MHF Design Consultants, Inc.

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February 14, 2014

Middleborough Board of Selectman
Town Hall Building
10 Nickerson Avenue
Middleborough, MA 02346
Attn: Mr. Charles J. Cristello, Town Manager

Re: WRPD Application
90 East Grove Street
Cumberland Farms

Sub: Atlantic Design Response
Comments #2

Dear Mr. Cristello:

Please find enclosed a revised set of plans and supporting documentation regarding the above referenced project. The plans have been revised to address the review comments in a letter from Atlantic Design Engineers dated February 5, 2014 and the comments received at the January 27, 2014 Board of Selectman meeting. We previously provided a written response to the Atlantic Design letter dated February 5, 2014 prior to revising the plans.

On February 14, 2014 we received additional hand written comments attached to an email from Atlantic Design Engineers in regards to our previous response (a copy is attached for reference). We offer the following in regards to the currently outstanding comments:

1. Comment acknowledged. Any revisions based on MassDOT review shall be submitted to the Town of Middleborough for review and approval as suggested.

2. We continue to respond, that in our professional opinion, the stormwater management system is a significant upgrade in comparison to the existing conditions and that the system as a whole will function possibly better, but certainly no worse, that it currently does today. Since we will be submitting plans and stormwater calculations to MassDOT we will discuss the drainage connection and revise the plans accordingly and submit back to the Board per response #1 above as required.

12. We have provided additional calculations and a summary chart (attached) assuming the basin to be impervious up to the top berm elevation of 99.00. These calculations indicate that the design still meets the pre versus post development peak rates of runoff. No further action is necessary.

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13. We have provided additional calculations (attached) assuming that only the 12" outlet pipe is functioning and the results indicate that this outlet pipe is adequate to handle the 100-yr storm event without the detention basin overtopping.

Please review the attached revised information and should you have any questions, please feel free to contact our office at your convenience.

Sincerely yours,
MHF Design Consultants, Inc.

Chris Tymula
Project Manager

F:\Projects\Eng\334713\334713-Atlantic Design Response2.doc
CR 334713

cc: Richard Tabaczynski, Atlantic Design Engineers, Inc.
Doug Troyer, MEEC
Dawn Johnson, Cumberland Farms, Inc.
Gary McNaughton, McMahon Associates

Christopher M Tymula

From: Rich Tabaczynski [rtab@atlanticcompanies.com]
Sent: Friday, February 14, 2014 12:42 PM
To: cmt@mhfdesign.com
Subject: FW: Cumberland Farms Review
Attachments: RJT Notes to MHF Letter_2-10-14.pdf

Chris,
I had forwarded the attached hand written notes to Charles on Monday as I was running out the door. Not sure if you had received them.

Richard J. Tabaczynski, P.E.
Vice President
Atlantic Design Engineers, Inc.
P.O. Box 1051
Sandwich, Massachusetts 02563
P: (508) 888 – 9282
F: (508) 888 – 5859
C: (508) 274 – 1712

From: Charles Cristello [mailto:ccristello@middleborough.com]
Sent: Tuesday, February 11, 2014 8:57 AM
To: 'Douglas Troyer'
Cc: Kathleen Sousa (KSousa@cumberlandgulf.com); 'Dawn Johnson (DJohnson@cumberlandgulf.com)'; Rich Tabaczynski
Subject: RE: Cumberland Farms Review

Doug,

We continued this hearing to Feb 24 at 8:30. Rich Tabacynski will be back in town Thursday. Please have your engineer get in touch with him so we can have everything resolved well before the 24th.

In the first hearing you made some commitments to screening, fencing and improving the catch basin on 28 in front of the driveway. Will those be reflected on the plans or do I need to make those conditions of the permit?

Charlie

From: Douglas Troyer [mailto:dtroyer@meeb.com]
Sent: Monday, February 10, 2014 5:57 PM
To: Charles Cristello
Cc: Kathleen Sousa (KSousa@cumberlandgulf.com); 'Dawn Johnson (DJohnson@cumberlandgulf.com)'
Subject: RE: Cumberland Farms Review

Charles:

2/24 is good for CFI to continue the Public Hearing.

Thank you for getting back to me after hours, I truly appreciate it.

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February 10, 2014

Middleborough Board of Selectman
Town Hall Building
10 Nickerson Avenue
Middleborough, MA 02346
Attn: Mr. Charles J. Cristello, Town Manager

Re: WRPD Application
90 East Grove Street
Cumberland Farms

Sub: Atlantic Design Response Comments

If MDOT requires changes, they should be submitted to the board for approval

Dear Mr. Cristello:

Please find enclosed a revised set of plans and supporting documentation regarding the above referenced project. The plans have been revised to address the comments in the Atlantic Design Engineers review letter dated February 5, 2014. Based on those comments we offer the following:

1. Comment acknowledged. Once we receive approvals from the Board of Selectman, final plans will be submitted to MassDOT for review and comment.

2. We have researched the existence of any drainage plans with both the Town and MassDOT and have determined that there are no plans to be found which would aid in determining the ultimately outfall of the drainage system along East Grove Street. In order to obtain the pertinent data to run an analysis on the East Grove Street drainage system we would be required to survey the entire roadway drainage system to the outfall location, which we feel is unreasonable since the site plan is a redevelopment project, shows a decrease in peak rates of runoff for all storm events and provides a stormwater management system that is a significant improvement over the current conditions. The proposed piped connection via the onsite drainage system is discharging runoff that is currently being collected by means of overland sheet and shallow concentrated flows draining into the East Grove Street drainage system. The current proposal "converts" the overland flows into piped flows routing the stormwater to the same point now providing treatment and a reduction in peak flows, consistent with the requirements of DEP and the Town regulations. In accordance with DEP standards, the site design is required to model the 2, 10 & 100-yr storm events. The 100-yr storm event is required to determine if there will be any impacts downstream and it is not required to meet pre vs. post conditions which is a requirement for the 2 and 10-yr storm events. Therefore, the proposed

Existing flow could be ponding, overflowing by-passing catch basin, now it is piped into it, so piping system needs to be able accomodate to it.

Functioning of the Basin depends on it handling flow. If it doesn't, basin will back up.

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stormwater design provides a decrease in the peak rate of runoff for the 100-yr design storm which would also confirm that there should be no impact to downstream areas as part of the proposed development and hence no reason to model the remaining drainage system.

3. It is our opinion that a fence around the detention basin is not needed since it is designed as a shallow, dry detention basin with a low flow orifice at the bottom to fully drain the basin. A fence is also not a requirement by DEP in the Stormwater Handbook.

Board to decide

4. The detail for OCS#2 was previously shown on Sheet 10 of 11, CFG9.1.

OK

5. No comment #5 provided by Atlantic Design.

OK

6. The outlet elevation for the roof infiltration system previously shown as 98.25 was a typo and has been revised to 99.25, consistent with the previously submitted stormwater calculations. The flood elevation in the "model" has been revised to account for the 4" of stone above the pipe and therefore meets the peak elevation for the 100-yr storm event. It should be noted that according to the Stormwater Handbook that within infiltration trenches it is "Generally it is not practical to provide storage for large infrequent storms such as the 100-yr storm".

OK

Will Review Calcs

7. DMH-1is shown with a low flow outlet designed to pass the 1" WQV design storm. It is also equipped with a higher flow outlet to pass storm events larger than the 1" WQV.

OK

8. Street sweeping is outlined in both the Operations/Maintenance Construction Phase and Regular Maintenance notes on Sheet 6, note 9 & note 3 respectively. Note 8 has been added to Sheet 6 referring to the O&M Plan for additional information and the notes within the plans and report have been checked for consistency.

OK For 5% TSS removal, need quarterly sweeping beyond Fall + Spring

9. The calculations for the sizing of the Oil/Water Separator were previously shown on the detail for the structure as shown on Sheet 10 of 11, CFG9.1.

OK

10. The sizing of the 15" opening has no affect on the smaller orifice openings within the structure and is designed to be one pipe size larger than the outlet pipe to avoid any constriction of flow. It is the smaller openings in the structure that regulate the outflow from the basin. The 15" opening under all flow conditions will be able to pass more water than the orifices in the outlet structure. To put it another ways, the 15" opening will never restrict the flow more than the 3" and 8" orifices. As far as providing a drop between the 3" orifice and 12" outlet pipe, we believe that this is unnecessary.

Probably OK but will review calcs

11. The minimum Tc has been revised to 6.0 minutes. It should be noted that this had little change in the overall design results.

Probably OK, will review calcs

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During storm, basin will have water in it. Any rainfall hitting surface of pond will be routed

12. The detention basin is designed as a dry detention basin under normal conditions with the low flow outlet located at the bottom of the basin. The CN value is based on groundcover conditions at the start of the storm. At that time since the basin is not saturated, therefore the selection of a CN value based on grass, good conditions is an appropriate classification and a typical design approach.

Disagree

13. The 4'-4" square overflow grate is designed as an emergency overflow device. The elevation of this grate is lower than the top of the basin berm and will provide the necessary device to divert overflows from abutting properties. In addition, the outlet structure is designed with a trash grate on the inlet opening to prevent clogging and has a 4' deep sump to collect any dirt or debris which also lessons the need for an additional emergency overflow device.

The concern is if the AOS structure inside the concrete box is blocked or the 12" outlet pipe clogged. Also, is 12" outlet pipe capable of handling 100 year storm un mitigated?

Please review the attached revised information and should you have any questions, please feel free to contact our office at your convenience.

Sincerely yours,
MHF Design Consultants, Inc.

Chris Tymula
Project Manager

F:\Projects\Eng\334713\334713-Atlantic Design Response.doc
CR 334713

cc: Richard Tabaczynski, Atlantic Design Engineers, Inc.
Doug Troyer, MEEC
Dawn Johnson, Cumberland Farms, Inc.
Gary McNaughton, McMahon Associates

CALCULATIONS RESPONDING TO COMMENT # 12.
(10 PAGES)

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Table 1: Drainage Summary

Design Storm	Pre-Development (cfs)	Post-Development (cfs)	Change (cfs)
DESIGN POINT #1 (East Grove Street Drainage System)			
2-year	1.06	0.77	-0.29
10-year	2.35	1.91	-0.44
100-year	4.61	3.93	-0.68
DESIGN POINT #2 (Eastern Property Line)			
2-year	0.00	0.00	0.00
10-year	0.08	0.01	-0.07
100-year	0.51	0.12	-0.39

(All values shown are peak rates in CFS)

The above information assumes that the Detention Basin surface area is a water surface up to the top of berm at an elevation of 99.00. The associated surface area with this elevation is 4,080 sf. Refer to the partial HydroCAD printouts labeled 3347-Postdrain--100-yr storm check.

Based upon the calculations provided, the detention basin is adequately sized to handle the proposed site development as currently designed.

Summary for Subcatchment 10S: RUNOFF TO BASIN

CN Value for basin area is assumed to be a Water Surface using the surface area within the basin at elevation 99.00 = 4,080 sf

Runoff = 0.21 cfs @ 12.10 hrs, Volume= 662 cf, Depth= 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.20"

	Area (sf)	CN	Description
	1,867	39	>75% Grass cover, Good, HSG A
*	4,080	98	Water Surface, HSG A
	5,947	79	Weighted Average
	1,867		31.39% Pervious Area
	4,080		68.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	20	0.0200	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.0	13	0.3300	8.62		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
2.7	33	Total, Increased to minimum Tc = 6.0 min			

Summary for Pond BASIN: PROP. ABOVE GROUND DETENTION BASIN

[80] Warning: Exceeded Pond DMH2 by 0.02' @ 12.25 hrs (0.56 cfs 409 cf)

Inflow Area = 33,905 sf, 87.57% Impervious, Inflow Depth = 1.89" for 2-year event
Inflow = 1.55 cfs @ 12.10 hrs, Volume= 5,352 cf
Outflow = 0.46 cfs @ 12.49 hrs, Volume= 5,352 cf, Atten= 71%, Lag= 23.8 min
Primary = 0.46 cfs @ 12.49 hrs, Volume= 5,352 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 96.94' @ 12.49 hrs Surf.Area= 1,798 sf Storage= 1,679 cf
Flood Elev= 99.00' Surf.Area= 4,080 sf Storage= 7,125 cf

Plug-Flow detention time= 44.5 min calculated for 5,343 cf (100% of inflow)
Center-of-Mass det. time= 44.5 min (837.3 - 792.8)

Volume	Invert	Avail.Storage	Storage Description
#1	95.50'	7,125 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
95.50	0	0.0	0	0	0
96.00	1,325	144.0	221	221	1,651
98.00	2,420	194.0	3,690	3,911	3,037
99.00	4,080	250.0	3,214	7,125	5,028

Device	Routing	Invert	Outlet Devices
#1	Primary	95.50'	**12.0" Round Culvert** L= 95.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 95.50' / 95.00' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	95.50'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	96.70'	**8.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	97.75'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	98.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.46 cfs @ 12.49 hrs HW=96.94' TW=95.27' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.46 cfs of 2.88 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.27 cfs @ 5.52 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.18 cfs @ 1.66 fps)
  ├─**4=Orifice/Grate** (Controls 0.00 cfs)
  └─**5=Orifice/Grate** (Controls 0.00 cfs)

Summary for Reach 1R: EAST GROVE STREET DRAINAGE SYSTEM (DP#1)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =	57,025 sf,	73.57% Impervious,	Inflow Depth =	1.53"	for 2-year event	
Inflow =	0.77 cfs @	12.11 hrs, Volume=	7,255 cf			
Outflow =	0.77 cfs @	12.11 hrs, Volume=	7,255 cf,	Atten= 0%,	Lag= 0.0 min	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Subcatchment 10S: RUNOFF TO BASIN

CN Value for basin area is assumed to be a Water Surface using the surface area within the basin at elevation 99.00 = 4,080 sf

Runoff = 0.40 cfs @ 12.09 hrs, Volume= 1,261 cf, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.70"

	Area (sf)	CN	Description
	1,867	39	>75% Grass cover, Good, HSG A
*	4,080	98	Water Surface, HSG A
	5,947	79	Weighted Average
	1,867		31.39% Pervious Area
	4,080		68.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	20	0.0200	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.0	13	0.3300	8.62		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
2.7	33	Total, Increased to minimum Tc = 6.0 min			

Summary for Pond BASIN: PROP. ABOVE GROUND DETENTION BASIN

Inflow Area = 33,905 sf, 87.57% Impervious, Inflow Depth = 3.19" for 10-year event
Inflow = 2.82 cfs @ 12.10 hrs, Volume= 9,015 cf
Outflow = 1.25 cfs @ 12.32 hrs, Volume= 9,015 cf, Atten= 55%, Lag= 13.6 min
Primary = 1.25 cfs @ 12.32 hrs, Volume= 9,015 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 97.34' @ 12.32 hrs Surf.Area= 2,025 sf Storage= 2,455 cf
Flood Elev= 99.00' Surf.Area= 4,080 sf Storage= 7,125 cf

Plug-Flow detention time= 40.7 min calculated for 9,000 cf (100% of inflow)
Center-of-Mass det. time= 40.7 min (823.0 - 782.3)

Volume	Invert	Avail.Storage	Storage Description
#1	95.50'	7,125 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
95.50	0	0.0	0	0	0
96.00	1,325	144.0	221	221	1,651
98.00	2,420	194.0	3,690	3,911	3,037
99.00	4,080	250.0	3,214	7,125	5,028

Device	Routing	Invert	Outlet Devices
#1	Primary	95.50'	**12.0" Round Culvert** L= 95.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 95.50' / 95.00' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	95.50'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	96.70'	**8.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	97.75'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	98.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.25 cfs @ 12.32 hrs HW=97.34' TW=95.44' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.25 cfs of 3.45 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.31 cfs @ 6.31 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.94 cfs @ 2.73 fps)
  ├─**4=Orifice/Grate** (Controls 0.00 cfs)
  └─**5=Orifice/Grate** (Controls 0.00 cfs)

Summary for Reach 1R: EAST GROVE STREET DRAINAGE SYSTEM (DP#1)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =	57,025 sf,	73.57% Impervious,	Inflow Depth =	2.69"	for 10-year event
Inflow =	1.91 cfs @	12.17 hrs, Volume=	12,795 cf		
Outflow =	1.91 cfs @	12.17 hrs, Volume=	12,795 cf,	Atten= 0%,	Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Subcatchment 10S: RUNOFF TO BASIN

CN Value for basin area is assumed to be a Water Surface using the surface area within the basin at elevation 99.00 = 4,080 sf

Runoff = 0.71 cfs @ 12.09 hrs, Volume= 2,272 cf, Depth= 4.58"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.00"

	Area (sf)	CN	Description
	1,867	39	>75% Grass cover, Good, HSG A
*	4,080	98	Water Surface, HSG A
	5,947	79	Weighted Average
	1,867		31.39% Pervious Area
	4,080		68.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	20	0.0200	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.0	13	0.3300	8.62		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
2.7	33	Total, Increased to minimum Tc = 6.0 min			

Summary for Pond BASIN: PROP. ABOVE GROUND DETENTION BASIN

Inflow Area = 33,905 sf, 87.57% Impervious, Inflow Depth = 5.29" for 100-year event
Inflow = 4.56 cfs @ 12.09 hrs, Volume= 14,936 cf
Outflow = 2.60 cfs @ 12.24 hrs, Volume= 14,937 cf, Atten= 43%, Lag= 8.9 min
Primary = 2.60 cfs @ 12.24 hrs, Volume= 14,937 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 97.91' @ 12.24 hrs Surf.Area= 2,365 sf Storage= 3,702 cf
Flood Elev= 99.00' Surf.Area= 4,080 sf Storage= 7,125 cf

Plug-Flow detention time= 38.9 min calculated for 14,912 cf (100% of inflow)
Center-of-Mass det. time= 38.8 min (811.5 - 772.7)

Volume	Invert	Avail.Storage	Storage Description
#1	95.50'	7,125 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
95.50	0	0.0	0	0	0
96.00	1,325	144.0	221	221	1,651
98.00	2,420	194.0	3,690	3,911	3,037
99.00	4,080	250.0	3,214	7,125	5,028

Device	Routing	Invert	Outlet Devices
#1	Primary	95.50'	**12.0" Round Culvert** L= 95.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 95.50' / 95.00' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	95.50'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	96.70'	**8.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	97.75'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	98.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.58 cfs @ 12.24 hrs HW=97.91' TW=95.71' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.58 cfs of 4.11 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.35 cfs @ 7.14 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 1.57 cfs @ 4.51 fps)
  ├─**4=Orifice/Grate** (Weir Controls 0.66 cfs @ 1.31 fps)
  └─**5=Orifice/Grate** (Controls 0.00 cfs)

Summary for Reach 1R: EAST GROVE STREET DRAINAGE SYSTEM (DP#1)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =	57,025 sf,	73.57% Impervious,	Inflow Depth =	4.65"	for	100-year event
Inflow =	3.93 cfs @	12.18 hrs, Volume=	22,090 cf			
Outflow =	3.93 cfs @	12.18 hrs, Volume=	22,090 cf,	Atten= 0%,	Lag= 0.0 min	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

CALCULATIONS RESPONDING TO COMMENT # 13. 1 OF 1

3347-Postdrain--100-yr storm check *Type III 24-hr 100-year Rainfall=7.00"*
Prepared by MHF Design Consultants, Inc Printed 2/14/2014
HydroCAD® 10.00 s/n 01710 © 2012 HydroCAD Software Solutions LLC

Summary for Pond BAS-MOD.: PROP. ABOVE GROUND DETENTION BASIN-MODIFIED

Assumes that all orifices are clogged and only the 12" outlet pipe is functional

Inflow Area = 33,905 sf, 87.57% Impervious, Inflow Depth = 5.29" for 100-year event
Inflow = 4.55 cfs @ 12.09 hrs, Volume= 14,937 cf
Outflow = 2.86 cfs @ 12.21 hrs, Volume= 14,937 cf, Atten= 37%, Lag= 7.2 min
Primary = 2.86 cfs @ 12.21 hrs, Volume= 14,937 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 96.92' @ 12.21 hrs Surf.Area= 1,789 sf Storage= 1,651 cf
Flood Elev= 99.00' Surf.Area= 4,080 sf Storage= 7,125 cf

Plug-Flow detention time= 4.9 min calculated for 14,912 cf (100% of inflow)
Center-of-Mass det. time= 4.8 min (777.6 - 772.7)

Volume	Invert	Avail.Storage	Storage Description
#1	95.50'	7,125 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
95.50	0	0.0	0	0	0
96.00	1,325	144.0	221	221	1,651
98.00	2,420	194.0	3,690	3,911	3,037
99.00	4,080	250.0	3,214	7,125	5,028

Device	Routing	Invert	Outlet Devices
#1	Primary	95.50'	**12.0" Round Culvert** L= 95.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 95.50' / 95.00' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.85 cfs @ 12.21 hrs HW=96.92' TW=95.75' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 2.85 cfs @ 3.63 fps)