 9.5 l/s/ha which is in the range of reasonable estimates for two flat quarter sections. More accurate analysis would require detailed topography and hydrology. Release rates for large watersheds have generally been estimated at between 0.8 to 2.5 l/s/ha. We note that no singular point within the quarter sections achieve these flows. A maximum flow rate would likely occur in the north ditch of 45 Avenue near 48 Street.

1.2 m^3/s of overland flow is significant, and when concentrated in a ditch is likely to exceed Alberta Environment's Depth vs Velocity Criteria. Also, if applied to a post-development condition, large conveyance pipes are required, and downstream overland flows will be characterized with drastically increased erosion potential. For these reasons, a lower unit area release rate is proposed that would be appropriate for pipe sizing, downstream ditches, and the overall watershed. For this development, a unit area release rate of 2.5 l/s/ha may be considered appropriate, and would produce up to 290 l/s in a 1:100 year event from both quarter sections. An initial assessment of grade has been made for the underground storm sewer outfall, and at 0.35%, a 600mm pipe is needed. Offsite construction drawings are currently being prepared for submission to the Town of Millet that detail the offsite storm sewer, and West Pond control orifice details.

4.2 Stormwater Retention

The storm system philosophy will require each quarter section to have a centrally located storm pond capable of containing the 1:100 year event, and releasing the storm drainage at 2.5 l/s/ha. The West Pond has been partially built, and requires completion to service the entire West Quarter. One analysis determined whether the existing pond, once connected to a downstream system (and ultimate controls), would have capacity for the Phase 1 lands outlined in the recent construction drawings. The assumption is that Phase 1 is developed, but future graded areas in the West Quarter will continue to drain towards the pond but with extensive ground cover as currently exists. The pond just exceeds the proposed high water level, but does not exceed the freeboard elevation.

Table 4.1 INTERIM West Pond Dimensions

Stage	Depth (m)	Elevation (m)	Area (m^2)	Volume (m3)	Active Storage (m3)
Pond Bottom	0	751.53	1,088	0	
Permanent Water Level	1.42	752.95	14,096	14,880	0
High Water Level	3.00	754.53	20,407	40,489	25,601
Freeboard	3.35	754.88	21,619	47,844	32,956

The second part of the analysis was to find a design basis for the ultimate west pond as shown on the Phase 1 construction drawings. From the construction drawings it appears that the pond has been sized to release up to 170 l/s from a 52.1 ha area at 65% imperviousness. The design storm event could not be confirmed, however, the pond appears to have been sized appropriately for the site. With the new assumption of a 2.5 l/s/ha release rate, the same catchment area, but 75% imperviousness, the ultimate pond extents have capacity for the 1:100 year event below the high water level.

Table 4.2 ULTIMATE West Pond Dimensions

Stage	Depth (m)	Elevation (m)	Area (m^2)	Volume (m3)	Active Storage (m3)
Pond Bottom	0	751.53	18,930	0	
Permanent Water Level	1.42	752.95	23,070	29,820	0
High Water Level	3.00	754.53	30.560	72,188	42,368
Freeboard	3.35	754.88	32,660	83,251	53,431

For the future East Pond, again, a release rate of 2.5 l/s/ha has been used over the 64 hectare area. Using the same criteria as the west quarter, we have evaluated the future drainage and ponding requirement. The following table describes the proposed pond characteristics. Pond elevations, dimensions, or an exact location have not been set and would be determined with the future detailed design. However, the East Pond will eventually need to flow into the downstream storm sewer and will need to be set at an appropriate elevation.

Table 4.3 Proposed Ponding Areas

Characteristics	Interim West Pond	Ultimate West Pond	Ultimate East Pond
Freeboard Volume (m^3)	32,284	53,431	TBD
Freeboard Elevation (m)	754.88	754.88	TBD
Freeboard Depth (m)	3.35	3.35	TBD
High Water Volume (m^3)	25,601	42,370	TBD
High Water Elevation (m)	754.53	754.53	TBD
High Water Depth (m)	3.00	3.00	TBD
1:100 Year Volume (m^3)	27,480	36,330	45,110
1:100 Year Elevation (m)	754.63	754.31	TBD
1:100 Year Depth (m)	3.10	2.78	TBD

TBD – To be determined.

4.3 Post Development Overland Flows

For the West Pond catchment area (52.1 ha.), the computer model generated 11.46 m^3/s from the developed lands in a 1:100 year event. A reminder that this flow rate will not occur at any one point, but on a unit area basis of nearly 220 l/s/ha, it does represent runoff of highly impervious areas (75%). If not controlled, even accumulations of overland flows on private parcels will exceed Alberta Environment's Depth vs Velocity criteria.

Controls must be placed on each individual parcel to ensure that overland drainage both in the public roadway ditches and private parcels is not excessive. Our recommendation is that each parcel have discharges restricted to an equivalent 1:5 year event or approximately 70 l/s/ha. In an overland drainage environment, this can be achieved by a ditches and culverts or onsite dry ponds with control culverts through into the road ditch. Onsite ponding requirements will be dependent on the actual development proposed.

Overland drainage controls for the future East Quarter must follow the same drainage control system as is proposed with the West Quarter.

5.0 Interim Conveyance

With the existing stormwater management facility providing excess storage capacity for the interim Phase 1 stage of the Millet Industrial Park, overland drainage from this site to the existing facility is proposed. Pipe conveyance would be constructed at the time of roadway construction for Phase 2 of the industrial park build out.

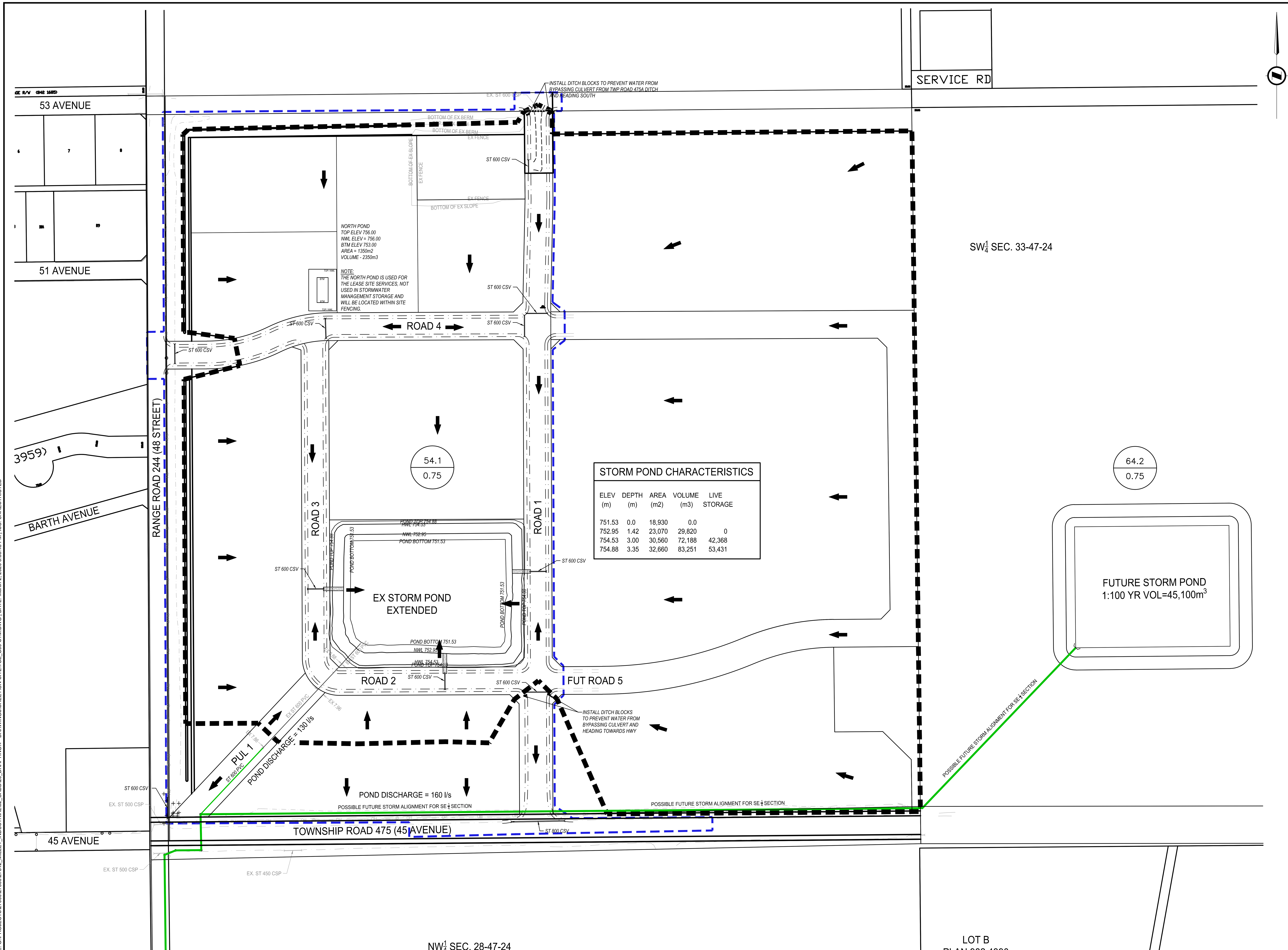
6.0 SUMMARY

This memo provides a design basis for the storm systems for the Millet Industrial Phase 1 construction drawings, the ultimate sizing of the West Pond, and storm discharges offsite to Pipestone Creek. The report also provides a design basis for the future East Quarter storm system. The ultimate West Pond has been sized using contemporary means, and is of an appropriate size to serve the West Quarter. Offsite storm discharges will use existing public rights of way as conveyance, either by pipe or overland ditch. The release rates are chosen based on cost effectiveness, watershed considerations, and as a low energy stream for overland drainage.

The current West Pond will have capacity for the Phase 1 development area without spill or ponding into any of the adjacent road right-of-ways. Subject to a downstream connection, the West Pond may continue to function

END OF DESIGN BRIEF

Enclosures



STORM POND CHARACTERISTICS

ELEV (m)	DEPTH (m)	AREA (m2)	VOLUME (m3)	LIVE STORAGE
751.53	0.0	18,930	0.0	
752.95	1.42	23,070	29,820	0
754.53	3.00	30,560	72,188	42,368
754.88	3.35	32,660	83,251	53,431

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NOTE: THIS DRAWING IS HALF SCALE WHEN PRINTED TO 11" x 17" FORMAT

NAD 83
COORDINATES

NO.	DESCRIPTION	DATE (YYYY-MM-DD)	BY	APPD
1	FINAL CONSTRUCTION DRAWINGS	2020-02-28	CDH	GD

PERMIT

SEAL

	BY	DATE (YYYY-MM-DD)
DESIGNED	CDH	2020-02-28
DRAWN	###	##########
CHECKED	###	##########

SCALE 1:2000 (0 40 80 m)

PROJECT

MILLET INDUSTRIAL PARK

SEC:33 - TWP:47 - RGE: 24 - W 4th M

SHEET TITLE

OVERALL STORM DRAINAGE PLAN & POND DETAILS

FILE NO.	ENG DWG NO.
TCE_C09-stm.dwg	1
SHEET ID.	**SHEET COUNT**
SD1.0	**01**

SHEET SIZE ANSI D