Atlantic Engineering & Survey Consultants, Inc.
97 Tenney Street • Georgetown, MA 01833
978-352-7870 • 978-352-9940 (fax) • atlantic84@gmail.com

John B. Paulson, P.L.S. President
George J. Zambouras, P.E.

February 5, 2018

Kate Newhall-Smith, Planner
Office of Planning & Development
Newburyport City Hall
60 Pleasant Street
Newburyport, MA 01950

Re: Site Plan Review
Hope Church – 11 Hale Street

Dear Ms. Newhall-Smith,

Attached please find our response to comments resulting from Christensen & Sergi, Inc. review and the accompanying revised plans and hydraulic report.

Sincerely,

George J. Zambouras, P.E.

Cc: Attorney Lisa Mead
Brad Gardner

PARKING IMPROVEMENTS
FOR
THE HOPE COMMUNITY CHURCH OF NEWBURYPORT
AT
11 HALE STREET
IN
NEWBURYPORT, MASSACHUSETTS

GENERAL NOTES

1. THE LOCATIONS OF EXISTING AND SUSPECTED EXISTING UNDERGROUND UTILITIES ARE TAKEN FROM EXISTING AVAILABLE INFORMATION AND SHOULD BE CONSIDERED APPROXIMATE. THERE MAY BE EXISTING UTILITY LINES OTHER THAN THOSE SHOWN. THE CONTRACTOR SHALL BE REQUIRED TO CONTACT THE PROPER UTILITY COMPANIES AND DIG-SAFE PRIOR TO BEGINNING ANY CONSTRUCTION ON THE SITE. ATLANTIC ENGINEERING DOES NOT WARRANT OR GUARANTEE THE LOCATION (S) OF ANY UTILITIES SHOWN ON THESE PLANS. THE CONTRACTOR SHALL BE RESPONSIBLE TO DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES PRIOR TO COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

2. THE CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY ALL DIMENSIONS AND GRADING ON THE SITE AND SHALL IMMEDIATELY REPORT ANY DISCREPANCIES OR DEVIATIONS FROM THE CONSTRUCTION PLANS TO THE ENGINEER. FAILURE TO PERFORM THIS VERIFICATION IN A TIMELY MANNER MAY RESULT IN A DELAY IN THE NECESSARY CORRECTIVE ACTION. NO ADDITIONAL COMPENSATION (TIME OR MONETARY) SHALL BE CONSIDERED DUE TO DELAYS IN THE CONTRACTOR'S INSTALLATIONS AS A RESULT OF CONDITIONS WHICH WERE NOT IDENTIFIED BY THE CONTRACTOR ON TIME FOR CORRECTION BY THE CONSTRUCTION MANAGER OR THE ENGINEER.

3. THE SITE SHALL BE GRADED AND COMPACTED TO THE ELEVATIONS AND CONTOURS SET FORTH IN THESE PLANS.

4. UNLESS OTHERWISE SPECIFIED, ALL INSTALLATION, CONSTRUCTION AND CONSTRUCTION MATERIALS SHALL, IN ALL RESPECTS, CONFORM TO THE FOLLOWING:
   - MASSACHUSETTS STATE BUILDING CODE, (LATEST EDITION)
   - MASSACHUSETTS HIGHWAY DESIGN STANDARDS (LATEST EDITION)
   - AMERICANS WITH DISABILITIES ACT
   - CITY OF NEWBURYPORT STANDARDS AND APPLICATION APPROVALS

5. IN THE CASE OF CONFLICT BETWEEN CODES, STANDARDS, REGULATIONS, SPECIFICATIONS, PLAN NOTES AND/OR MANUFACTURER REQUIREMENTS, THE MOST STRINGENT STANDARD AND PROVISION IS TO BE USED, UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SURVEY LAYOUT OF ALL ITEMS REQUIRED TO COMPLETE THE SCOPE OF WORK. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR ANY CORRECTIVE ACTION REQUIRED FOR ITEMS NOT CONSTRUCTED WHERE PROPOSED.

7. THE CONTRACTOR SHALL CALL DIG-SAFE A MINIMUM OF 72 HOURS, EXCLUSIVE OF SATURDAYS, SUNDAYS AND LEGAL HOLIDAYS, PRIOR TO BEGINNING ANY EXCAVATION AT THE SITE.

8. THE CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE FEDERAL, STATE AND LOCAL SAFETY CODES.

9. THE CONTRACTOR SHALL TAKE ADEQUATE PRECAUTIONS TO PROTECT ALL WALKS, STREETS, TREES, UTILITIES AND PLANTINGS ON OR OFF THE PREMISES, AND SHALL BE RESPONSIBLE, AT NO EXPENSE TO THE OWNER, TO REPAIR AND/OR REPLACE OR OTHERWISE MAKE GOOD AS DIRECTED BY THE OWNER ANY SUCH OR OTHER DAMAGE SO CAUSED.

10. THE CONTRACTOR SHALL REMOVE FROM THE SITE ALL RUBBISH AND DEBRIS DURING SITE CONSTRUCTION. STORAGE OF SUCH MATERIALS ON THE PROJECT SITE WILL NOT BE PERMITTED.

11. THE CONTRACTOR SHALL GIVE A NOTICE TO THE PERTINENT MUNICIPAL DEPARTMENTS AS REQUIRED BY PERMITS AND PROJECT APPROVALS BEFORE COMMENCING WORK IN THE FIELD.

12. THE PLANS AND SPECIFICATIONS FOR THIS SITE ARE INTENDED TO BE EXPLANATORY OF THE WORK TO BE DONE AND OF EACH OTHER, BUT SHOULD ANY OMISSION, ERRORS OR OTHER DISCREPANCIES APPEAR, THEY SHALL BE SUBJECT TO CORRECTION AND INTERPRETATION BY ATLANTIC ENGINEERING THEREBY FULFILLING THE INTENT OF THE PLANS.

13. GAS, TELEPHONE, CABLE AND ELECTRIC UTILITIES SHALL BE INSTALLED AT THE DIRECTION OF THE RESPECTIVE UTILITY AND TO THE STANDARDS REQUIRED BY THOSE UTILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE TO INCORPORATE THE COST AND SCHEDULING OF THESE ITEMS IN THEIR SCOPE OF SERVICES.

14. THE EXISTING CONDITIONS SHOWN ON THESE PLANS ARE TO BE CONSIDERED APPROXIMATE. THE EXISTING PLAN INFORMATION SHOWN SHALL BE USED FOR REFERENCE ONLY TO AID THE CONTRACTOR IN DETERMINING THE OVERALL EXISTING SITE CONDITIONS AND THE EXISTING SITE FEATURES WHICH WILL NEED TO BE DEMOLISHED OR CHANGED AS PART OF THE SITE IMPROVEMENTS. THE CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY ALL INFORMATION. THE OWNER SHALL NOT BE RESPONSIBLE FOR ANY ADDITIONAL COST INCURRED BY THE CONTRACTOR FOR CURRENT EXISTING CONDITIONS WHICH WERE NOT VERIFIED.

15. ALL CONSTRUCTION IS SUBJECT TO THE GRANTING OF ALL NECESSARY PERMITS BY THE CITY/TOWN. THE CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY THAT ALL PERMITS ARE IN PLACE PRIOR TO BEGINNING ANY CONSTRUCTION.

16. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY WORK PERFORMED OUTSIDE THE LIMIT OF WORK, AND IF NECESSARY SHALL, AT NO EXPENSE TO THE OWNER, CORRECT AND REMEDY ANY WORK DONE IN THESE AREAS. ANY QUESTIONS REGARDING THE LOCATION OF THE LIMIT OF WORK SHALL BE DIRECTED TO THE ENGINEER PRIOR TO PROCEEDING WITH ANY WORK ON THE SITE.

17. ALL FILL MATERIAL SHALL BE REMOVED FROM UNDERNEATH ALL INFILTRATING STRUCTURES DOWN TO CLEAN PERVIOUS IN-SITU SOIL. ALL OVER EXCAVATIONS SHALL BE REPLACED BY CLEAN COMPACTED COARSE SAND.

PUBLIC SAFETY

IN ORDER TO PROTECT THE PUBLIC SAFETY DURING CONSTRUCTION, THE CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLING AND MAINTAINING AT ALL TIMES ALL NECESSARY SAFETY DEVICES AND PERSONNEL; WARNING LIGHTS; BARRICADES; AND FOR THE HIRING OF POLICE OFFICERS AS REQUIRED BY THE MUNICIPAL AUTHORITIES.

SITE CLEANING

THE CONTRACTOR SHALL REGULARLY INSPECT THE PERIMETER OF THE SITE TO CLEANUP AND REMOVE LOOSE CONSTRUCTION DEBRIS BEFORE IT LEAVES THE SITE. ALL DEMOLITION DEBRIS SHALL BE PROMPTLY REMOVED FROM THE SITE AND DISPOSED OF TO A LEGAL DUMP SITE. ALL TRUCKS LEAVING THE SITE SHALL BE COVERED.

EROSION CONTROL NOTES

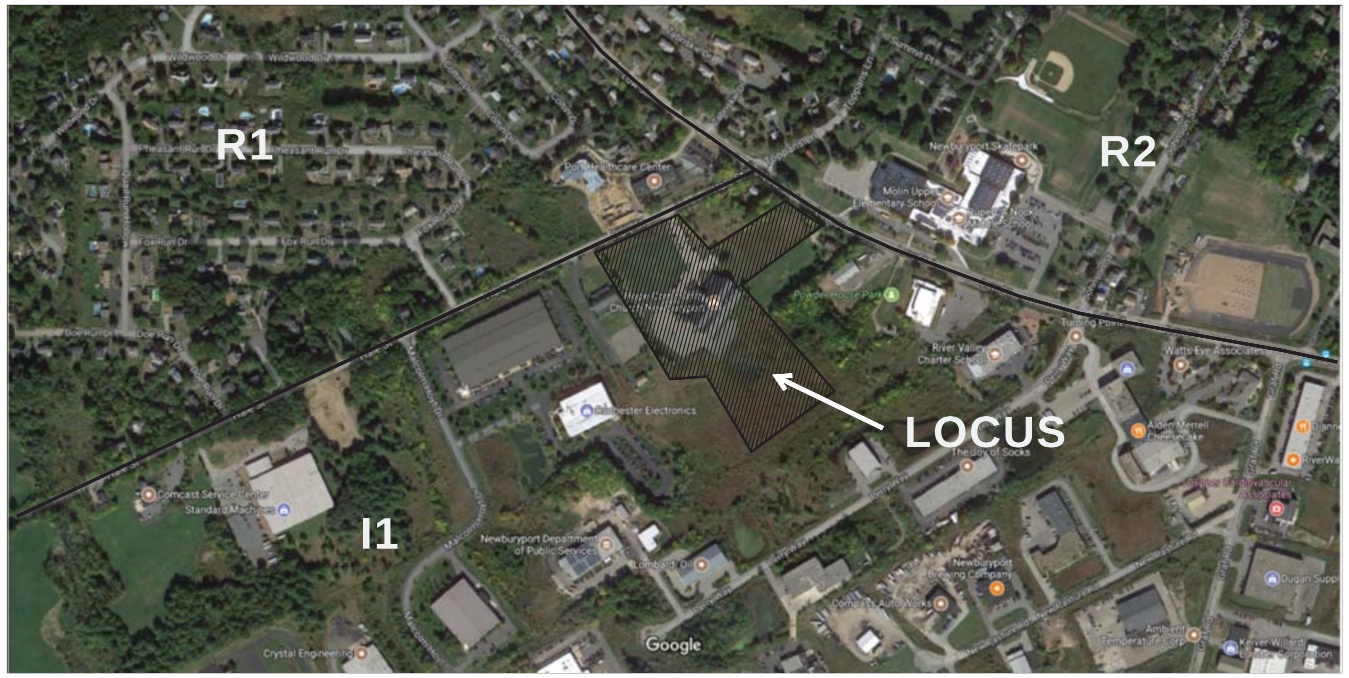
IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO INSTALL EROSION CONTROL MEASURES ON AN AS NECESSARY BASIS TO AVOID EXCESSIVE SOIL EROSION AND TO INSURE SOIL EROSION DOES NOT OCCUR OFF SITE. MEASURES MAY INCLUDE, BUT IS NOT LIMITED TO, HAY BALE DIKES AROUND DRAINAGE INLETS, SILT SOCKS, SILTATION FENCES, TEMPORARY DIVERSION AND SEDIMENTAITON BASINS, MULCHING AND PLANTING OF DISTURBED AREAS. DURING CONSTRUCTION ANY EROSION CONTROL MEASURES SHALL BE INSPECTED WEEKLY AND WITHIN 24 HOURS OF ANY STORM EVENT GENERATING MORE THAN 1/2 OF RAINFALL. ALL DISTURBED OR DAMAGED CONTROL DEVICES SHALL BE CLEANED, REPAIRED AND RESET AS NECESSARY.

DRAINAGE STRUCTURE NOTES

PRIOR TO THE COMMENCEMENT OF ANY SITE DEMOLITION OR WORK THE CONTRACTOR SHALL INSTALL SILTATION PROTECTION AT ALL CATCH BASINS, MANHOLES AND AT EACH EXISTING DRAINAGE INLET(S) THAT MAY BE AFFECTED BY THE WORK AT THE SITE AND AS INDICATED ON THE PLANS. AS SITE DRAINAGE IS BEING INSTALLED EACH NEWLY INSTALLED DRAINAGE STRUCTURE, LINE AND INLET SHALL RECEIVE SILTATION PROTECTION TO PREVENT SEDIMENT AND DEBRIS FROM ENTERING THE EXISTING AND NEW DRAINAGE SYSTEM, WATER COURSE OR RESOUCE AREA. UPON COMPLETION OF CONSTRUCTION THE CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY THAT ALL SILTATION PROTECTIONS ARE REMOVED AND ALL DRAINAGE STRUCTURES, LINES, WATER COURSES AND RESOUCE AREAS ARE FREE OF SILTATION, STONES AND OTHER DEBRIS. ALL STRUCTURES, LINES, WATER COURSES AND RESOUCE AREAS THAT REQUIRE CLEANING SHALL BE CLEAN OF SILT, STONES AND OTHER DEBRIS BY THE CONTRACTOR AT NO ADDITIONAL EXPENSE TO THE OWNER.

SITE MANAGEMENT NOTES

SEE ADDITIONAL SITE MANAGEMENT NOTES ON THE FINAL SHEET OF THESE PLANS.



LOCUS MAP
NTS

PLAN INDEX

ASSESSOR'S LOCATION
ASSESSOR'S MAP 83, PARCEL: 3
RECORD ADDRESS: 11 HALE STREET

OWNER OF RECORD
THE HOPE COMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET, NEWBURYPORT, MA
DEED REF: BOOK 14537, PAGE 422 & 423

APPLICANT
THE HOPE COMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET, NEWBURYPORT, MA

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

GEORGE ZAMBOURAS CIVIL

P.E. OCT. 12, 2017
Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH
AT
11 HALE STREET
IN
NEWBURYPORT, MASS.

TITLE SHEET

PREPARED FOR:
THE HOPE CUMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET – SUITE 5 – GEORGETOWN, MA 01833
PHONE: 978–352–7870 FAX: 978–352–9940

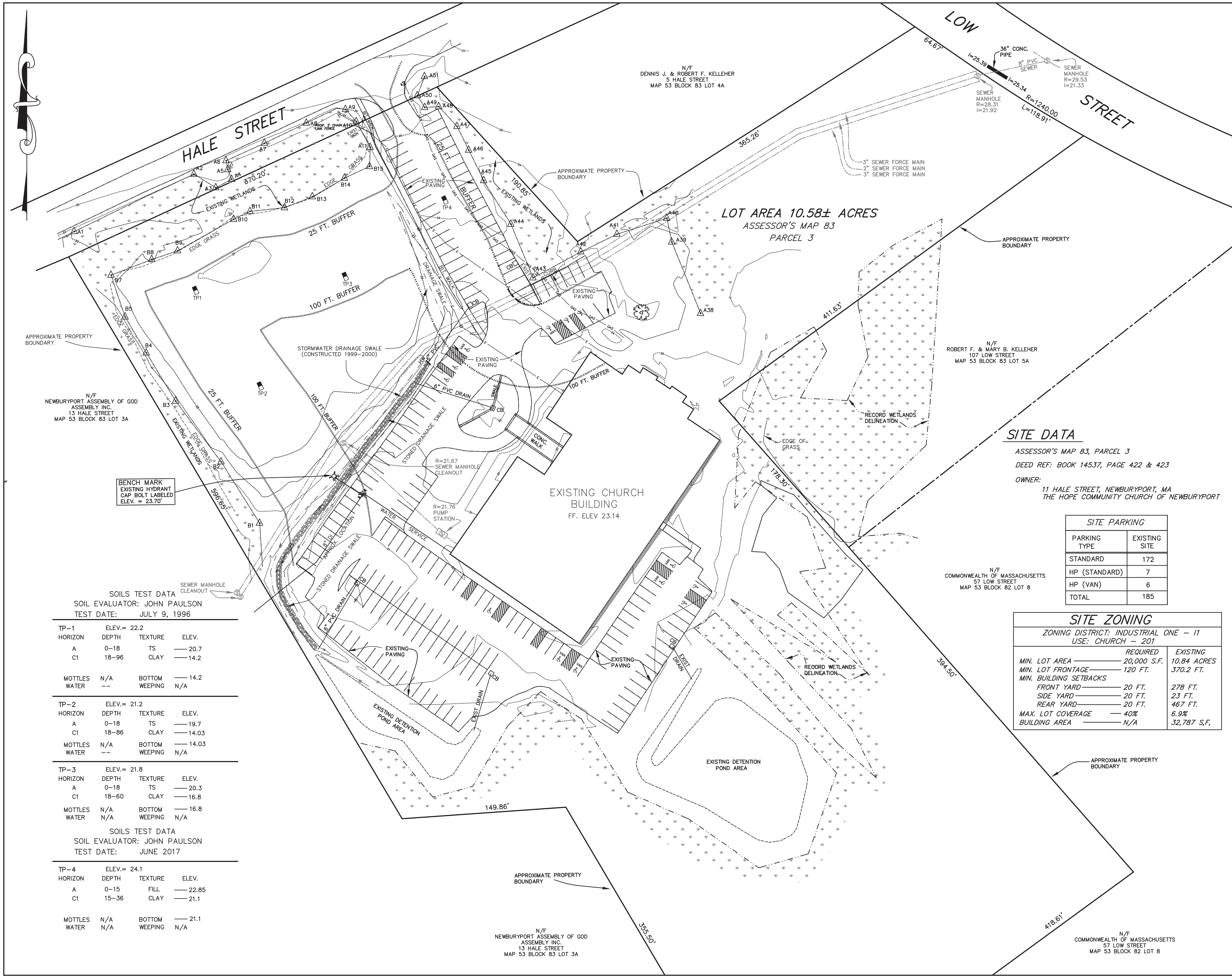
DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 | DATE: DEC. 14, 2017

revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

Scale: 1"= 20'
20 0 20 40

SHEET 1 OF 15



LEGEND

EXISTING CONTOUR	---100---
PROPOSED CONTOUR	——100——
EXISTING SPOT ELEVATION	+100.0
PROPOSED SPOT ELEVATION	100x0
EXISTING EDGE OF PAVEMENT	
CONCRETE CURBING	
SEWER LINE	—S——S—
DRAIN LINE	—D——D—
WATER LINE	—W——W—
ELECTRIC CONDUIT	—E——E—
GAS LINE	—GAS——GAS—
CATCH BASIN	
DRAIN MANHOLE	D
HYDRANT	
GATE VALVE	WG
STONE WALL	
CENTERLINE / STATION	1+00 2+00
FLARED END SECTION	FE
CONCRETE HEADWALL	HW
EXISTING SITE LIGHT	
PROPOSED SITE LIGHTING	LP
GUARDRAIL	
FENCE	—x——x——x—
RIP – RAP	
TEST PIT	TP
WETLAND FLAG	A48
STORMWATER DRAINAGE SWALE FLAG	A18
BUFFER ZONES	
BORDERING VEGETATED WETLANDS	
WETLAND AREA	
TEMPORARY EROSION CONTROL	SILT BARRIER

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

GEORGE ZAMBOURAS CIVIL #36230

OCT.12, 2017
Date

SITE DATA

ASSESSOR'S MAP 83, PARCEL 3

DEED REF: BOOK 14537, PAGE 422 & 423

OWNER:
11 HALE STREET, NEWBURYPORT, MA
THE HOPE COMMUNITY CHURCH OF NEWBURYPORT

SITE PARKING	
PARKING TYPE	EXISTING SITE
STANDARD	172
HP (STANDARD)	7
HP (VAN)	6
TOTAL	185

SITE ZONING

ZONING DISTRICT: INDUSTRIAL ONE – I1
USE: CHURCH – 201

	REQUIRED	EXISTING
MIN. LOT AREA	20,000 S.F.	10.84 ACRES
MIN. LOT FRONTAGE	120 FT.	370.2 FT.
MIN. BUILDING SETBACKS		
FRONT YARD	20 FT.	278 FT.
SIDE YARD	20 FT.	23 FT.
REAR YARD	20 FT.	467 FT.
MAX. LOT COVERAGE	40%	6.9%
BUILDING AREA	N/A	32,787 S.F.

SOILS TEST DATA
SOIL EVALUATOR: JOHN PAULSON
TEST DATE: JULY 9, 1996

TP–1 ELEV.= 22.2

HORIZON	DEPTH	TEXTURE	ELEV.
A	0–18	TS	20.7
C1	18–96	CLAY	14.2
MOTTLES	N/A	BOTTOM	14.2
WATER	--	WEEPING	N/A

TP–2 ELEV.= 21.2

HORIZON	DEPTH	TEXTURE	ELEV.
A	0–18	TS	19.7
C1	18–86	CLAY	14.03
MOTTLES	N/A	BOTTOM	14.03
WATER	--	WEEPING	N/A

TP–3 ELEV.= 21.8

HORIZON	DEPTH	TEXTURE	ELEV.
A	0–18	TS	20.3
C1	18–60	CLAY	16.8
MOTTLES	N/A	BOTTOM	16.8
WATER	N/A	WEEPING	N/A

SOILS TEST DATA
SOIL EVALUATOR: JOHN PAULSON
TEST DATE: JUNE 2017

TP–4 ELEV.= 24.1

HORIZON	DEPTH	TEXTURE	ELEV.
A	0–15	FILL	22.85
C1	15–36	CLAY	21.1
MOTTLES	N/A	BOTTOM	21.1
WATER	N/A	WEEPING	N/A

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

EXISTING CONDITIONS

PREPARED FOR:
THE HOPE COMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET – SUITE 5 – GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

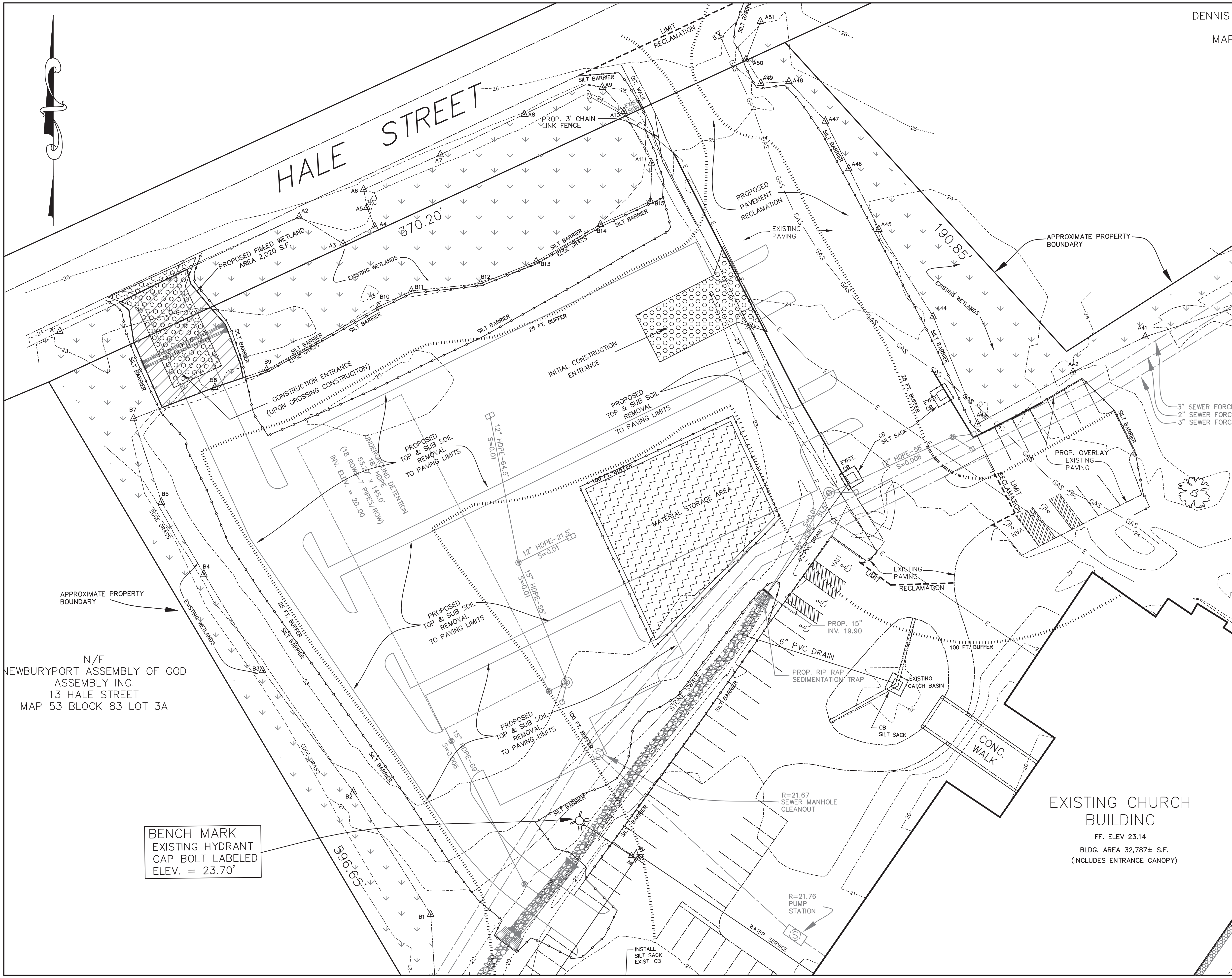
DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 DATE: DEC. 14, 2017

revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

Scale: 1"= 40'
40 0 40 80

SHEET 2 OF 15



LEGEND

EXISTING CONTOUR	– – – 100 – – –
PROPOSED CONTOUR	——— 100 ———
EXISTING SPOT ELEVATION	+100.0
PROPOSED SPOT ELEVATION	100x0
EXISTING EDGE OF PAVEMENT	
CONCRETE CURBING	
SEWER LINE	— S — S —
DRAIN LINE	— D — D —
WATER LINE	— W — W —
ELECTRIC CONDUIT	— E — E —
GAS LINE	— GAS — GAS —
CATCH BASIN	
DRAIN MANHOLE	
HYDRANT	
GATE VALVE	WG
STONE WALL	
CENTERLINE / STATION	
FLARED END SECTION	FE
CONCRETE HEADWALL	HW
EXISTING SITE LIGHT	
PROPOSED SITE LIGHTING	LP
GUARDRAIL	
FENCE	— x — x — x —
RIP – RAP	
TEST PIT	TP
WETLAND FLAG	A48
BUFFER ZONES	
BORDERING VEGETATED WETLANDS	
WETLAND AREA	
TEMPORARY EROSION CONTROL	SILT BARRIER

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

GEORGE ZAMBOURAS CIVIL

P.E. OCT.12, 2017
Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

SITE PREPARATION

PREPARED FOR:
THE HOPE CUMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET – SUITE 5 – GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 | DATE: DEC. 14, 2017

revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

Scale: 1"= 20'
20 0 20 40

SHEET 3 OF 15

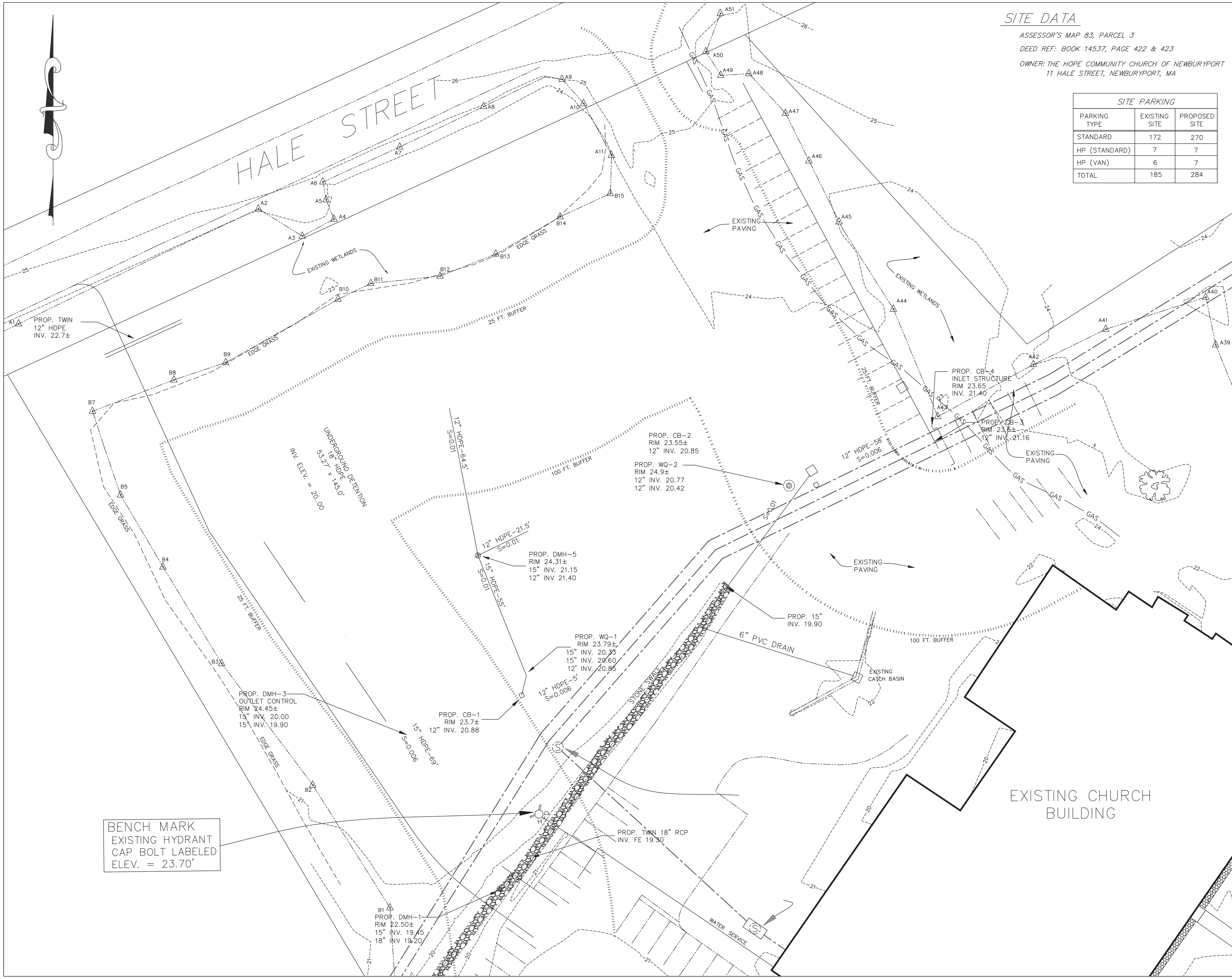
SITE DATA

ASSESSOR'S MAP 83, PARCEL 3

DEED REF: BOOK 14537, PAGE 422 & 423

OWNER: THE HOPE COMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET, NEWBURYPORT, MA

SITE PARKING		
PARKING TYPE	EXISTING SITE	PROPOSED SITE
STANDARD	172	270
HP (STANDARD)	7	7
HP (VAN)	6	7
TOTAL	185	284



LEGEND

EXISTING CONTOUR	---100---
PROPOSED CONTOUR	100
EXISTING SPOT ELEVATION	+100.0
PROPOSED SPOT ELEVATION	100x0
EXISTING EDGE OF PAVEMENT	
CONCRETE CURBING	
SEWER LINE	S
DRAIN LINE	D
WATER LINE	W
ELECTRIC CONDUIT	E
GAS LINE	GAS
CATCH BASIN	
DRAIN MANHOLE	D
HYDRANT	
GATE VALVE	WG
STONE WALL	
CENTERLINE / STATION	1+00 2+00
FLARED END SECTION	FE
CONCRETE HEADWALL	HW
EXISTING SITE LIGHT	
PROPOSED SITE LIGHTING	LP
GUARDRAIL	
FENCE	x
RIP - RAP	
TEST PIT	TP
WETLAND FLAG	A48
BUFFER ZONES	
BORDERING VEGETATED WETLANDS	
WETLAND AREA	
TEMPORARY EROSION CONTROL	SILT BARRIER

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

GEORGE ZAMBOURAS CIVIL #36230

P.E.

OCT.12, 2017
Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

SITE IMPROVEMENTS

PREPARED FOR:
THE HOPE CUMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET - SUITE 5 - GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

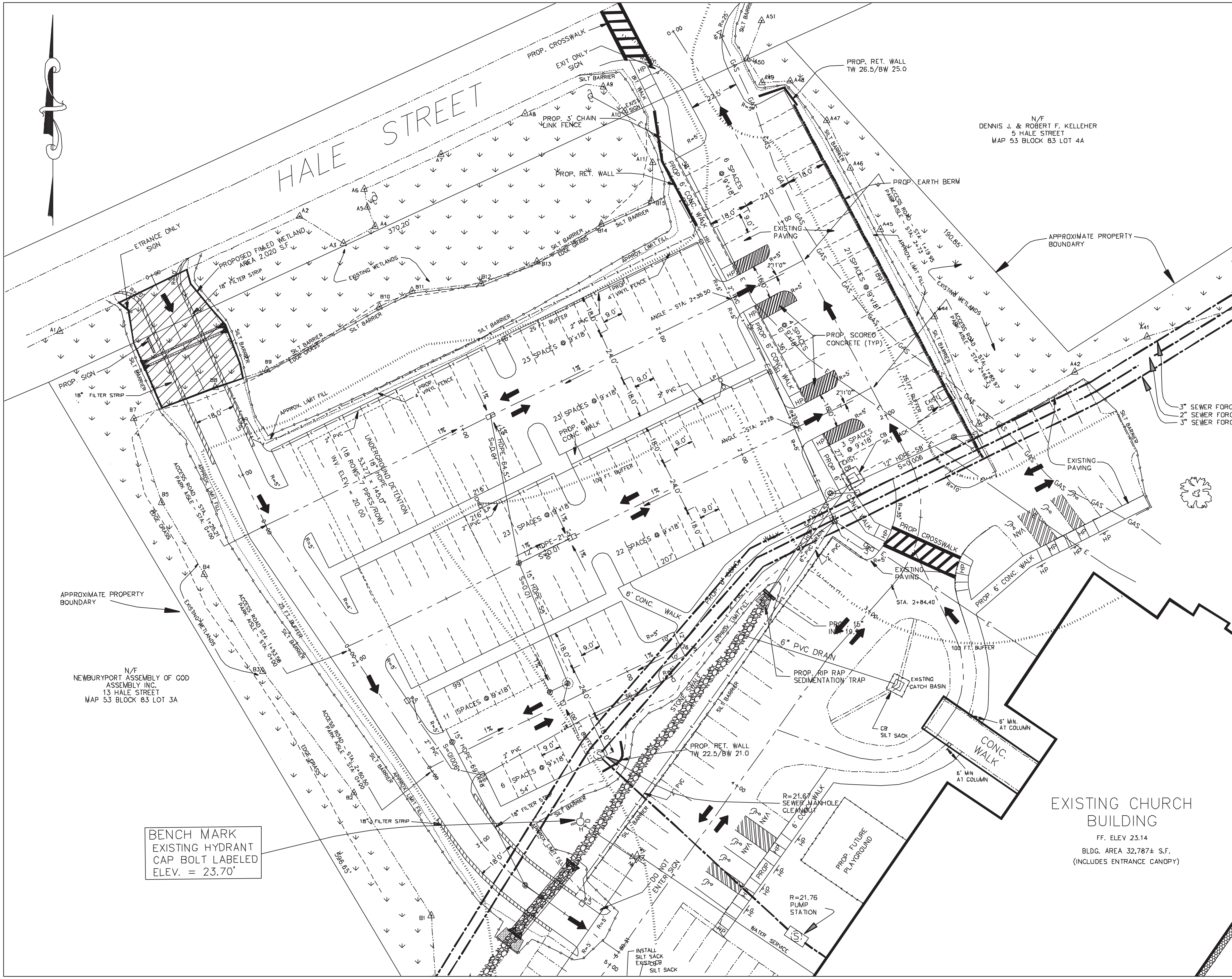
DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 | DATE: DEC. 14, 2017

revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

Scale: 1"= 20'
20 0 20 40

SHEET 4 OF 15



LEGEND

EXISTING CONTOUR	— — — 100 — — —
PROPOSED CONTOUR	——— 100 ———
EXISTING SPOT ELEVATION	+100.0
PROPOSED SPOT ELEVATION	100x0
EXISTING EDGE OF PAVEMENT	
CONCRETE CURBING	
SEWER LINE	— S — S —
DRAIN LINE	— D — D —
WATER LINE	— W — W —
ELECTRIC CONDUIT	— E — E —
GAS LINE	— GAS — GAS —
CATCH BASIN	
DRAIN MANHOLE	
HYDRANT	
GATE VALVE	WG
STONE WALL	
CENTERLINE / STATION	1+00 2+00
FLARED END SECTION	FE
CONCRETE HEADWALL	HW
EXISTING SITE LIGHT	
PROPOSED SITE LIGHTING	LP
GUARDRAIL	
FENCE	— x — x — x —
RIP - RAP	
TEST PIT	TP
WETLAND FLAG	A48
BUFFER ZONES	
BORDERING VEGETATED WETLANDS	
WETLAND AREA	
TEMPORARY EROSION CONTROL	SILT BARRIER

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

(Seal: COMMONWEALTH OF MASSACHUSETTS — GEORGE J. ZAMBOURAS — CIVIL — No. 36230 — REGISTERED PROFESSIONAL ENGINEER)

P.E.
OCT.12, 2017
Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

SITE LAYOUT

PREPARED FOR:
THE HOPE CUMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

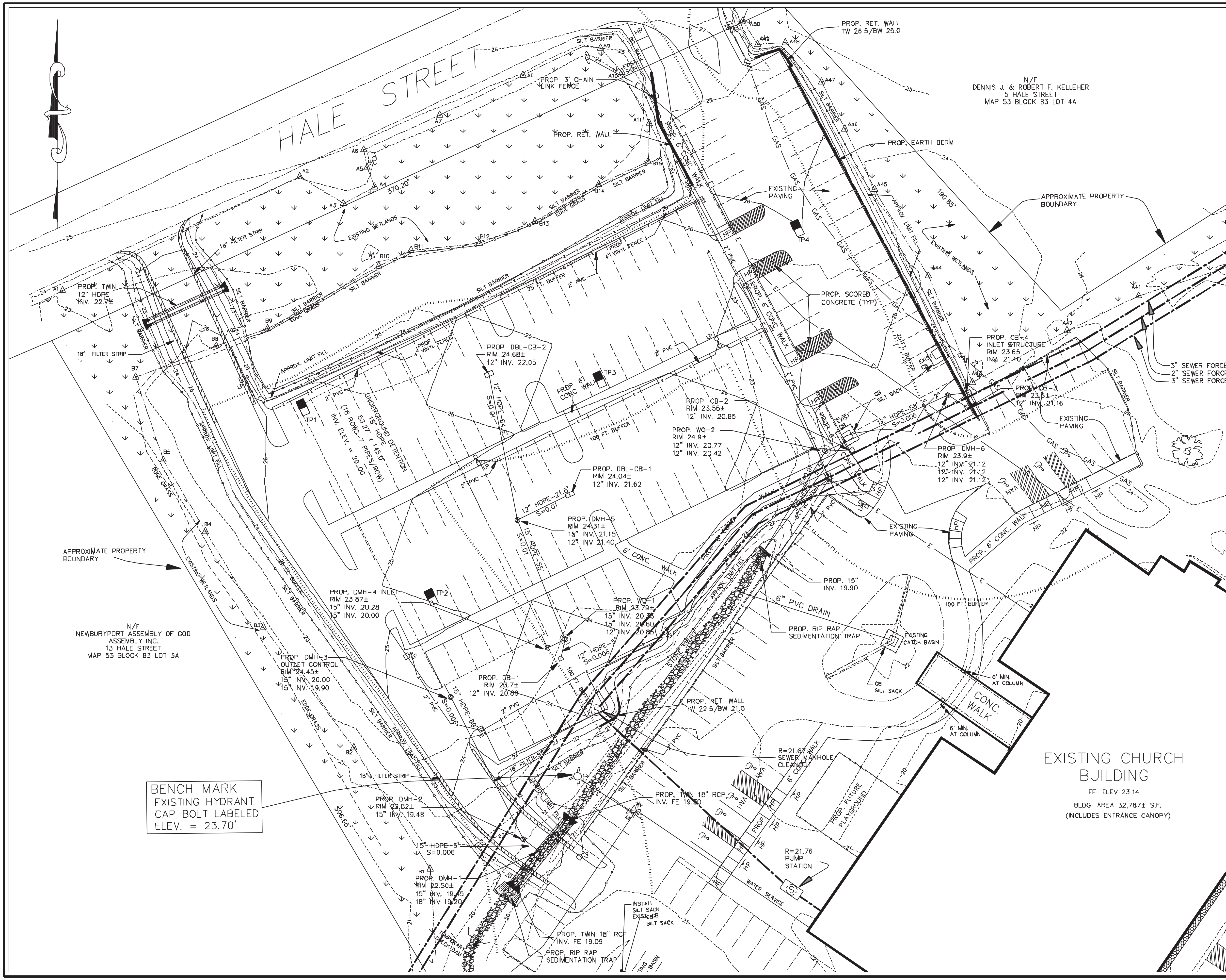
ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET – SUITE 5 – GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

DRAWING FILE: \SE093\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 | DATE: DEC. 14, 2017

revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

Scale: 1" = 20'
20 0 20 40



LEGEND

- EXISTING CONTOUR
- PROPOSED CONTOUR
- EXISTING SPOT ELEVATION — +100.0
- PROPOSED SPOT ELEVATION — 100x0
- EXISTING EDGE OF PAVEMENT
- CONCRETE CURBING
- SEWER LINE — S
- DRAIN LINE — D
- WATER LINE — W
- ELECTRIC CONDUIT — E
- GAS LINE — GAS
- CATCH BASIN
- DRAIN MANHOLE
- HYDRANT
- GATE VALVE — WG
- STONE WALL
- CENTERLINE / STATION
- FLARED END SECTION — FE
- CONCRETE HEADWALL — HW
- EXISTING SITE LIGHT
- PROPOSED SITE LIGHTING — LP
- GUARDRAIL
- FENCE
- RIP - RAP
- TEST PIT — TP
- WETLAND FLAG — A48
- BUFFER ZONES
- BORDERING VEGETATED WETLANDS
- WETLAND AREA
- TEMPORARY EROSION CONTROL — SILT BARRIER

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

GEORGE J. ZAMBOURAS CIVIL #36230

P.E. OCT.12, 2017
Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

GRADING & DRAINAGE PLAN

PREPARED FOR:
THE HOPE CUMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

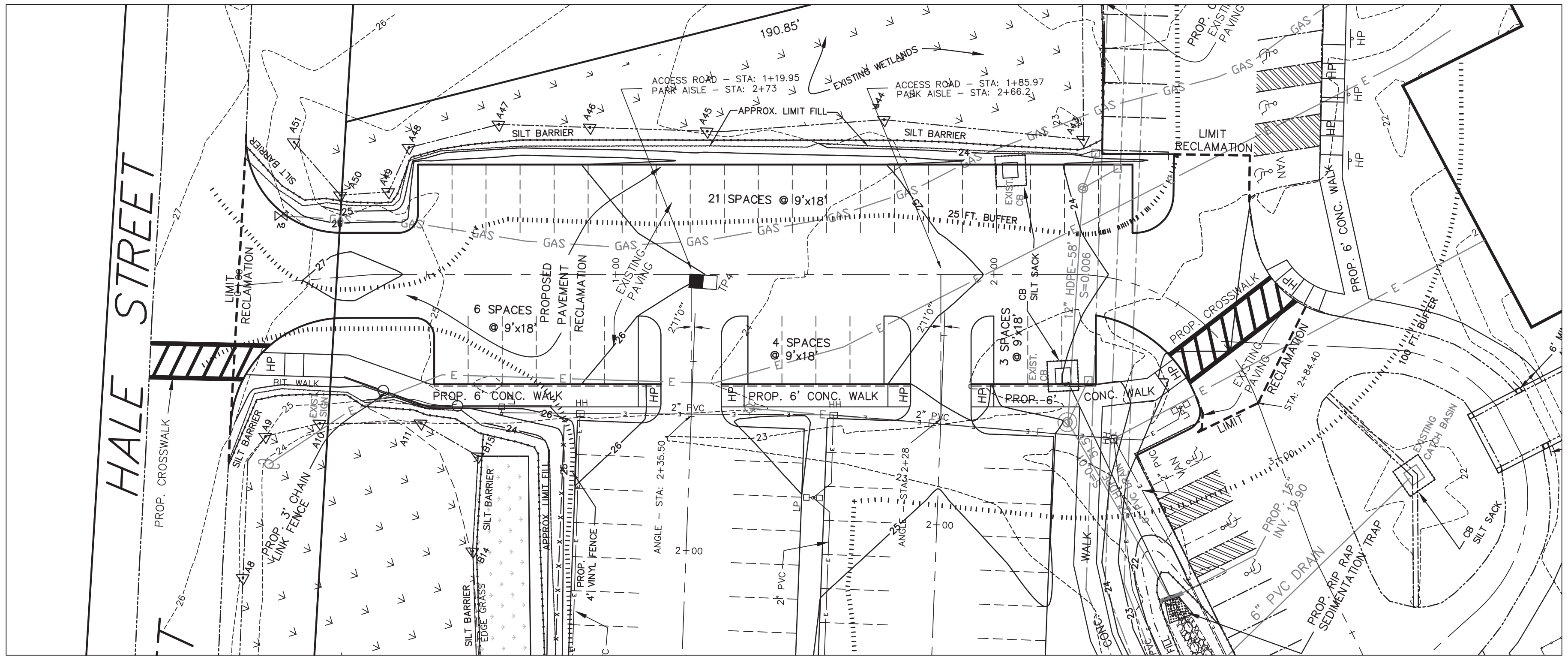
ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET - SUITE 5 - GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

DRAWING FILE: \SE093\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 | DATE: DEC. 14, 2017

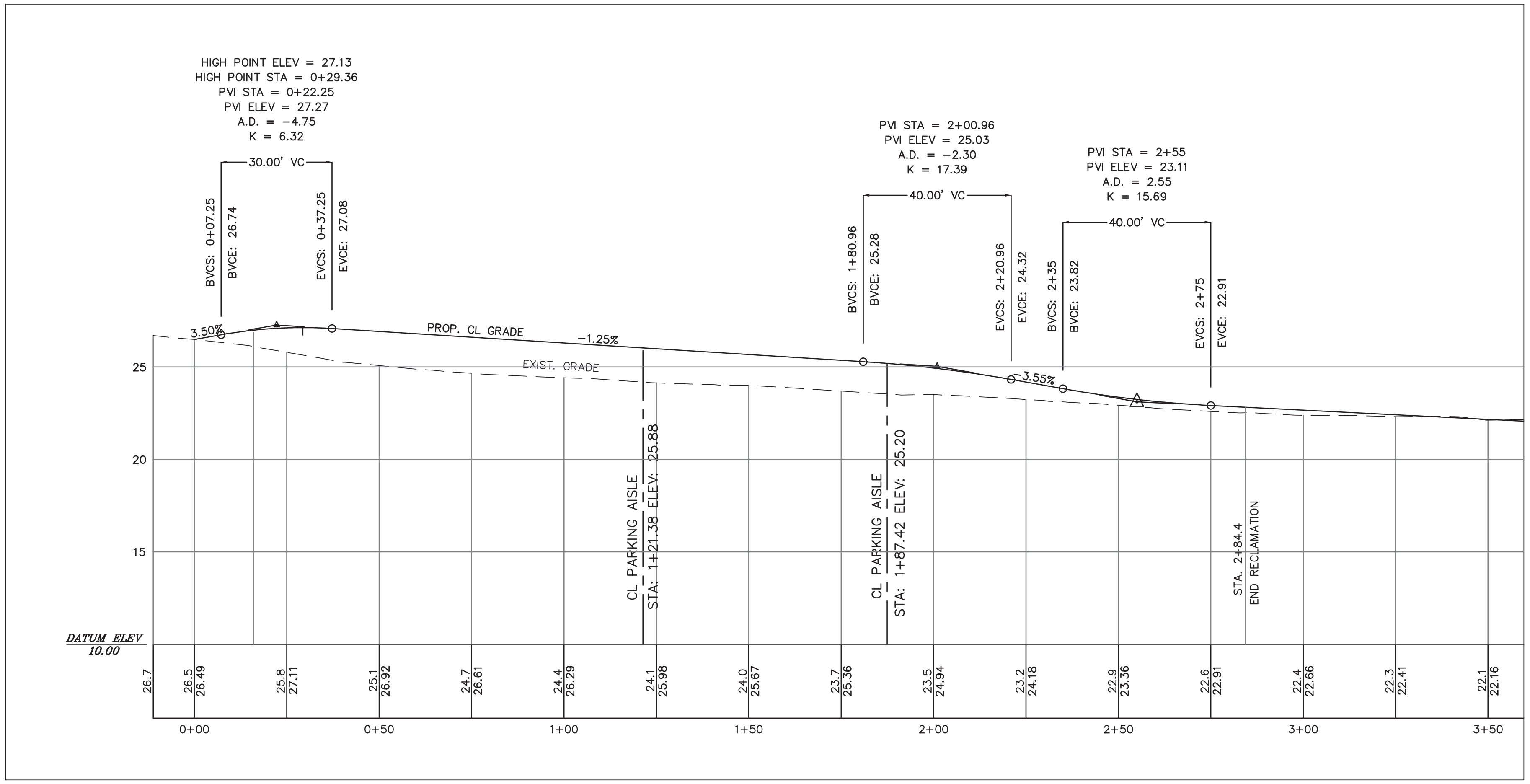
revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

Scale: 1"= 20'
20 0 20 40



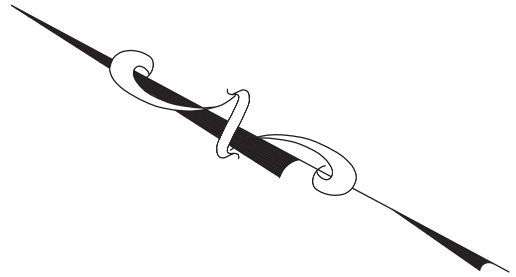
EXISTING ACCESS AISLE PLAN

SCALE: 1"=20'



EXISTING ACCESS AISLE PROFILE

SCALE : 1"=20' HORZ.
1"=4' VERT.



I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

GEORGE ZAMBOURAS CIVIL

P.E. OCT.12, 2017
Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

EXIST. ACCESS AISLE PROFILE

PREPARED FOR:
THE HOPE COMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

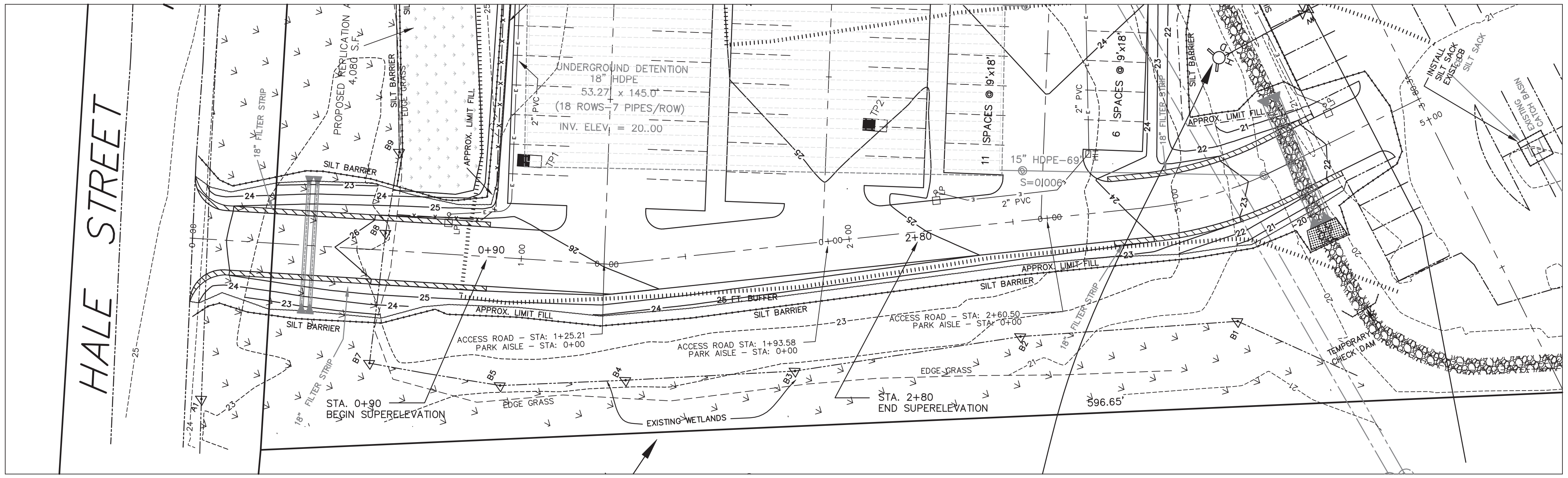
ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET – SUITE 5 – GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 | DATE: DEC. 14, 2017

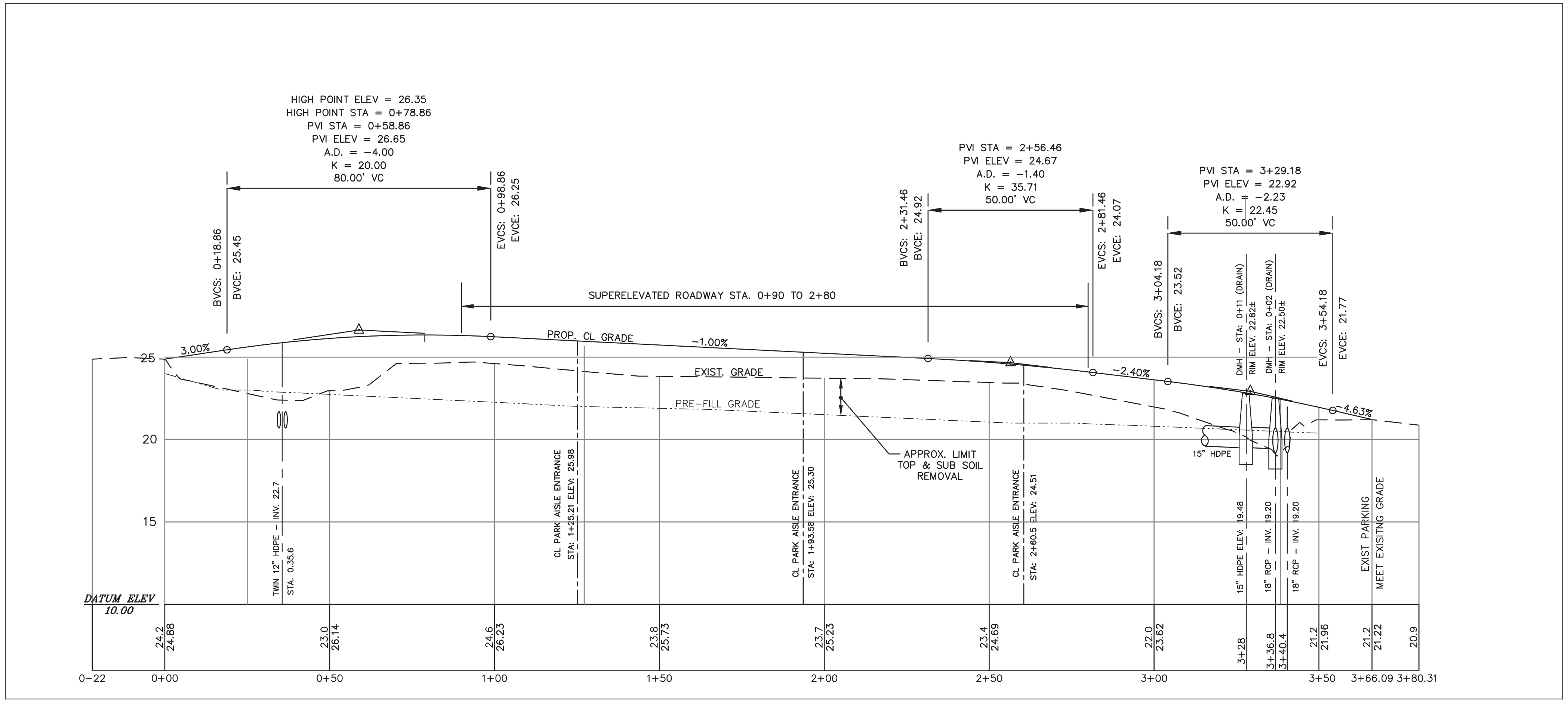
revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

2 0 2 4 VERT.
20 0 20 40 HORZ.
Scale : 1"= 2' V
20' H



PROPOSED ACCESS AISLE PLAN

SCALE: 1"=20'



PROPOSED ACCESS AISLE PROFILE

SCALE : 1"=20' HORZ.
1"=4' VERT.

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

GEORGE ZAMBOURAS CIVIL

P.E. OCT.12, 2017
Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

PROP. ACCESS AISLE PROFILE

PREPARED FOR:
THE HOPE CUMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET - SUITE 5 - GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

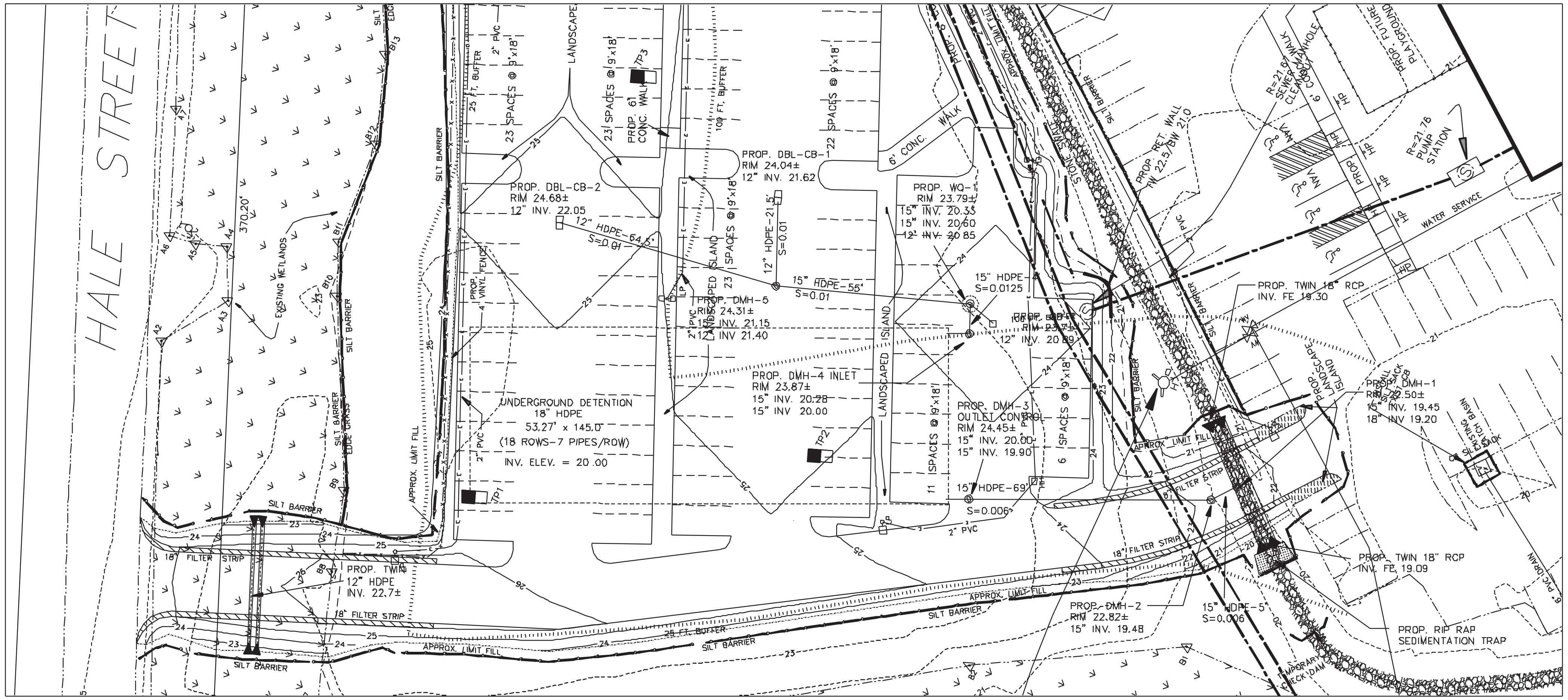
DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 | DATE: DEC. 14, 2017

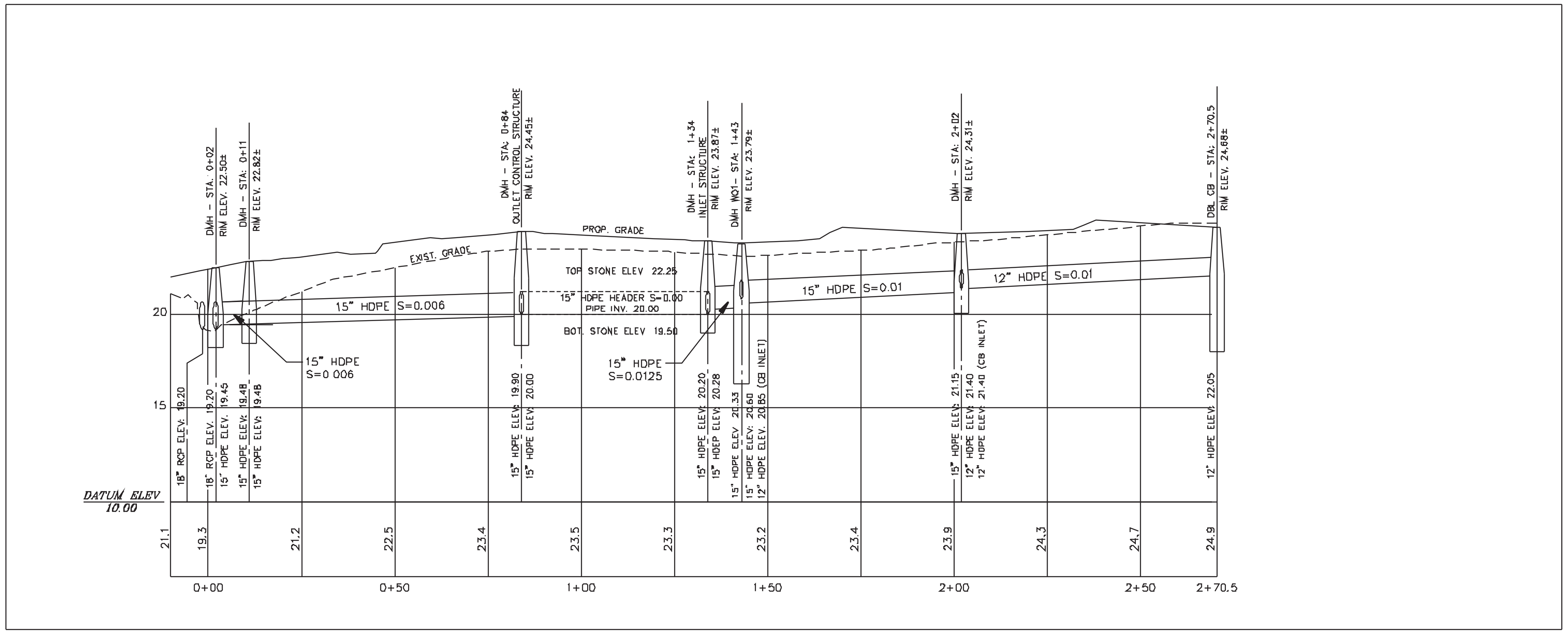
revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

2 0 2 4 VERT.
20 0 20 40 HORZ.
Scale : 1"= 2' V
20' H

SHEET 8 OF 15



DRAINAGE LAYOUT
SCALE: 1"=20'



DRAINAGE PROFILE
SCALE : 1"=20' HORZ.
1"=4' VERT.

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

P.E.
OCT.12, 2017
Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

DRAINAGE PROFILE

PREPARED FOR:
THE HOPE COMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET - SUITE 5 - GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

DRAWING FILE: \SE093\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 DATE: DEC. 14, 2017

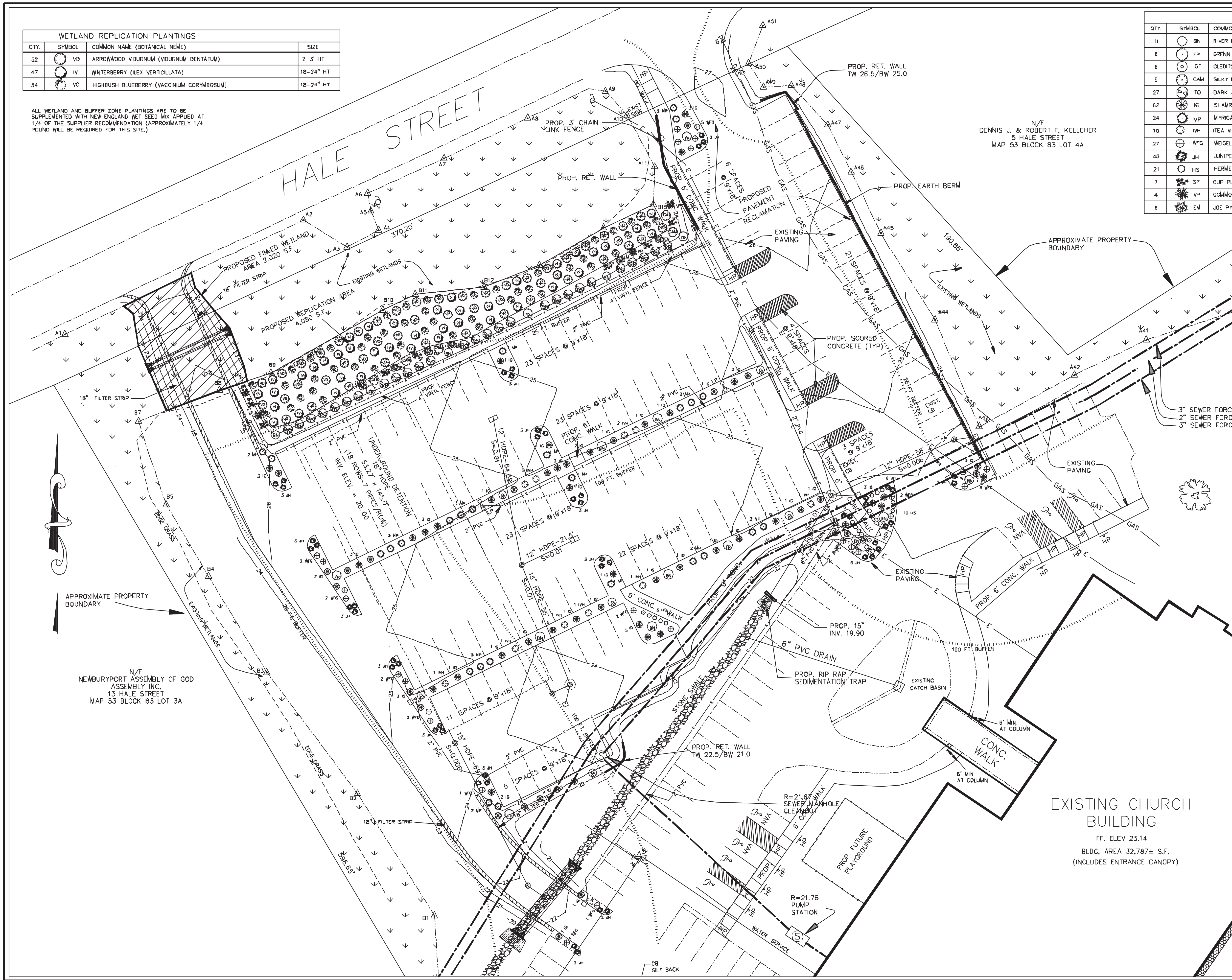
revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

2 0 2 4 VERT.
20 0 20 40 HORZ.
Scale ; 1"= 2' V 20' H

WETLAND REPLICATION PLANTINGS			
QTY.	SYMBOL	COMMON NAME (BOTANICAL NEME)	SIZE
52	VD	ARROWWOOD VIBURNUM (VIBURNUM DENTATUM)	2-3' HT
47	IV	WINTERBERRY (ILEX VERTICILLATA)	18-24" HT
54	VC	HIGHBUSH BLUEBERRY (VACCINIUM CORYMBOSUM)	18-24" HT

ALL WETLAND AND BUFFER ZONE PLANTINGS ARE TO BE SUPPLEMENTED WITH NEW ENGLAND WET SEED MIX APPLIED AT 1/4 OF THE SUPPLIER RECOMMENDATION (APPROXIMATELY 1/4 POUND WILL BE REQUIRED FOR THIS SITE.)

PLANT LIST			
QTY.	SYMBOL	COMMON NAME (BOTANICAL NEME)	SIZE
11	BN	RIVER BIRCH (BETULA NIGRA)	2 1/2 -3" CAL.
6	FP	GRENN ASH (FRAXINUS PENNSYLVANICA)	2 1/2 -3" CAL.
6	GT	GLEDITSIA TRIACANTHOS 'SHADEMASTER' (SHADEMASTER HONEYLOCUST)	2 1/2 -3" CAL.
5	CAM	SILKY DOGWOOD (CORNUS AMOMUM)	2-3' HT
27	TO	DARK AMERICAN ARBORVITAE (THUJA OCCIDENTALIS)	3-4' HT
62	IG	SHAMROCK INKBERRY (ILEX GLABRA)	18-24" HT
24	MP	MYRICA PENNSYLVANICA (BAYBERRY)	18-24" HT
10	IVH	ITEA VIRGINICA 'HENRY'S GARNET' (HENRY'S GARNET VIRGINIA SWEETSPIRE)	18-24" HT
27	WFG	WEIGELA FLORIDA 'GHOST' (GHOST WEIGELA)	2 GAL.
48	JH	JUNIPERUS HORIZONTALIS (CREEPING JUNIPER)	2 GAL.
21	HS	HERMEROCALLIS (STELLA D'ORO DAYLILY)	1 GAL
7	SP	CUP PLANT (SILPHIUM PERFOLIATIUM)	1 GAL
4	VP	COMMON BLUE VIOLET (VIOLA PAPILIONACEA)	1 GAL
6	EM	JOE PYE WEED (EUPATORIUM MACULATUM)	1 GAL



I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

COMMONWEALTH OF MASSACHUSETTS GEORGE J. ZANBOURAS CIVIL #36230 REGISTERED PROFESSIONAL ENGINEER

P.E.
OCT.12, 2017
Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

LANDSCAPE PLAN

PREPARED FOR:
THE HOPE CUMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

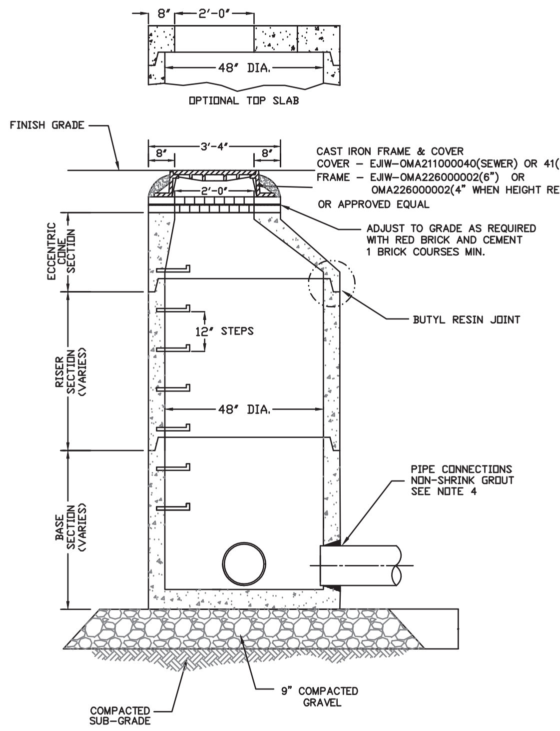
ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET - SUITE 5 - GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 DATE: DEC. 14, 2017

revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

Scale: 1" = 20'
20 0 20 40

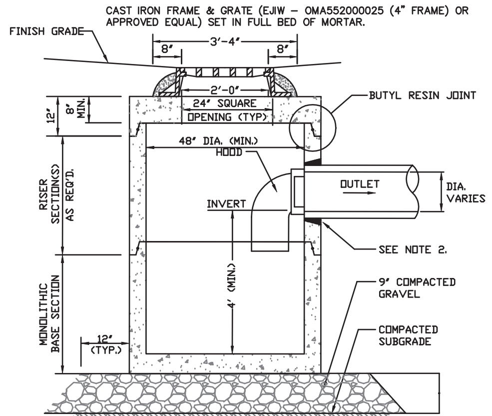


DRAIN MANHOLE

N.T.S.

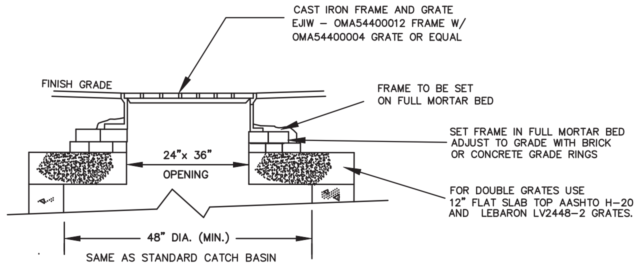
PRECAST STRUCTURES GENERAL NOTES:

1. CONCRETE: 4,000 PSI MINIMUM AFTER 28 DAYS.
2. REINFORCED STEEL CONFORMS TO LATEST ASTM A185 SPEC. 0.12 SQ. IN./LINEAL FT. AND 0.12 SQ. IN. (BOTH WAYS) BASE BOTTOM.
3. H-20 DESIGN LOADING PER AASHTO HS-20-44; ASTM C478 SPEC FOR "PRECAST REINFORCED CONCRETE MANHOLE SECTIONS."
4. SECTION JOINTS SHALL BE BUTYL RUBBER CONFORMING TO LATEST ASTM C990 SPEC.
5. STEEL REINFORCED COPOLYMER POLYPROPYLENE PLASTIC STEP CONFORMS TO LATEST ASTM C478 SPEC.
6. PROVIDE "V" KNOCKOUTS FOR PIPES WITH 2" MAX. CLEARANCE TO OUTSIDE OF PIPE. MORTAR ALL PIPE CONNECTIONSMOR FLEXIBLE PIPE SLEEVE.
7. BASE SECTION SHALL BE ONE-POUR MONOLITHIC.



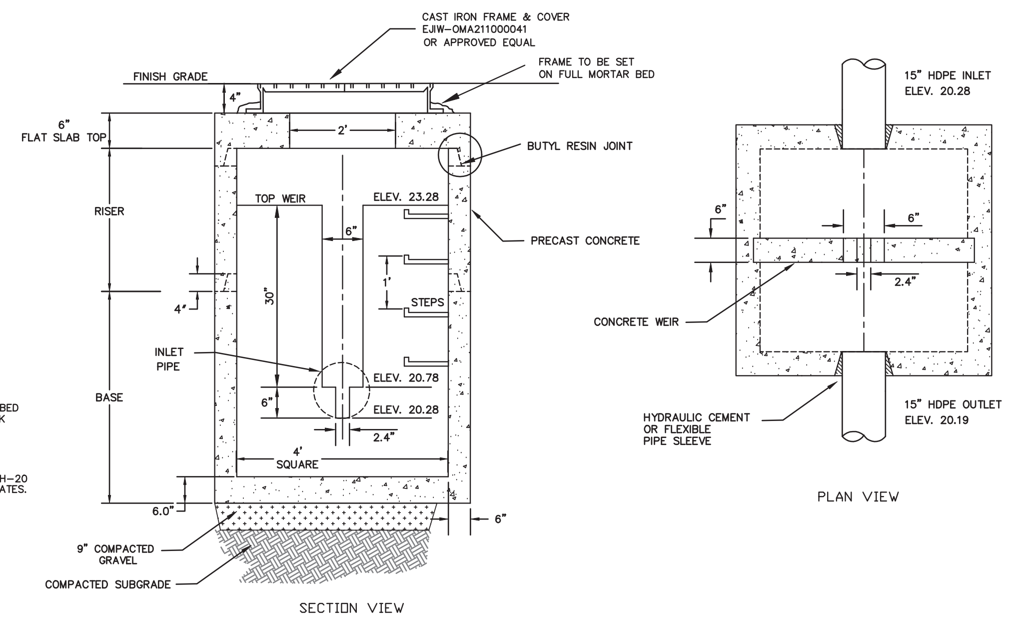
CATCH BASIN

N.T.S.



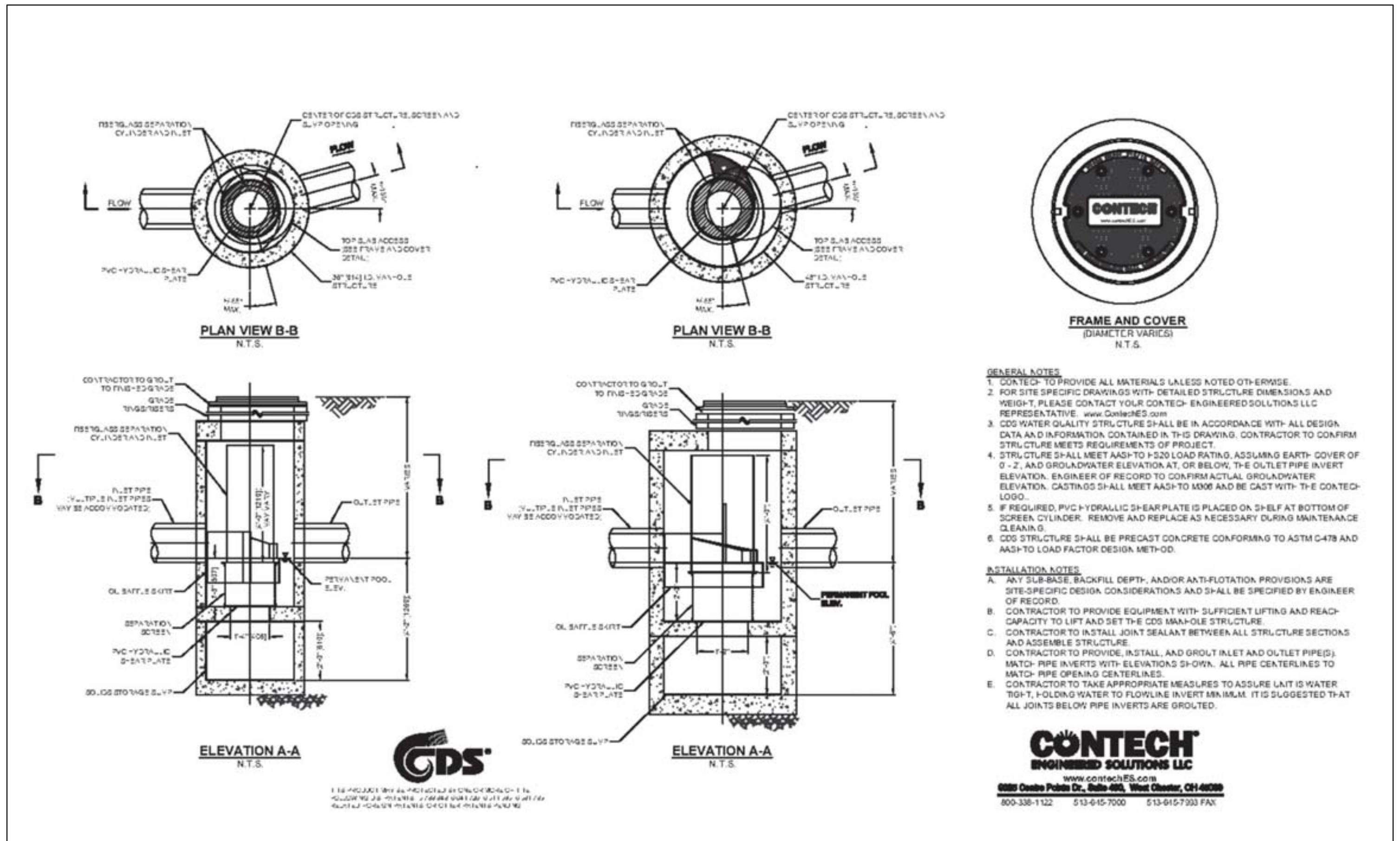
FLAT TOP CATCH BASIN–DOUBLE GRATE

N.T.S.



OUTLET CONTROL STRUCTURE–4' SQUARE MANHOLE

N.T.S.

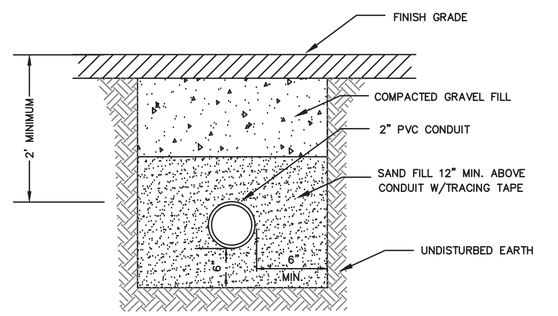


WQ–2
CDS1515–3–C (INLINE)

N.T.S.

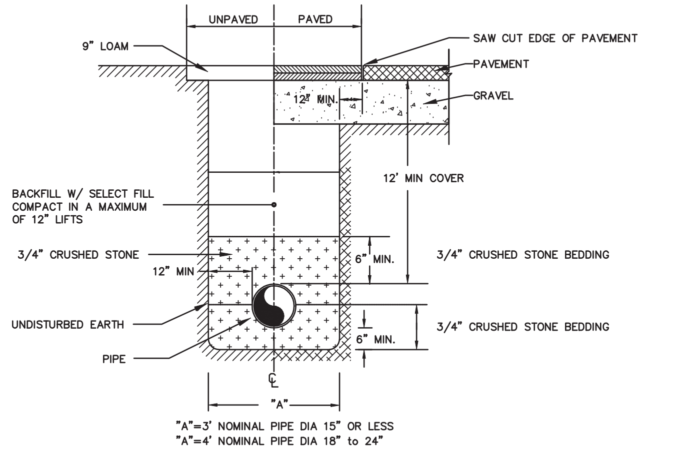
WQ–1
CDS2015–4–C (INLINE)

N.T.S.



ELECTRICAL CONDUIT TRENCH

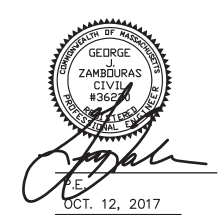
N.T.S.



TYPICAL TRENCH DETAIL SECTION

N.T.S.

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.



P.E.

OCT. 12, 2017

Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

DETAILS

PREPARED FOR:
THE HOPE COMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

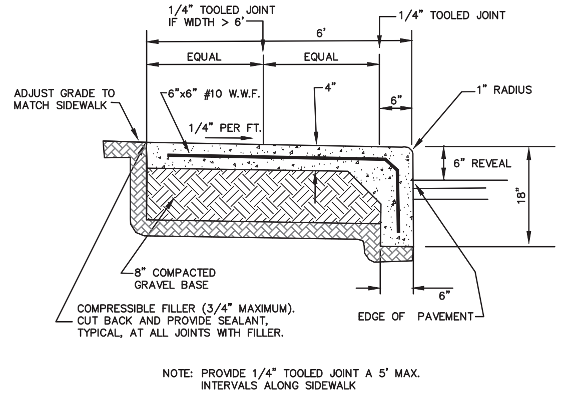
ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET – SUITE 5 – GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 | DATE: DEC. 14, 2017

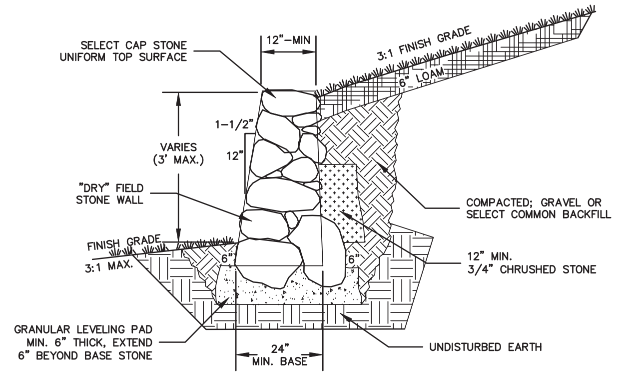
revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

AS NOTED



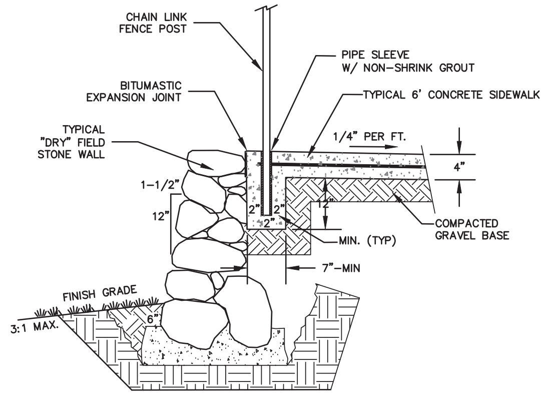
CONCRETE CURB/SIDEWALK

N.T.S.



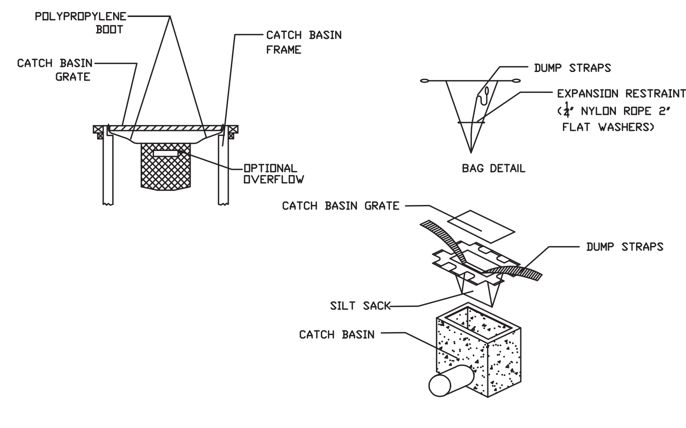
TYPICAL SECTION – STONE RETAINING WALL

N.T.S.



TYPICAL SECTION
CHAIN LINK POST IN CONCRETE SIDEWALK W/ WALL

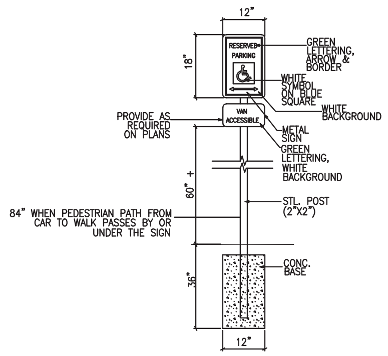
N.T.S.



MAINTENANCE SHALL OCCUR WHEN NECESSARY. SILT SACKS SHALL BE CLEANED ONCE THE BAG IS FILLED HALF WAY WITH DEBRIS. CONTRACTOR SHALL REMOVE SILT SACK AND INSTALL A NEW UNIT. CONTENTS OF SILT SACK SHALL NOT BE EMPTIED INTO THE CATCH BASIN.

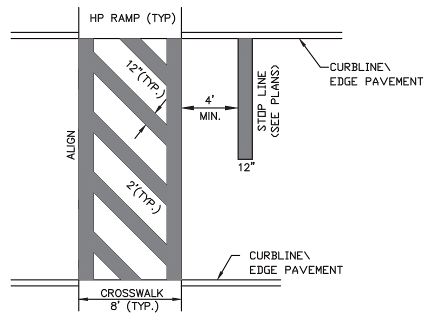
CATCH BASIN W/ SILT SACK
INLET PROTECTION

N.T.S.



HANDICAP PARKING SIGN

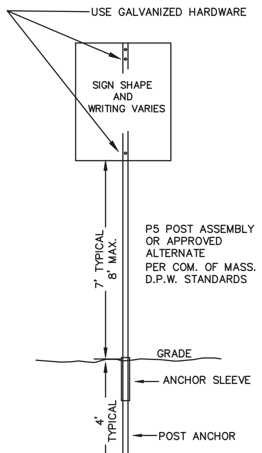
N.T.S.



NOTES:
1. TWELVE INCH (12") LINES SHALL BE APPLIED IN ONE APPLICATION, NO COMBINATION OF LINES (TWO - 6 INCH LINES) WILL BE ACCEPTED.
2. LONGITUDINAL CROSSWALK LINES TO BE PARALLEL TO CURBLINE.
3. ALL LONGITUDINAL CROSSWALK LINES TO BE THE SAME LENGTH AND PROPERLY ALIGNED.

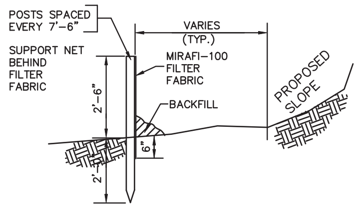
CROSSWALK

N.T.S.



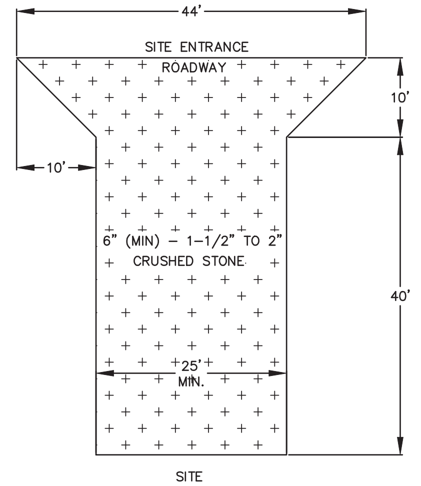
TYPICAL SMALL SIGNS

N.T.S.



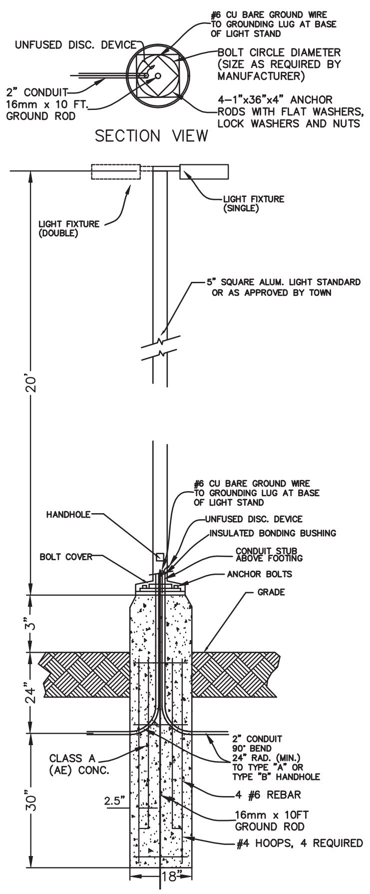
SILT FENCE

N.T.S.



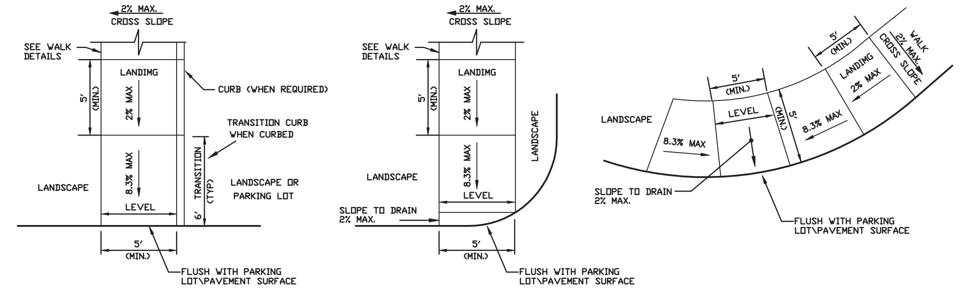
STONED ENTRANCE

N.T.S.



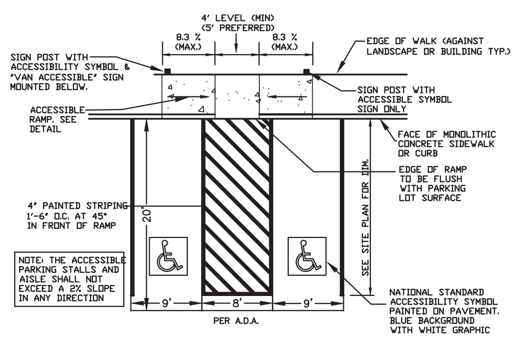
TYPICAL LIGHT STANDARD & BASE

N.T.S.



ON-SITE ACCESSIBLE RAMP

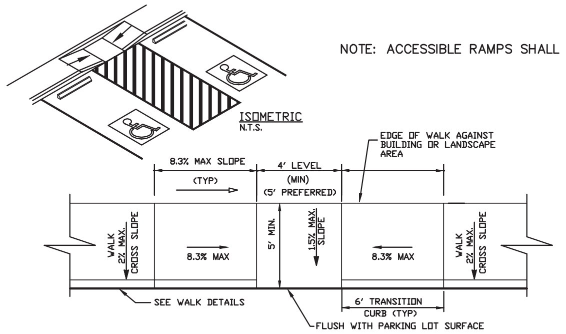
N.T.S.



ACCESSIBLE PARKING STALLS

N.T.S.

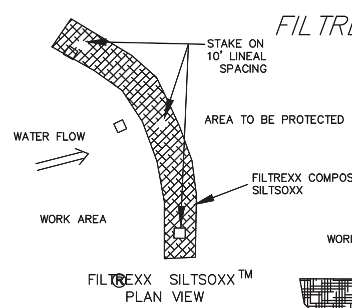
NOTE: ACCESSIBLE RAMPS SHALL MEET LATEST A.D.A. STANDARDS.

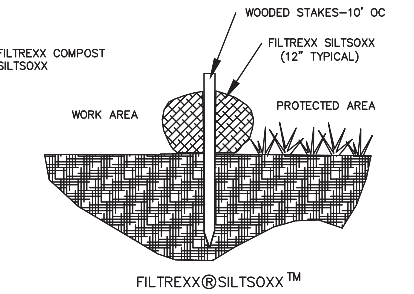


ACCESSIBLE PARKING RAMP

N.T.S.

FILTREXX® SILTSOXX™
DETAIL





USE FILTREXX SILTSOXX (OR APPROVED EQUAL), AVAILABLE THROUGH PROBARK, INC.
PHONE: 978-352-7543
WEBSITE: WWW.PROBARK.COM

NOTES:
1. ALL MATERIALS TO MEET FILTREXX SPECIFICATIONS.
2. SILTSOXX COMPOST/SOIL/ROCK/SEED/FILL TO MEET APPLICATION REQUIREMENTS.
3. SILTSOXX DEPICTED IS FOR MINIMUM SLOPES. GREATER SLOPES MAY REQUIRE LARGER SOCKS PER ENGINEER.
4. COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY ENGINEER.

FILTREXX SILTSOXX

SILTATION BARRIERS

N.T.S.

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

GEORGE ZAMBOURAS CIVIL

P.E. OCT. 12, 2017
Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

DETAILS

PREPARED FOR:
THE HOPE COMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

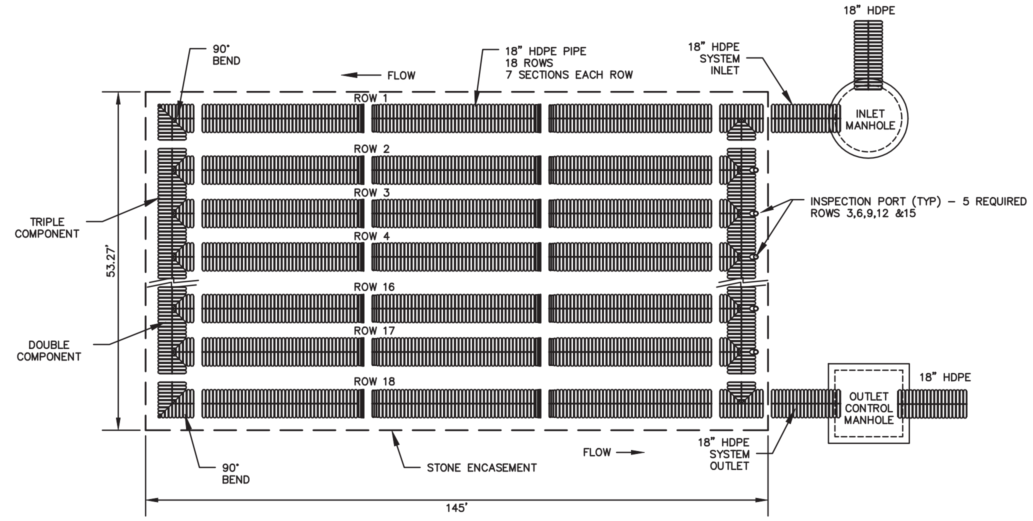
ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET – SUITE 5 – GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 DATE: DEC. 14, 2017

revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

AS NOTED

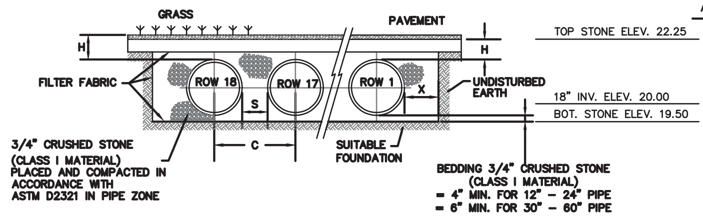


PLAN VIEW

NOTES:

1. ALL REFERENCES TO CLASS I OR II MATERIAL ARE PER ASTM D2321 "STANDARD PRACTICE FOR UNDERGROUND INSTALLATION OF THERMOPLASTIC PIPE FOR SEWERS AND OTHER GRAVITY FLOW APPLICATIONS", LATEST EDITION.
2. ALL SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D2321, LATEST EDITION AND THE MANUFACTURER'S PUBLISHED INSTALLATION GUIDELINES.
3. FILTER FABRIC: A GEOTEXTILE FABRIC SHALL BE USED AS SPECIFIED BY THE ENGINEER TO PREVENT THE MIGRATION OF FINES FROM THE NATIVE SOIL INTO THE SELECT BACKFILL MATERIAL.
4. FOUNDATION: WHERE THE TRENCH BOTTOM IS UNSTABLE, THE CONTRACTOR SHALL EXCAVATE TO A DEPTH REQUIRED BY THE ENGINEER AND REPLACE WITH SUITABLE MATERIAL AS SPECIFIED BY THE ENGINEER. AS AN ALTERNATIVE AND AT THE DISCRETION OF THE DESIGN ENGINEER, THE TRENCH BOTTOM MAY BE STABILIZED USING A GEOTEXTILE MATERIAL.
5.. BEDDING: SUITABLE MATERIAL SHALL BE CLASS I OR II. THE CONTRACTOR SHALL PROVIDE DOCUMENTATION FOR MATERIAL SPECIFICATION TO ENGINEER. UNLESS OTHERWISE NOTED BY THE ENGINEER, MINIMUM BEDDING THICKNESS SHALL BE 4" FOR 4"–24"; 6" FOR 30"–60".
6. INITIAL BACKFILL: SUITABLE MATERIAL SHALL BE CLASS I OR II IN THE PIPE ZONE EXTENDING NOT LESS THAN 6" ABOVE CROWN OF PIPE. THE CONTRACTOR SHALL PROVIDE DOCUMENTATION FOR MATERIAL SPECIFICATION TO ENGINEER. MATERIAL SHALL BE INSTALLED AS REQUIRED IN ASTM D2321, LATEST EDITION.
7. MINIMUM COVER: MINIMUM COVER OVER ALL SYSTEMS IN NON–TRAFFIC APPLICATIONS (GRASS OR LANDSCAPE AREAS) IS 12" FROM TOP OF PIPE TO GROUND SURFACE. ADDITIONAL COVER MAY BE REQUIRED TO PREVENT FLOATATION. FOR TRAFFIC APPLICATIONS, MINIMUM COVER IS 12" UP TO 36" DIAMETER PIPE AND 24" OF COVER FOR 42" – 60" DIAMETER PIPE, MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TO TOP OF RIGID PAVEMENT.

* CLASS I BACKFILL SHALL BE REQUIRED AROUND 60" DIAMETER FITTINGS.



NOMINAL DIAMETER	NOMINAL O.D.	TYPICAL SPACING "S"	NOMINAL SPACING "C"	TYPICAL SIDE WALL "X"	H (NON–TRAFFIC)	H (TRAFFIC)
12"	14.5"	11"	25.5"	8"	12"	12"
15"	18"	11.5"	29.0"	8"	12"	12"
18"	21"	17.0"	38.0"	9"	12"	12"
24"	28"	14.0"	41.5"	10"	12"	12"
30"	36"	18"	53.0"	18"	12"	12"
36"	42"	22"	63.0"	18"	12"	12"
42"	48"	24"	72.0"	18"	12"	24"
48"	54"	25"	78.5"	18"	12"	24"
60"	67"	24"	90"	18"	12"	24"

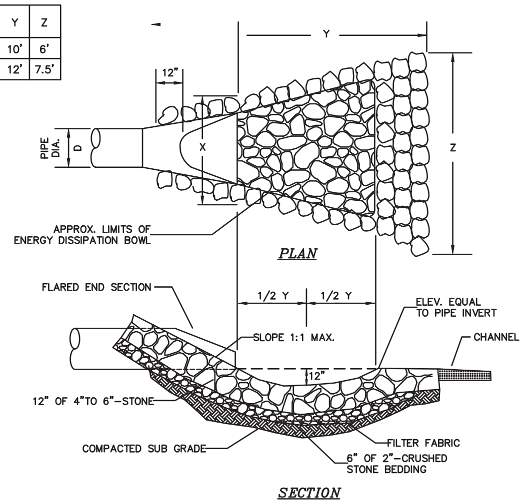
ADS 4640 TRUEMAN BLVD HILLIARD, OHIO 43026
ADVANCED DRAINAGE SYSTEMS, INC.

CROSS SECTION

DETENTION SYSTEM – ADS 18" Dia.

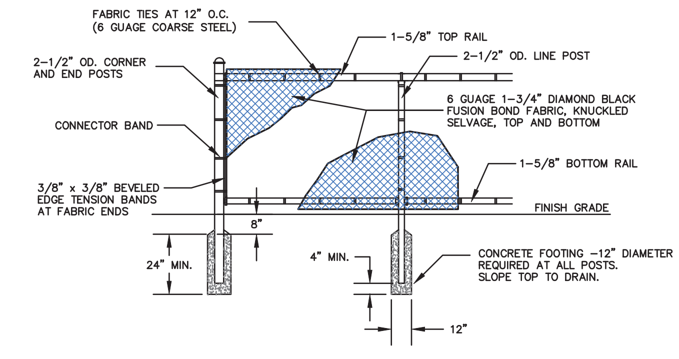
N.T.S.

PIPE DIA. "D"	X	Y	Z
12"	4'	10'	6'
18"	5.5'	12'	7.5'



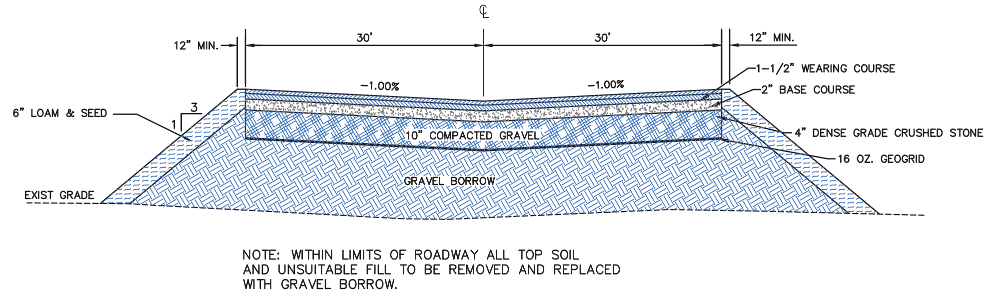
FLARED END SECTION WITH STONED SEDIMENT TRAP

N.T.S.



CHAIN LINK FENCE

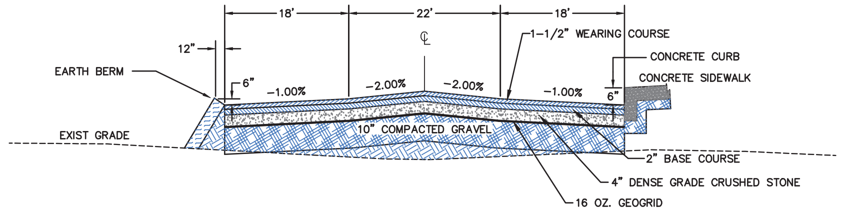
N.T.S.



NOTE: WITHIN LIMITS OF ROADWAY ALL TOP SOIL AND UNSUITABLE FILL TO BE REMOVED AND REPLACED WITH GRAVEL BORROW.

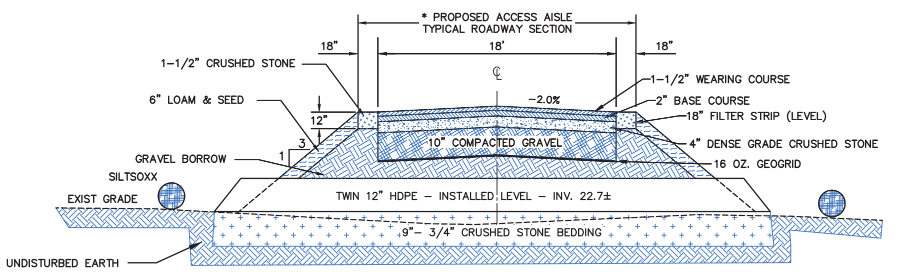
PROPOSED PARKING AREA TYPICAL SECTION

N.T.S.



EXISTING ACCESS AISLE TYPICAL SECTION

N.T.S.

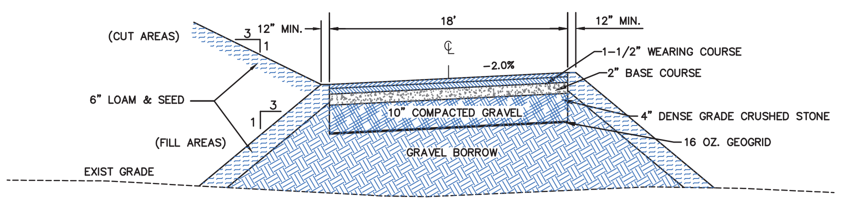


NOTE: WITHIN LIMITS OF ROADWAY ALL TOP SOIL AND UNSUITABLE FILL TO BE REMOVED AND REPLACED WITH GRAVEL BORROW.

* PROPOSED ACCESS AISLE TYPICAL ROADWAY SECTION:
STA. 0+00 TO 0+90 AND STA. 2+80 TO 3+50

PROPOSED ACCESS AISLE SECTION – TWIN CULVERT CROSSING – STA. 0+35.6

N.T.S.



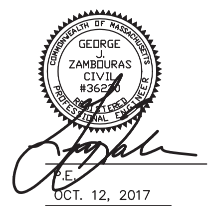
NOTE: WITHIN LIMITS OF ROADWAY ALL TOP SOIL AND UNSUITABLE FILL TO BE REMOVED AND REPLACED WITH GRAVEL BORROW.

* PROPOSED ACCESS AISLE TYPICAL ROADWAY SECTION:
STA. 0+90 TO 2+80

PROPOSED ACCESS AISLE TYPICAL SECTION

N.T.S.

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.



P.E. OCT. 12, 2017
Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

DETAILS

PREPARED FOR:
THE HOPE CUMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET – SUITE 5 – GEORGETOWN, MA 01833
PHONE: 978–352–7870 FAX: 978–352–9940

DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 | DATE: DEC. 14, 2017

revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

AS NOTED

SHEET 13 OF 15

BEST MANAGEMENT PRACTICES (BMP'S) FOR EROSION AND SEDIMENTATION CONTROL

The BMP's to be used during project construction are to prevent the generation of erosion products and their transport to environmentally and off-site sensitive areas. Environmentally and off-site sensitive areas include all designated resource areas, those areas of the site that do not need to be altered for development purposes, the designated perimeter buffer zones and all off-site abutting properties and roadways.

The primary BMP is to maintain an organized, smooth flowing and rapid Construction Sequence as outlined. Coupled with the continuous monitoring of TEC devices and their integrity, this rapid construction process should result in prompt stabilization of surfaces thereby reducing erosion potential. The Contractor is responsible to maintain the Construction Sequence subject to seasonal, atmospheric and site specific physical constraints.

A second important BMP is the prevention of concentrated water flow. Sheet flow does not demonstrate the erosive potential of concentrated channels. The Contractor is therefore encouraged to apply construction methods which will promote sheet flow with concentrated shallow channel flow paths only as necessary.

The Contractor shall be solely responsible for erosion and sedimentation control on site. The Contractor shall use a method of operation and construction and all necessary erosion and sedimentation control measures even if not specified herein or on the plans, to minimize erosion damage on and off site. The BMP's to follow should be used as a guide for erosion and sedimentation control and do not replace the practice of good judgement, common sense and thoughtful environmentally sensitive construction practices.

CONSTRUCTION SITE MANAGEMENT

In addition to the storm water management and erosion control methods discussed above, responsible construction site management is required to minimize the transport of sediment and non-sediment related pollutants from entering storm water runoff.

EQUIPMENT AND VEHICLE MANAGEMENT

Specific areas shall be designated for equipment and vehicle maintenance and repair. Maintenance areas shall include appropriate waste receptacles for spent gasoline, oil, grease, and solvents.

Specific areas shall be designated for equipment and vehicle washdown. Washdown areas shall be located on sections of the site that drain to regularly maintained sediment and non-sediment pollution control devices designed to accommodate such discharges.

The contractor shall provide positive controls to minimize raising dust from construction activities on this site. All dust and mud control measures shall be as approved by the Town.

The contractor shall provide daily positive controls to prevent mud and dirt from leaving the site on equipment tires. The stone construction apron shall be used by all vehicles and shall be maintained or replaced in kind to prevent mud accumulation off the site.

MATERIAL STORAGE AND USE

Pesticides shall be stored in a dry area that is protected from precipitation. Pesticides shall be handled as infrequently as possible. The manufacturers' recommendations as well as all applicable local, State, and federal regulations shall be strictly followed when pesticides are handled.

Application of fertilizer shall be limited to minimum required area and amount. More frequent, lower applications are preferable to infrequent high application rates. After application, fertilizer shall be worked into the soil where feasible.

Fueling vehicles and petroleum products including oil, gasoline, lubricants, and asphaltic materials shall be stored in covered areas where feasible. Routinely maintain on-site equipment and vehicles to prevent leakage of gas, oil or lubricants.

Hazardous materials include but are not limited to paints, acids, solvents, soil stabilization chemicals, concrete admixtures and other materials that have been mixed with hazardous substances. All hazardous materials shall be stored in a dry area protected from precipitation. The manufactures' recommendations as well as all applicable local, State, and federal regulations shall be strictly followed when hazardous materials are handled, transported, applied, or disposed of.

Storage areas for raw materials used in construction that can be carried by storm water runoff shall be located only in areas which drain to retention-type sedimentation control devices.

BMP'S DURING CONSTRUCTION

CUTTING AND CLEARING
Vehicles used in the wood clearing process shall not travel through running water.
As the clearing process continues, the movement of vehicles shall be limited, as much as possible, to the area of development.
Trees shall be felled directly down or up slope to prevent the diversion and concentration of storm water runoff around the trunks.
Wheel ruts shall be filled in and graded to prevent concentration of storm water runoff.
Vehicle tracks leading downhill shall be blocked during periods of intense precipitation by haybales, dikes or silt fences which shall be constructed to entrap the sediment.
All timber and cord wood shall be used for its value; consideration shall be given to chipping of brush and branches that generate wood chip mulch for the use in stabilization of disturbed surfaces. No spoil (e.g., tree stumps) shall be disposed of by burying.

GRUBBING, STRIPPING AND GRADING
Erosion control devices shall be in place as shown on the design plans before grading commences.
As much topsoil as possible shall be reclaimed for on-site use.
No topsoil shall leave the site without permission of local authorities.
Striping shall be done in a manner which will not concentrate runoff. If precipitation is expected, earthen berms shall be constructed around the area being stripped, with a silt fence or haybale dike located in an arc at the low point of the berm.
If intense precipitation is anticipated, haybales, dikes and/or silt fences shall be used as required to prevent erosion and sediment transport. The materials required shall be stored on site at all times.
If water is required for soils compaction, it shall be added in a uniform manner that does not allow excess water to flow off the area being compacted.
Dust should be held at a minimum by sprinkling exposed soil with an appropriate amount of water.

MAINTENANCE OF DISTURBED SURFACES
Runoff shall be diverted from disturbed side slopes in both cut and fill.
Mulching may be used for temporary stabilization.
Haybale dikes or silt fences shall be set where required to trap products of erosion and shall be maintained on a continuing basis during the construction process.

BMP'S DURING CONSTRUCTION

LOAMING
Loaming and seeding of slopes shall be an ongoing construction process and is not limited to any one phase of construction.
Loam shall not be placed unless it is to be seeded directly thereafter.
All disturbed areas shall have a minimum of 4" of loam placed before being seeded and mulched.
Consideration should be given to hydro-mulching, especially on slopes in excess of 3 to 1.
Loamed and seeded slopes shall be protected from washout by mulching or other acceptable slope protection until vegetation beings to grow.

STORM WATER COLLECTION SYSTEM INSTALLATION
The storm water drainage system shall be installed in a manner which will not allow run-off from disturbed areas to enter pipes.
Outlet rip-rap shall be placed immediately upon the installation of the associated pipe. Areas in the vicinity of outfalls shall be stabilized with vegetation.
Excavations for the drainage system shall not be left open when rainfall is expected overnight. If left open under other circumstances, pipe ends should be closed by a staked board or by an equivalent method.
All catch basin openings shall be covered by filter fabric placed between the grate and the frame and protected from heavy sediment by staked haybales surrounding the catch basin grate.

COMPLETION OF PAVED AREAS
During the placement of subbase and pavement, the entrances to the storm water drainage system shall be sealed if rain is expected. When these entrances are closed, consideration must be given to the direction of runoff and measures shall be undertaken to minimize erosion and to provide for the collection of sediment.
In some situations it may be necessary to keep catch basins open. Appropriate arrangements shall be made downstream to remove all sediment deposition.

STABILIZATION OF SURFACES
Stabilization of surfaces shall be an ongoing process.
Stabilization of surfaces includes the placement of pavement, rip rap, wood bark mulch and the establishment of vegetated surfaces.
Upon the completion of construction, all surfaces shall be stabilized even though it is apparent that future construction efforts will cause their disturbance.
Vegetated cover shall be established during the proper growing season and should be enhanced by soils adjustment for proper pH, nutrients and moisture content.
Surfaces that are disturbed by erosion processes, vandalism or by construction shall be stabilized as soon as possible.
Hydro-mulching of grass surfaces is recommended, especially if seeding of the surfaces is required outside the normal growing season.
Hay mulch, if used, must be properly secured.

Seed should be spread uniformly by the method most appropriate for the site. Methods include broadcasting, drilling and hydro-seeding. Hydro-seeding is the preferred method of seeding. The soil should be rolled or packed after seeding if possible. All legumes (Crown Vetch, Birdsfoot Trefoil and Clovers) must be innoculated.
Once seeded areas have been mulched, plantings may be placed from early spring to late October.
If seeded areas are not mulched, planting should be made from early spring to June 20th or between August 1st and September 15th. Plantings made after mid-November must be mulched.
If required, hay, straw or other mulch should be applied immediately after seeding. For hydro-seeding, a heavy mulch tackifier at the rate of 1500 lb. per acre shall be applied.
Planted areas should be protected from damage. Fertilization requirements during the establishment period may be determined by on-site inspections.

WASTE DISPOSAL

CONSTRUCTION WASTE
Construction waste may include but is not limited to trees, stumps, shrubs, scrap or surplus building materials, demolition material, and packaging material.
Designated waste collection areas shall be established at locations convenient to site workers.
Receptacles shall be of adequate capacity to hold waste accumulated between collection times.
Receptacles shall be covered or otherwise protected from precipitation.

WASTE CONCRETE
Excess concrete and washwater from concrete trucks shall be disposed of in a manner that prevents contact between these materials and storm water that shall be used to contain waste concrete and washwater until it hardens and can be properly disposed of.

SANITARY FACILITIES
Temporary sanitary facilities shall be provided on-site in convenient locations to site workers.
Sanitary facilities shall be adequately maintained to prevent contact between associated wastes and storm water runoff.

BMP'S POST-CONSTRUCTION

STORM WATER DETENTION AREA
Any accumulation of the products of erosion which have collected in the basin and forebay after construction is complete and basin side slopes are fully stabilized shall be removed.

DRAINAGE SWALES
After construction is complete and all slopes are stabilized by the full establishment of vegetative cover, all swales are to be periodically inspected and any accumulation of sedimentation is to be removed.

SUGGESTED SEEDING MIXTURE AND APPLICATION RATE
The seed bed should be prepared by conducting a soils test and fertilizing as required. When a soils test is not available, the following minimum amount should be applied:

Limestone 2 tons per acre.
Nitrogen (N) 40 lb. per acre or 1 lb. per 1000 square feet.
Phosphate (P205) 80 lb. per acre or 2 lb. per 1000 square feet.
Pot Ash (K20) 80 lb. per acre or 2 lb. per 1000 square feet.

The following seed mix (State Slope Mix) shall be applied at the rate of 200 lb. per acre:

50% Creeping Red Fescue	5% Red Top
30% Kentucky Tall Fescue	5% Lindino Clover
10% Annual Rye	

CONSTRUCTION SEQUENCE

GENERAL
This construction sequence provides the Contractor with an order of construction that will minimize erosion and the transport of sediments. The individual objectives of the construction process described herein shall be considered an integral component of the project design intent for each project phase. The construction sequence is not intended to prescribe definitive construction methods and shall not be interpreted as a construction specification document. The contractor shall use the construction sequence and techniques as a general guide and shall modify the suggested methods and procedures as required to best suit seasonal, atmospheric, and site specific physical constraints for the purpose of minimizing the environmental impact of construction.

SITE ACCESS
Construction site access will be confined to proposed roadway entrances at the Access Way.
The contractor shall install a 22' x 30' stone (2" to 3") construction apron at the Construction Site entrance.

INSTALLATION OF TEMPORARY EROSION CONTROL (TEC) DEVICES
Install TEC devices as shown on the plans and/or as otherwise required or deemed necessary by the Engineer and/or Municipal Inspector. If necessary, selectively cut and clear an area for the TEC devices. In general, use of existing trees to back haybales and silt fence is encouraged.

CUTTING AND CLEARING
Clear and cut only trees that are within the limits of the construction of project side slopes, drainage and paved areas. Logged timber shall be removed from the site. Tree bases and slash shall be ground and chipped and stockpiled on site for use as temporary erosion control as well as for mulch to stabilize slopes and other exposed areas. No tree bases shall be buried on site. All remaining tree bases and slash shall be removed from the site. All exposed surfaces that will not be under immediate construction shall be stabilized.

GRUBBING AND STRIPING
Inspect positioning and condition of TEC devices to assure integrity and purpose. Adjust and supplement TEC devices as necessary to assure prevention of sediment transport. Remove balance of slash and stumps from site. Consideration should be given to additional grinding and chipping for creation of mulch and chips for slope stabilization. Remove all brush, scrub and roots. Remove same from site. Remove and stockpile all topsoil upslope of TEC.
Provide a solid secure ring of haybales around the lower portion and sides of the stockpile leaving the upper side open to work from. Stabilize all exposed surfaces that will not be under immediate construction.

PROJECT ROUGH GRADING
Inspect positioning and condition of TEC devices to assure integrity and purpose. Adjust and supplement TEC devices as necessary to assure prevention of sediment transport. Perform cut and fill earthwork for project construction to rough subgrade. Remove all excess and unusable material from the site as soon as practicable. Stockpile excess material to be used in

Provide a solid secure ring of haybales around the lower portion and sides of the stockpile leaving the upper side open to work from. Stabilize all exposed surfaces that will not be under immediate construction. Dress paved areas to finished level subgrade. Install stone subbase in compacted lifts. Apply water as necessary to achieve proper compaction and to control air suspension of dust.

UTILITY INSTALLATION
Inspect positioning and condition of TEC devices to assure integrity and purpose. Adjust and supplement TEC devices as necessary to assure prevention of sediment transport. Install waterlines and other water appurtenances. Complete the installation of the drainage system. Install manhole and catch basin frames, covers and grates per plan.
The catch basins should be set with a temporary grate setting at a grade that will allow them to receive ponded run-off. Install temporary erosion berm and sediment receiving area around the catch basins as shown on the plans.

PAVEMENT BASE COURSE CONSTRUCTION
Fine grade and compact stone subbase to design grades. Install pavement base course.
Upon completion of base course, restore hay bale rings around catch basins receiving run-off. Maintain same.

CURB AND SIDEWALK CONSTRUCTION
Install bit. conc. berm as shown on plan. Install curb cuts for drive way and handicap ramp.
Prepare finished subgrade and gravel subbase and install pavement for sidewalks.

FINISHED SLOPE CONSTRUCTION, FINISHED GRADING, SLOPE STABILIZATION, TOPSOIL AND SEEDING
Inspect positioning and condition of TEC devices to assure integrity and purpose. Adjust and supplement TEC devices as necessary to assure prevention of sediment transport. Complete all finished grading and slope construction including all grass and rip-rap slopes. Apply loam and seed and stabilize all exposed surface areas and slopes.

DRAINAGE SYSTEM
Install remainder of drainage system making final adjustments as necessary for all manhole and catch basin frames, lids and grates. Clean and remove any sediment from all catch basins and drain manholes. Install all hoods and grease traps in catch basins. Complete all poured/formed inverts through drain manholes. Install all steps as required.

UTILITY SYSTEM COMPLETION
Install all utility system appurtenances.

FINISHED PAVING
Inspect positioning and condition of TEC devices to assure integrity and purpose. Adjust and supplement TEC devices as necessary to assure prevention of sediment transport. Repair any damaged side slopes, curbs, other. Adjust all main and service appurtenance features to finished grade. Adjust any drainage structures as necessary to finished grade. Install finish surface course of paving.

FINAL CLEAN-UP
Clean Inverts of culverts and catch basins. Remove sediment and debris from site.
Repair side slopes as necessary. Remove all construction debris from site. Remove all TEC devices in areas where permanent vegetation and erosion control has been established. Secure and supplement TEC devices In areas where permanent vegetation and erosion control has yet to be established. Install signs and pavement markings as applicable. Install plantings, supplement finished loam and seeding as required.

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

COMMONWEALTH OF MASSACHUSETTS
GEORGE J. ZAMBOURAS
CIVIL
#36220
REGISTERED PROFESSIONAL ENGINEER

P.E.
OCT.12, 2017
Date

PREPARED FOR:
THE HOPE CUMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

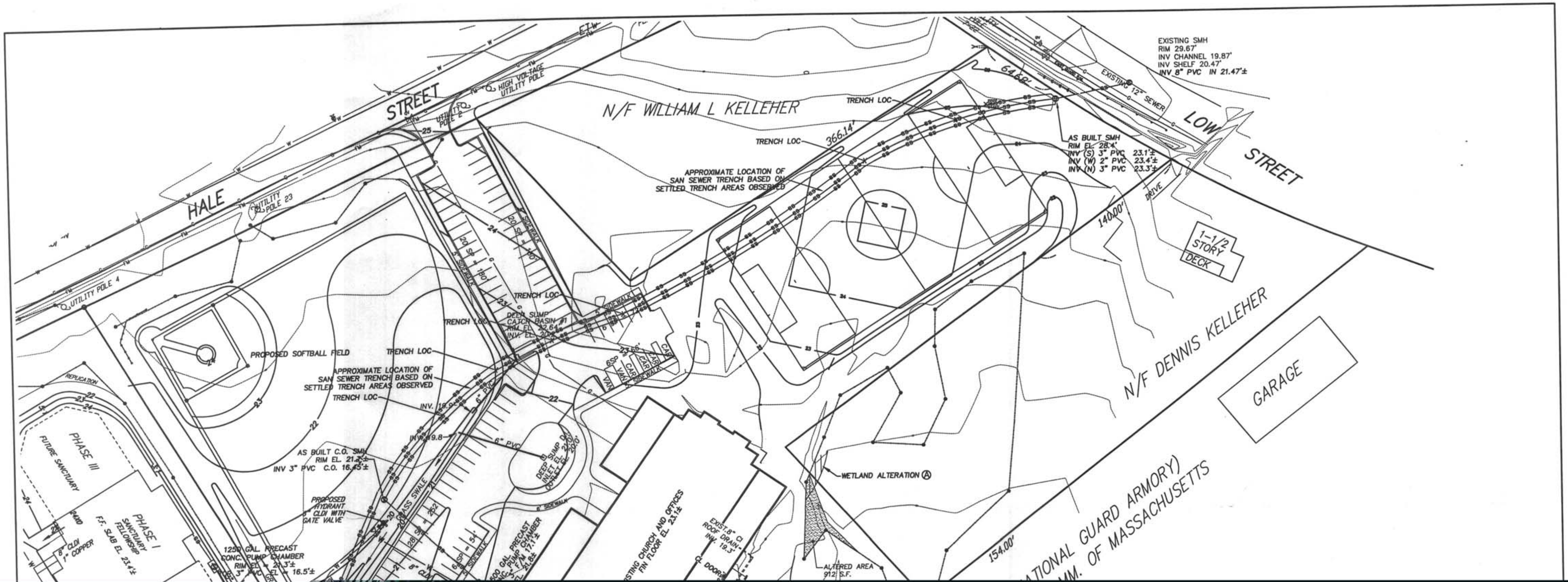
ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET – SUITE 5 – GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 | DATE: DEC. 14, 2017

revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

Scale: 1"= 20'
20 0 20 40

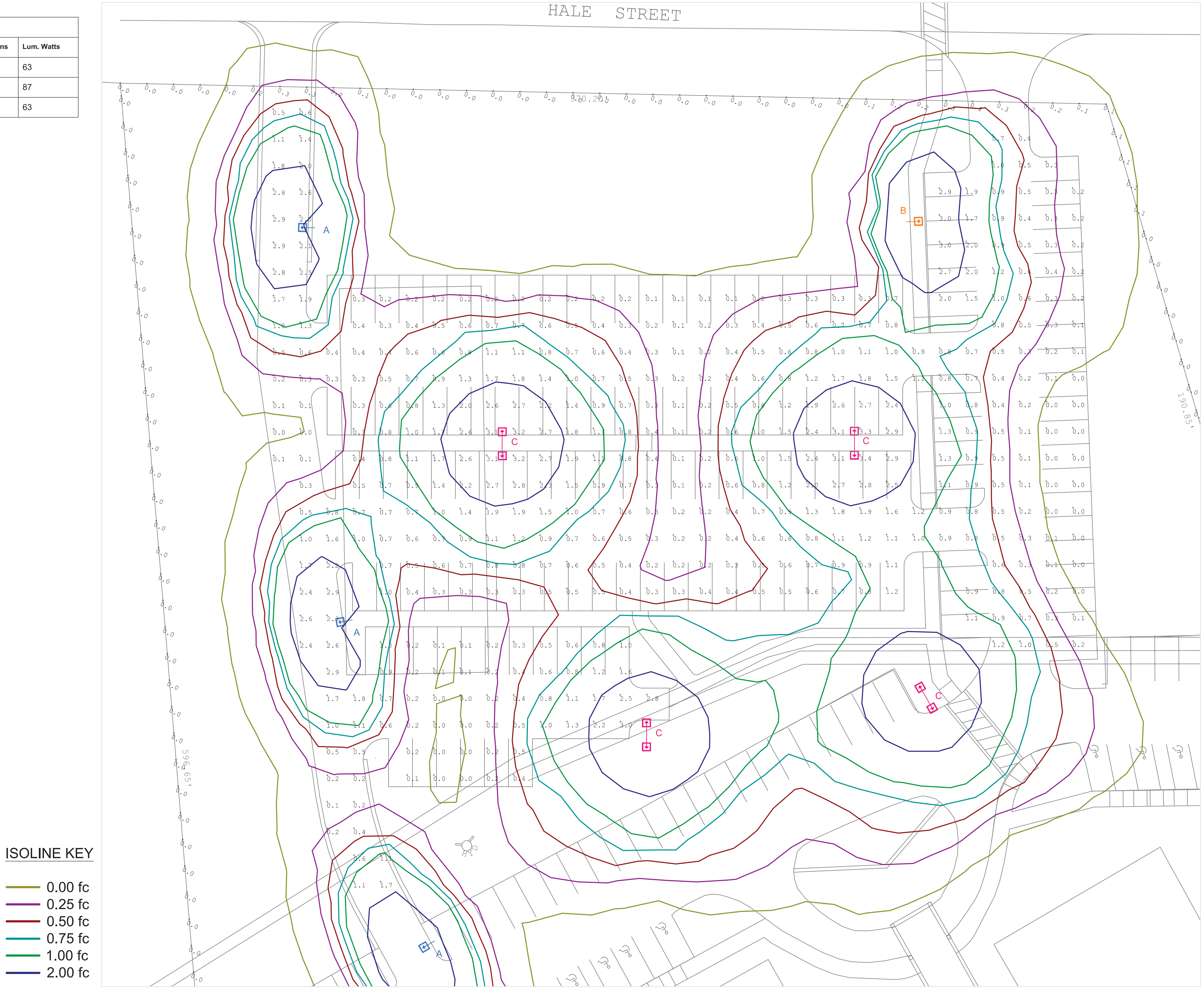

HALE
STREET
LOW
STREET
N/F WILLIAM L KELLEHER
N/F DENNIS KELLEHER
GARAGE
1-1/2
STORY
DECK
DRIVE
EXISTING SMH
RIM 29.67'
INV CHANNEL 19.87'
INV SHELF 20.47'
INV 8" PVC IN 21.47'±
EXISTING 12" SEWER
AS BUILT SMH
RIM EL. 28.4'
INV (S) 3" PVC 23.1'±
INV (W) 2" PVC 23.4'±
INV (N) 3" PVC 23.3'±
TRENCH LOC
366.14'
140.00'
154.00'
APPROXIMATE LOCATION OF
SAN SEWER TRENCH BASED ON
SETTLED TRENCH AREAS OBSERVED
HIGH VOLTAGE
UTILITY POLE
UTILITY POLE 23
UTILITY POLE 4
PROPOSED SOFTBALL FIELD
AS BUILT C.O. SMH
RIM EL. 21.2'±
INV 3" PVC C.O. 16.45'±
PROPOSED
HYDRANT
CLDI WITH
GATE VALVE
1250 GAL. PRECAST
CONC. PUMP CHAMBER
PHASE III
FUTURE SANCTUARY
PHASE I
SANCTUARY
FELLOWSHIP
F.F. SLAB EL. 23.4'±
8" CLDI
1" COPPER
REPLICATION
GRASS SWALE
SIDEWALK
6" PVC
DEEP SUMP CATCH BASIN
EXISTING CHURCH AND OFFICES
FIN FLOOR EL. 23.1'±
EXIST. 8" CI
ROOF DRAIN
INV. 19.3'
WETLAND ALTERATION Ⓐ
ALTERED AREA
912 S.F.
NATIONAL GUARD ARMORY)
COMM. OF MASSACHUSETTS

[redacted]

Photometric Study - Run 4

Luminaire Schedule									
Symbol	Qty	Label	Description	Arrangement	Arm	MH	LLF	Lum. Lumens	Lum. Watts
	3	A	AR18-10M2-MV-NW-2-XX-530	SINGLE	1.5	20	0.850	7730	63
	1	B	AR18-10M2-MV-NW-4-XX-700	SINGLE	1.5	20	0.850	9937	87
	4	C	AR18-10M2-MV-NW-5-XX-530	BACK-BACK	1.5	20	0.850	7628	63

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Parking	Illuminance	Fc	0.9	3.4	0.0	N.A.	N.A.
Property Line	Illuminance	Fc	N.A.	0.4	0.0	N.A.	N.A.



Project: Hope Community Church

Location: Newburyport, MA

Project No.: 17-676
Drawing No.: PH4
Version: 1
Revision: 0
Size: B
Sheet: 1 of 1
Scale: N.T.S.
Date: 15DEC2017

speclines INNOVATIVE OUTDOOR LIGHTING SOLUTIONS

WETLAND REPLICATION PLANTINGS

QTY.	SYMBOL	COMMON NAME (BOTANICAL NEME)	SIZE
52	VD	ARROWWOOD VIBURNUM (VIBURNUM DENTATUM)	2-3' HT
47	IV	WINTERBERRY (ILEX VERTICILLATA)	18-24" HT
54	VC	HIGHBUSH BLUEBERRY (VACCINIUM CORYMBOSUM)	18-24" HT

ALL WETLAND AND BUFFER ZONE PLANTINGS ARE TO BE SUPPLEMENTED WITH NEW ENGLAND WET SEED MIX APPLIED AT 1/4 OF THE SUPPLIER RECOMMENDATION (APPROXIMATELY 1/4 POUND WILL BE REQUIRED FOR THIS SITE.)

PLANT LIST

QTY.	SYMBOL	COMMON NAME (BOTANICAL NEME)	SIZE
11	BN	RIVER BIRCH (BETULA NIGRA)	2 ½ -3" CAL.
6	FP	GRENN ASH (FRAXINUS PENNSYLVANICA)	2 ½ -3" CAL.
6	GT	GLEDITSIA TRIACANTHOS 'SHADEMASTER' (SHADEMASTER HONEYLOCUST)	2 ½ -3" CAL.
5	CAM	SILKY DOGWOOD (CORNUS AMOMUM)	2-3' HT
27	TO	DARK AMERICAN ARBORVITAE (THUJA OCCIDENTALIS)	3-4' HT
62	IG	SHAMROCK INKBERRY (ILEX GLABRA)	18-24" HT
24	MP	MYRICA PENNSYLVANICA (BAYBERRY)	18-24" HT
10	IVH	ITEA VIRGINICA 'HENRY'S GARNET' (HENRY'S GARNET VIRGINIA SWEETSPIRE)	18-24" HT
27	WFG	WEIGELA FLORIDA 'GHOST' (GHOST WEIGELA)	2 GAL.
48	JH	JUNIPERUS HORIZONTALIS (CREEPING JUNIPER)	2 GAL.
21	HS	HERMEROCALLIS (STELLA D'ORO DAYLILY)	1 GAL.
7	SP	CUP PLANT (SILPHIUM PERFOLIATIUM)	1 GAL.
4	VP	COMMON BLUE VIOLET (VIOLA PAPILIONACEA)	1 GAL.
6	EM	JOE PYE WEED (EUPATORIUM MACULATUM)	1 GAL.

I CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF IT CONFORMS WITH TECHNICAL, ETHICAL AND PROCEDURAL STANDARDS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING IN THE COMMONWEALTH OF MASSACHUSETTS.

COMMONWEALTH OF MASSACHUSETTS GEORGE J. ZANBOURAS CIVIL #36230 REGISTERED PROFESSIONAL ENGINEER

P.E.

OCT.12, 2017

Date

PARKING IMPROVEMENTS FOR HOPE COMMUNITY CHURCH AT 11 HALE STREET IN NEWBURYPORT, MASS.

LANDSCAPE PLAN

PREPARED FOR:
THE HOPE CUMMUNITY CHURCH OF NEWBURYPORT
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET - SUITE 5 - GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940

DRAWING FILE: \SEQ93\HOPECHURCH-FEB-2017.DWG

JOB NO. A1510-02 DATE: DEC. 14, 2017

revision #	date	description
1	2/3/2018	CONSULTANT COMMENTS REV.

Scale: 1"= 20'

20 0 20 40

SHEET 10 OF 15

Hydrologic Report

Parking Improvements

The Hope Community Church of Newburyport

located at

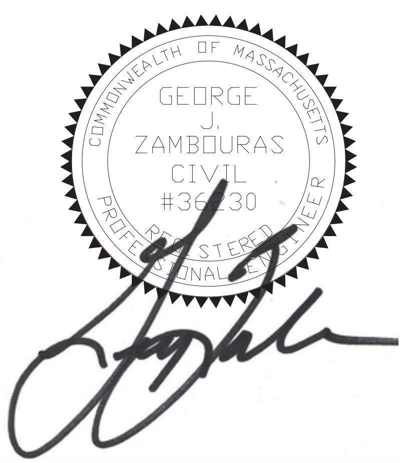
11 Hale Street

Newburyport, Massachusetts 01950

Prepared For

The Hope Community Church of Newburyport
11 Hale Street
Newburyport, MA 01950

2, 10, 25 & 100 Year Storm
24 Hour Duration



Date: December 14, 2017
Rev. February 3, 2018

Atlantic Engineering & Survey Consultants Inc.
97 Tenney Street, Georgetown, Massachusetts 01833
(978) 352-7870

TABLE OF CONTENTS

INTRODUCTION:

This report describes the pre and post hydraulic analysis and stormwater management measures to be implemented to mitigate the impacts to the environment and surrounding properties in the development of the Proposed Parking Lot and Site Improvements for The Hope Community Church of Newburyport located at 11 Hale Street, Newburyport, Massachusetts.

In analyzing the impacts of the proposed improvements only the portions of the sites watershed being affected were studied. The hydraulic report does not calculate run-off rates or quantities for the areas of the site were no work is proposed.

The design of the stormwater system's components are based on the hydraulic analysis performed utilizing "HydroCAD Storm water Modeling Software" for storm events of 25 and 100-year storm frequencies in accordance with the City of Newburyport's regulations and guidelines.

Run-off quantities are calculated using the most current data obtained from the Northeast Regional Climate Center (NRCC) and Natural Resources Conservation Service (NRCS) on July 26, 2017. The rainfall data and calculated IDF curves are located in Appendix "E".

EXISTING CONDITIONS:

The site is identified by the City of Newburyport Assessors Map 83 as Parcel 3 and is located on the southeasterly side of Hale Street approximately 350 feet southwest of the Low Street intersection. The site has frontage along Hale Street and Low Street and is accessed from Hale Street. Due to wetland constraints within the property access to the site from Low Street is not feasible. The site is a 10.8 acre developed parcel consisting of a 31,858 square foot building, 1.54 acres of impervious paved surfaces, and a grassy field area of approximately 1.5 acres. The remainder of the property is comprised of bordering vegetated wetlands and stormwater management areas which were constructed during the development of the site in 1998.

The current building houses the Hope Community Church and Mrs. Murray's Nursery School. The site also serves as a meeting area for numerous local organization events and is one of the public voting sites for the City.

The site's bordering vegetate wetlands were delineated by Rimmer Environmental Consulting (REC) on March 2, 2016 and November 9, 2016. The sites bordering vegetated wetlands are delineated by flags A1-A51, A1-A11 and B7-B15. The wetlands associated with the drainage swale along Hale Street are further explained below. Refer to REC's wetland delineation report dated September 20, 2017.

As indicated in REC's report the grass and stone lined drainage swale located to the south and east of the existing parking areas was constructed as a stormwater management component during the development of the site in 1999 to 2000. As this drainage swale was created as a stormwater management component during the development of the site it is not considered a wetland resource area.

It is also possible that the drainage swale along the southerly side and parallel to Hale Street was constructed during 1997 to 1998 as part of the stormwater management system for the industrial park in the area. This swale is delineated by flags A1-A11 and B7-B15 on the plans and has been considered as a wetland for the project. However, if the needed information can be discovered that the drainage swale was created as a stormwater management component for the development of the industrial park area it is also would not be considered a wetland resource area.

PROPOSED CONDITIONS:

The proposed site development consists of constructing a new parking area which results in 103 new parking spaces, a 350 foot access drive and the rehabilitation of approximately 19,000 square feet of existing paved surfaces. The improvements also include landscaping and buffer zone enhancement plantings; new sidewalks, site lighting and traffic management signage to improve safety within the site.

To mitigate the effects of the new construction additional drainage, subsurface stromwater detention and proprietary stormwater unit are also proposed. In the area of the site were redevelopment is occurring improvements to the exiting drainage system and a proprietary stormwater unit is proposed. These stromwater components are explained in detail within this report.

SITE SOILS:

Existing soils, as identified by the United States Department of Agriculture Natural Resources Conservation Services (NRCS) Soil Report, located in Appendix "H", are comprised of Scantic silt loam, Suffield silt loam and Maybid silt loam. The portion of the site were work is proposed is comprised of Scantic silt loam soils. The Suffield silt loam soils are located at the westerly portion of the site adjacent to Low Street and Maybid silt loam soils are located within the southerly half of the site.

Scantic silt loams consist of soft fine silty glacial deposits and/or soft fine silty marine deposits over hard fine silty glacial and/or marine deposits. These soils are poorly drained, have a water table within 12 inches of the surface and belong to the Hydrologic Soil Group (HSG) C/D

Maybid silt loams consist of soft silty and clayey and/or firm silty marine deposits. These soils are very poorly drained, have a water table at or near the surface and belong to the HSG C/D

Suffield silt loams consist of soft coarse silty glacial deposits over hard clayey glacial deposits. These soils are well drained and belong to the HSG C.

Soil testing within the site occurred on two (2) occasions. The first soil tests occurred July 9, 1997and the most recent soil test occurred on January 11, 2017. On July 9, 1996 the soil was examined in three (3) test pits. These test pits are located in the northerly portion of the site were the proposed parking expansion is to take place. These excavations occurred prior to the filling of this portion of the site with 18" to 24" of topsoil. On January 11, 2017 one additional test pit was made within the existing parking area of the main entrance to the site. The location and soils analysis of these tests are included on the project plans.

Of the 4 test pits all indicated an 18" layer of top soil and/or fill with an underlying material of clay. In each of the test pits the estimated high ground water table was located approximately at the top surface of the clay stratum.

As these test pits confirmed the soils types as identified in the NRCS report, throughout this analysis the site was modeled utilizing soils belonging to the Hydrologic Soil Group D to establish a comparison of pre and post run-off rates and volumes.

Due to the restrictions of class "D" soils which exist within the site; the high ground water table elevation and DEP's restriction* on utilizing "D" soils for infiltration the calculations provided in the hydraulic report are performed without considering any infiltration.

*Per DEP Stormwater Manual the minimum allowable infiltration rate is 0.17 inches per hour and the applicable Rawl's rate for clay is 0.02 inches per hour. Additionally the Stormwater Manual stipulates no Infiltration is permitted in class "D" soils.

STORMWATER MANAGEMENT

COMPLIANCE WITH DEP STORMWATER MANAGEMENT POLICY

The sites existing stormwater runoff is managed thought the use of a catch basin collections system, these basins discharge into a stoned lined drainage channel. Runoff is then conveyed into two separate constructed wetland marsh areas which also includes pre-treatment settling basins prior to its ultimate discharge into the wetland.

The proposed stormwater management for the site improvements is divided into two areas. The first being the redevelopment of the existing parking area and the second being the new parking lot constriction.

<u>Site Redevelopment - Exsiting Parking Area and Entrance Access Aisle</u>
The drainage system in the redevelopment of the existing parking lot will be upgraded. These upgrades include new deep sumped hooded catch basins and the addition of a proprietary stormwater unit to treat stormwater. These system improvements enable TSS removal in excess of 80% as explained below.

<u>Site New Development – Proposed Parking and Secondary Access Aisle</u>

To effectively manage the impacts of the project to the environment; to surrounding properties; and to mitigate post construction run-off rates the design relies on conventional stormwater management components. The proposed improvements include components consisting of deep sumped hooded catch basins, sub-surface detention and a proprietary stormwater unit for TSS removal. A designed the proposed improvements and stormwater management system provides the following:

- A reduction in post development run-off rates when compared to pre-development rates
- Treatment of stormwater in excess of 80% TSS removal
- Planned construction BMP's to control sedimentation and erosion during construction
- Establishes a long-term Operation and Maintenance Plan to ensure the protection of the resource areas
- Enhances the value of buffer zones through plantings

Standard 1 – Untreated Stormwater
Standard 1 states that “No new stormwater conveyances (e.g. outfalls) will discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.”

The proposed site improvements do not include new conveyances that discharge directly to the resource areas without treatment and BMP’s are proposed to prevent erosion to the surrounding resource areas. As no new conveyances will directly discharge untreated stormwater, the project meets this Standard.

Standard 2 – Post Development Peak Discharge Rates
“Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.”

Summary of Site Discharge Flows

Design Storm	*Pre-Development Peak Discharge (CFS.)*	*Post-Development Peak Discharge (CFS.)*
2 Yr.	*4.70*	*4.56*
10 Yr.	*7.59*	*7.20*
25 Yr.	*9.87*	*9.29*
100 Yr.	*14.29*	*13.79*

Post development discharge rates result in a reduction of pre-development rates for the 2, 10, 25 and 100-year storm events therefore the project meets Standard 2.

Standard 3 – Recharge to Groundwater
Storm Water Recharge Calculation:
Required Recharge Volume

The Required Recharge Volume (Rv) is calculated using the following formula:

Rv = F x Impervious Area
Where Target Depth Factor F: F= 0.10 inch (for HSG D Soils)
Site Impervious Area* = 30,679 square feet (4.860 acres)

*Impervious new construction only

Parking Area, Access Drive and Walkways (Sub-catchment P3)	35,755 square feet
Access Drive Dwellings (Sub-catchment P3)	12,644 square feet
Total Site Impervious New Construction	38,069 square feet

Rv = ((0.10/12) x 38,069) = 335 cubic feet

Site Recharge Volumes Provided: None

The stormwater management system provides none of the required recharge volume as a result of DEP's restriction on class D soils.

Standard 4 – Removal of 80% Total Suspended Solids (TSS)

Tss Removal Calculation:

The BMP's proposed for the management of storm water enable the development to achieve TSS removal rate of 88% for the re-development sub-catchment area P1; 91% for the new development sub-catchment area P2; 82% for the new development sub-catchment area P3; and 86% for the pre development and existing development sub-catchment area P6 as identified below.

Sub-Catchment P1 - Existing Parking – Re-development

Location: 11 Hale Street - Newburyport, MA

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 5%	**0.05**	**1.00**	**0.05**	**0.95**
Deep Sump and Hooded Catch Basin	**0.25**	**0.95**	**0.24**	**0.71**
Proprietary Treatment Unit WQ-1	**0.835**	**0.71**	**0.59**	**0.12**
		Total TSS Removal =	**88%**	

Sub-Catchment P2 - Proposed Parking and Access Roadway – New Construction

Location: 11 Hale Street - Newburyport, MA

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 5%	0.05	1.00	0.05	0.95
Deep Sump and Hooded Catch Basin	0.25	0.95	0.24	0.71
Proprietary Treatment Unit WQ-2	0.871	0.71	0.62	0.09

Total TSS Removal = 91%

Sub-Catchment P3 - Portion of Proposed Access Roadway, Existing Wetland & Wetland Replacement – New Construction*

***Note – Discharge Flows to Existing Stormwater Constructed Sedimentation Basin & Wetland**

Location: 11 Hale Street - Newburyport, MA

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Stone Filter Strip	0.1	1.00	0.1	0.90
Exist Constructed Sed. Basin & Wetland Detention	0.8	0.90	0.72	0.18

Total TSS Removal = 82%

Sub-Catchment P5 - Proposed Access Roadway Connection to Exist Parking Area – New Construction and Existing Undisturbed Paved Area*

***Note – Discharge Flows to Existing Stormwater Drainage System and Constructed Sedimentation Basin & Wetland**

Location: 11 Hale Street - Newburyport, MA

TSS Removal Calculation Worksheet

B	C	D	E	F
BMP[1]	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
Street Sweeping - 5%	**0.05**	**1.00**	**0.05**	**0.95**
Deep Sump and Hooded Catch Basin	**0.25**	**0.95**	**0.24**	**0.71**
Exist Constructed Sed. Basin & Wetland Detention	**0.80**	**0.71**	**0.57**	**0.14**
		Total TSS Removal =	**86%**	

Proprietary Treatment Units - Water Quality Treatment Volume Calculation:

Required Water Quality Treatment Volume (using MassDEP standard method reference to covert required water quality volume to a discharge rate, dated Sept. 10, 2013)

<u>Proposed Parking Lot and Drive - New Development, Sub-Catchment Area P-2</u>
WQV = Water quality volume in watershed inches = ½”
A = Impervious Surface = 0.82 acres = 0.0012813 sq. miles
Tc = 5 min
Qu = 773 csm/in (from figure 2 DEP reference)
$Q_{0.5}$ = flow rate associated with first ½” runoff

$Q_{0.5}$ = (Qu) (A) (WQV) = 0.5 cfs

Proposed CDS (Unit WQ-1) Treatment Capacity = 1.4 cfs*
*Refer to Contech documentation Appendix “F”.

Condition met treatment capacity 1.4 cfs > required 0.5 cfs

<u>Proposed Parking Lot Rehabilitation – Re-Development, Sub-Catchment Area P-1</u>
WQV = Water quality volume in watershed inches = ½”
A = Impervious Surface = 0.29 acres = 0.0004453 sq. miles
Tc = 5 min
Qu = 773 csm/in (from figure 2 DEP reference)
$Q_{0.5}$ = flow rate associated with first ½” runoff

$Q_{0.5}$ = (Qu) (A) (WQV) = 0.17 cfs

Proposed CDS (Unit WQ-2) Treatment Capacity = 1.0 cfs*
*Refer to Contech documentation Appendix “F”.

Condition met treatment capacity 1.0 cfs > required 0.5 cfs

The removal of Total Suspended Solids (TSS) proposed is accomplished through the use of structural and non-structural BMPs. The components are sized to adequately to treat the required water quality volume and achieve TSS removal rates in excess of 80%. A long-term pollution prevention plan (refer to Appendix”G”) has been developed which establishes practices to control and prevent pollution.

Therefore the project meets Standard 4.

Standard 5 – Land Uses with Higher Potential Pollutant Loads

The project use is not a Land Use with Higher Potential Pollutant Loads. Therefore, Standard 5 is not applicable to this project.

Standard 6 – Critical Areas

The project is not located within a Zone II or Interim Wellhead Protection Area of a public water supply and the project’s stormwater discharges do not discharge near or to any critical areas, therefore
The project’s is not located in estimated habitat or any critical area therefore Standard 6 does not apply.

Standard 7 - Redevelopment

Standard 7 states that “A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5 and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.”

The re-development portion of the project has fully met Standards 1, 2 and 4; and Standards 5 and 6 do not apply. As the site is completely comprised of class “D” soils credit for recharge is not possible in any areas of the site due to MassDEP Stormwater Regulations which does not permit recharge in class “D” soils,

Standard 8 – Erosion and Sedimentation Controls

A Stormwater Pollution Prevention Plan for the Project has been submitted for the site (refer to the Site Management Notes Sheet No. 14 of the project drawings) and will be revised as needed or required prior to any land disturbance on the site.
Therefore the Project complies with Standard 8.

Standard 9 – Operation and Maintenance Plans

A long-term operation and maintenance plan is included in Appendix "G". The Plan includes provisions for Construction-Phase measures, as well as long term maintenance and inspections. Therefore the Project complies with Standard 9.

Standard 10 – Illicit Discharges to Drainage System

There are no known or suspected illicit discharges to the stormwater management system at the project site.
Therefore the Project complies with Standard 10.

SUMMARY:

The proposed stormwater management systems employed in the site's development provide for the removal of suspended solids and for the recharge of stormwater runoff thereby meeting DEP Stormwater Standards.

As indicated in the summary below the stormwater management system effectively mitigates the effects of the site's development by reducing peak runoff rates for the 2, 10, 25 and 100-year events.

Summary of Total Site Discharge Flows and Volumes

Design Storm	*Pre-Development Max. Discharge (CFS.)*	*Post-Development Max. Discharge (CFS.)*	*Pre-Development Max. Volume (Acre-FT.)*	*Post-Development Max. Volume (Acre-FT.)*
2 Yr.	*4.70*	*4.56*	*0.571*	*0.680*
10 Yr.	*7.59*	*7.20*	*1.038*	*1.166*
25 Yr.	*9.87*	*9.29*	*1.426*	*1.563*
100 Yr.	*14.29*	*13.79*	*2.251*	*2.398*

Summary of Southeasterly Site Discharge Flows and Volumes

Design Storm	Pre-Development Max. Discharge (CFS.)	Post-Development Max. Discharge (CFS.)	Pre-Development Max. Volume (Acre-FT.)	Post-Development Max. Volume (Acre-FT.)
2 Yr.	0.45	0.39	0.039	0.034
10 Yr.	0.74	0.64	0.072	0.063
25 Yr.	0.95	0.85	0.099	0.088
100 Yr.	1.35	1.23	0.155	0.141

Summary of Southwesterly Site Discharge Flows and Volumes

Design Storm	Pre-Development Max. Discharge (CFS.)	Post-Development Max. Discharge (CFS.)	Pre-Development Max. Volume (Acre-FT.)	Post-Development Max. Volume (Acre-FT.)
2 Yr.	4.25	4.17	0.532	0.646
10 Yr.	6.88	6.56	0.966	1.102
25 Yr.	8.97	8.45	1.327	1.475
100 Yr.	13.03	12.78	2.096	2.257

Assumptions:

The following assumptions are being used for design purposes:

1) 2, 10, 25 & 100 year storm frequency.

2) 24 hour storm duration (min.)

3) Hydro logic soils groups for the run-off areas are classified class as "D" – Clay.

4) Existing and proposed Cn values are as noted in the report.

5) Exfiltration rate for Clay is 0.02 inches/hour based on DEP's Table 2.3.3 "1982 Rawls Rates". Due to the extent of "D" soils throughout the site, and DEP's Stormwater Manual's requirement that "D" soils is not permitted to be utilized for infiltration no infiltration is calculated within the analysis..

Design Criteria:

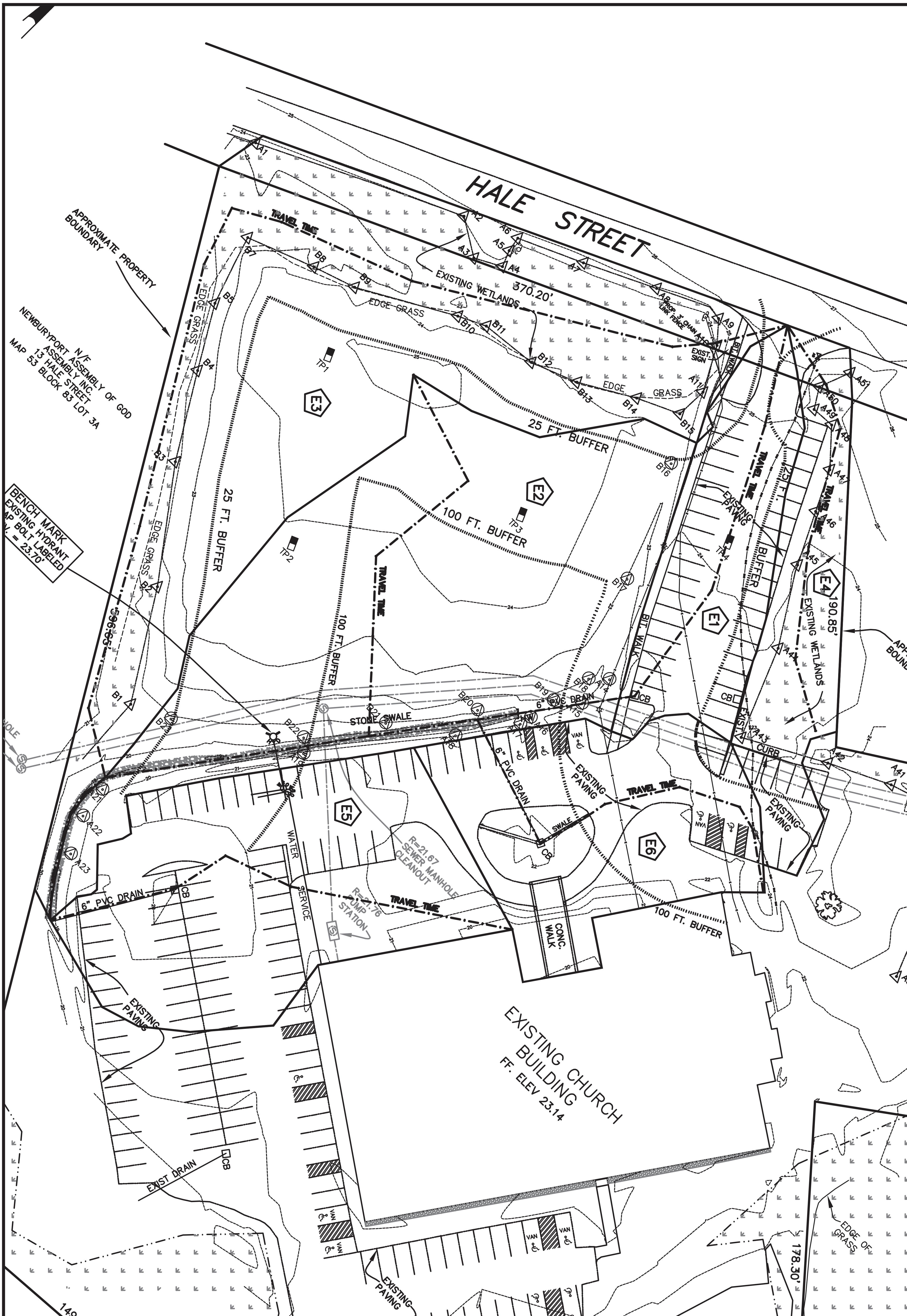
1) ***Run-off quantities are calculated using the most current data obtained from the Northeast Regional Climate Center (NRCC) and Natural Resources Conservation Service (NRCS on July 26, 2017. A copy of the rainfall data and IDF curves are appended to this report.***
2) ***Extreme Precipitation rainfall Data***

Storm Event in Years	***Inches per 24 Hours***
2	3.22
10	4.95
25	6.33
50	7.62
100	9.19

3) ***Proposed Cn values are as noted in the report.***
4) ***Hyetograph shape = Custom synthetic storm generated by NRCC extreme rainfall IDF curve for eastern MA.***
5) ***The maximum post-development run-off flow rates for the 2, 10, 25 & 100 yr. design storms shall be equal or less than pre-development run-off rates.***
6) ***Conduit design capacity based on 25-year design storm.***

APPENDIX A

PRE- DEVELOPMENT CALCULATIONS



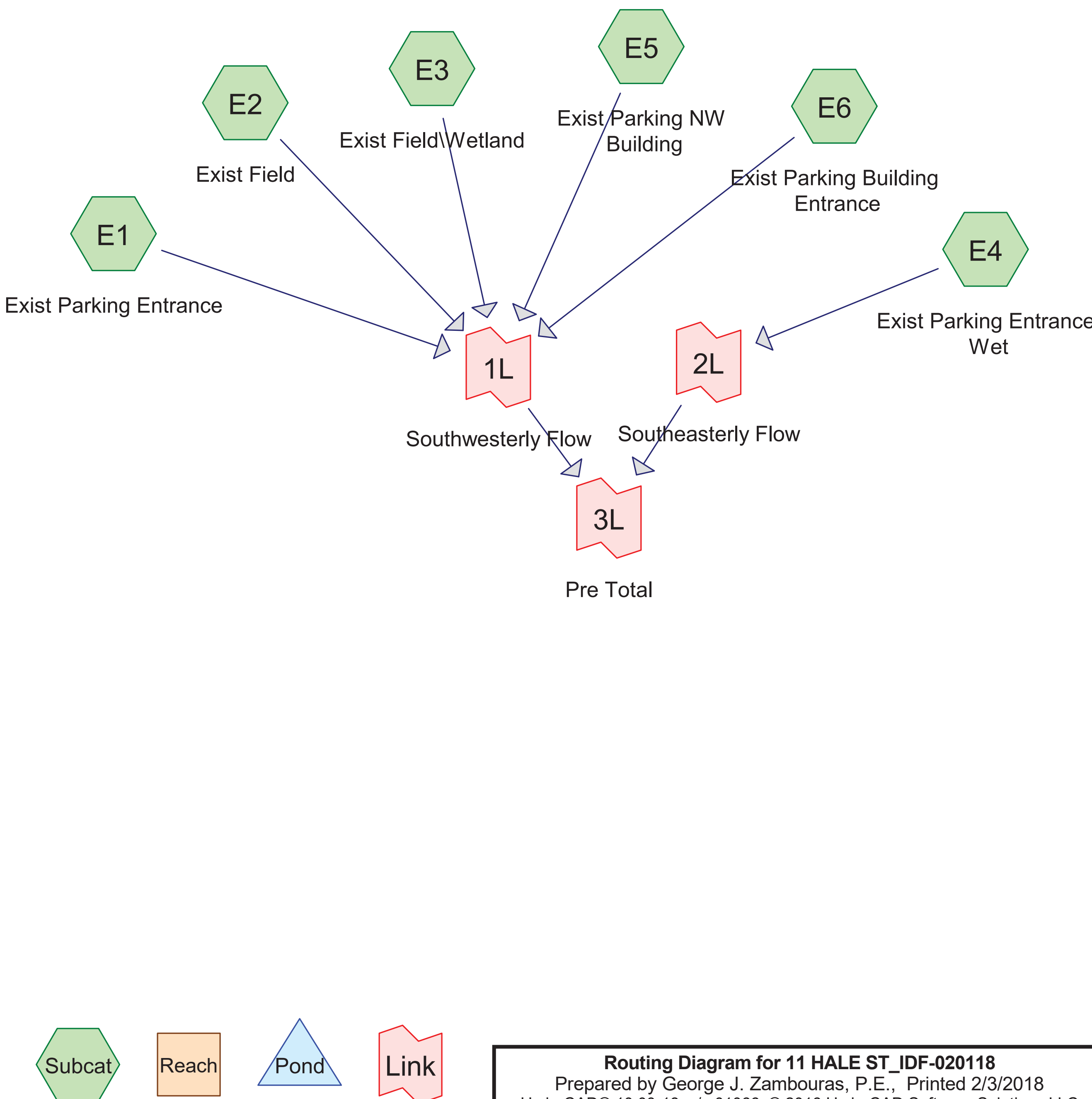
PRE-DEVELOPMENT WATERSHED
PARKING IMPROVEMENTS
THE HOPE COMMUNITY CHURCH
11 HALE STREET
NEWBURYPORT, MASSACHUSETTS

DATE: SEPTEMBER 13, 2017

SCALE 1"=60'

ENGINEER:

ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
97 TENNEY STREET – – GEORGETOWN, MA 01833
PHONE: 978-352-7870 FAX: 978-352-9940



Routing Diagram for 11 HALE ST_IDF-020118
Prepared by George J. Zambouras, P.E., Printed 2/3/2018
HydroCAD® 10.00-18 s/n 01066 © 2016 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.009	84	50-75% Grass cover, Fair, HSG D (E5)
0.156	89	<50% Grass cover, Poor, HSG D (E2, E3)
1.831	80	>75% Grass cover, Good, HSG D (E1, E2, E3, E4, E5, E6)
0.596	83	Brush, Poor, HSG D (E3, E4)
1.023	98	Paved parking, HSG D (E1, E3, E4, E5, E6)
3.614	**86**	**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Exist Parking Entrance Runoff Area=12,326 sf 94.00% Impervious Runoff Depth>2.87"
Flow Length=602' Tc=4.3 min CN=97 Runoff=0.90 cfs 0.068 af

Subcatchment E2: Exist Field Runoff Area=42,660 sf 0.00% Impervious Runoff Depth>1.48"
Flow Length=462' Tc=15.0 min CN=81 Runoff=1.13 cfs 0.121 af

Subcatchment E3: Exist Field\Wetland Runoff Area=49,240 sf 0.92% Impervious Runoff Depth>1.54"
Flow Length=728' Tc=22.5 min CN=82 Runoff=1.12 cfs 0.145 af

Subcatchment E4: Exist Parking Entrance Runoff Area=10,694 sf 29.40% Impervious Runoff Depth>1.93"
Flow Length=234' Tc=9.0 min CN=87 Runoff=0.45 cfs 0.039 af

Subcatchment E5: Exist Parking NW Runoff Area=24,990 sf 75.84% Impervious Runoff Depth>2.56"
Flow Length=262' Tc=10.2 min CN=94 Runoff=1.31 cfs 0.122 af

Subcatchment E6: Exist Parking Building Runoff Area=17,522 sf 59.47% Impervious Runoff Depth>2.27"
Flow Length=535' Tc=7.0 min CN=91 Runoff=0.97 cfs 0.076 af

Link 1L: Southwesterly Flow Inflow=4.25 cfs 0.532 af
Primary=4.25 cfs 0.532 af

Link 2L: Southeasterly Flow Inflow=0.45 cfs 0.039 af
Primary=0.45 cfs 0.039 af

Link 3L: Pre Total Inflow=4.70 cfs 0.571 af
Primary=4.70 cfs 0.571 af

Total Runoff Area = 3.614 ac Runoff Volume = 0.571 af Average Runoff Depth = 1.90"
71.70% Pervious = 2.591 ac 28.30% Impervious = 1.023 ac

Summary for Subcatchment E1: Exist Parking Entrance

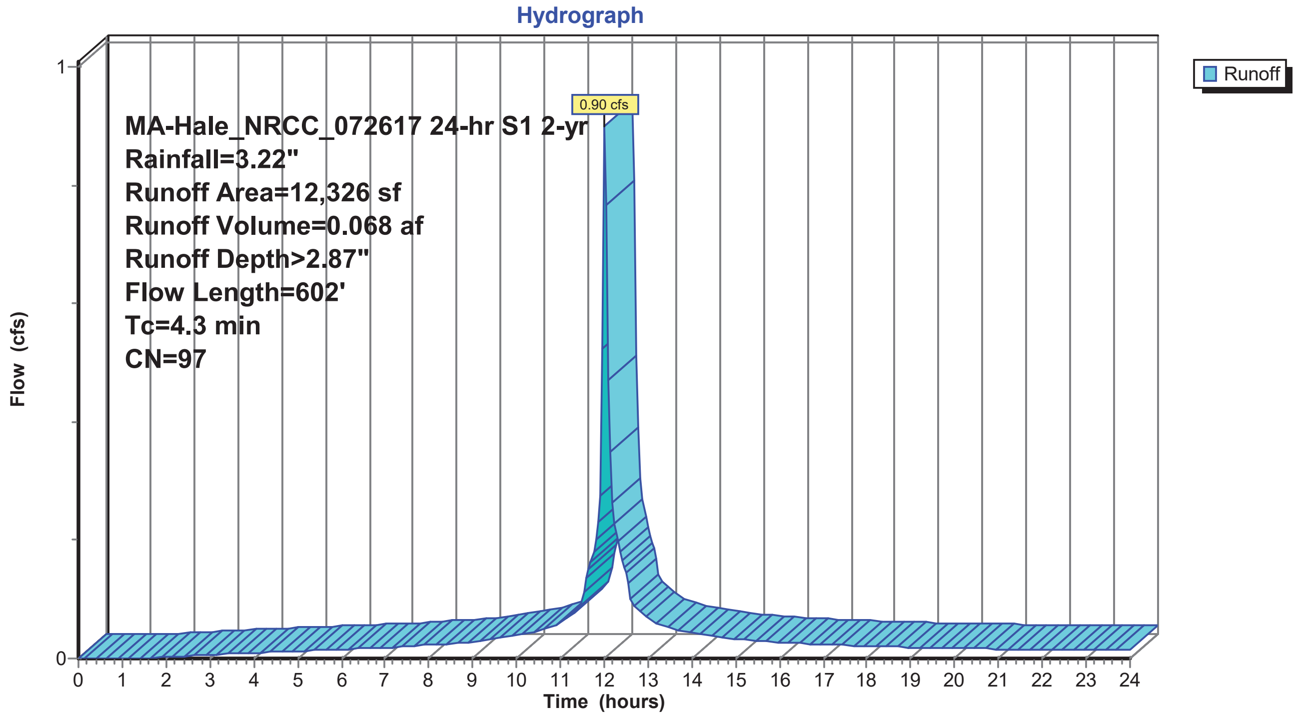
Runoff = 0.90 cfs @ 12.01 hrs, Volume= 0.068 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
740	80	>75% Grass cover, Good, HSG D
11,586	98	Paved parking, HSG D
12,326	97	Weighted Average
740		6.00% Pervious Area
11,586		94.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.31		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.22"
1.2	173	0.0140	2.40		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
0.3	65	0.0116	4.00	0.79	**Pipe Channel, PVC Drain to Channell** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.010 PVC, smooth interior
2.2	314	0.0040	2.39	28.66	**Trap/Vee/Rect Channel Flow, Channel** Bot.W=5.00' D=1.50' Z= 2.0 '/' Top.W=11.00' n= 0.040 Earth, cobble bottom, clean sides
4.3	602	Total			

Subcatchment E1: Exist Parking Entrance



Summary for Subcatchment E2: Exist Field

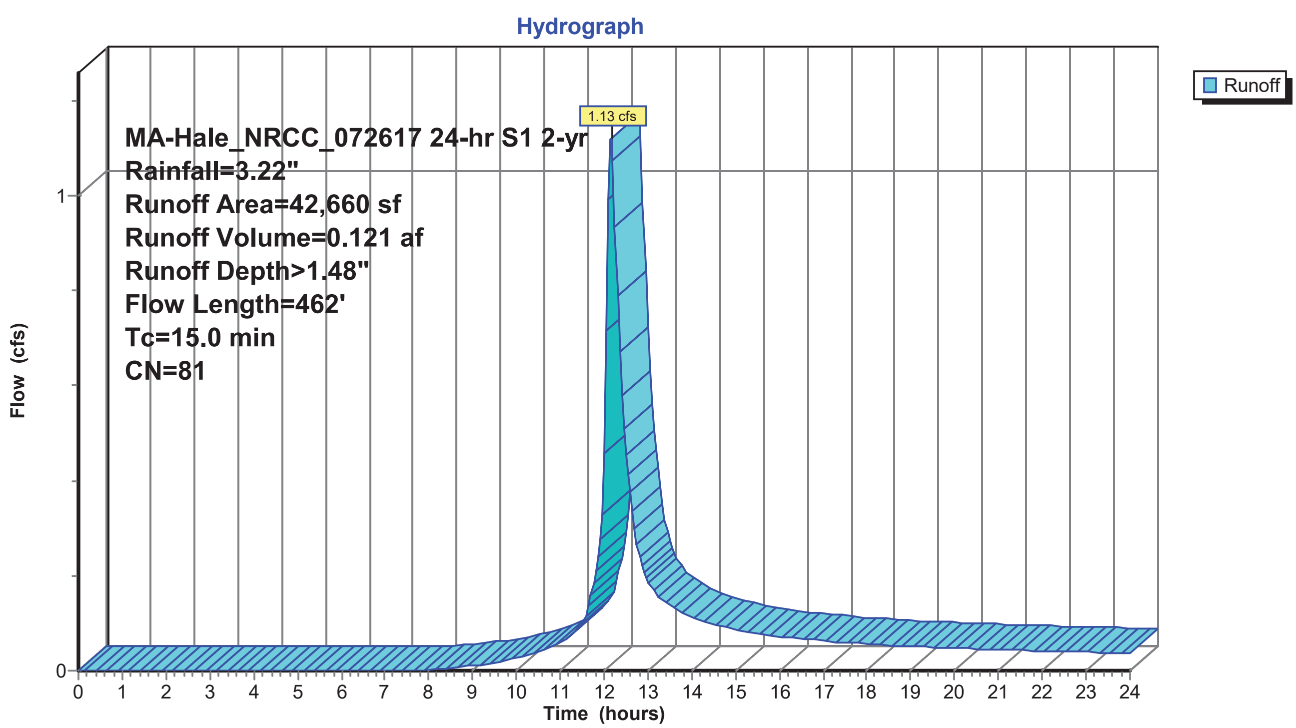
Runoff = 1.13 cfs @ 12.16 hrs, Volume= 0.121 af, Depth> 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
38,610	80	>75% Grass cover, Good, HSG D
4,050	89	<50% Grass cover, Poor, HSG D
42,660	81	Weighted Average
42,660		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	50	0.0120	0.08		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 3.22"
3.4	180	0.0160	0.89		**Shallow Concentrated Flow, Grass Field** Short Grass Pasture Kv= 7.0 fps
1.6	232	0.0040	2.39	28.66	**Trap/Vee/Rect Channel Flow, Channel** Bot.W=5.00' D=1.50' Z= 2.0 '/' Top.W=11.00' n= 0.040 Earth, cobble bottom, clean sides
15.0	462	Total			

Subcatchment E2: Exist Field



Summary for Subcatchment E3: Exist Field\Wetland

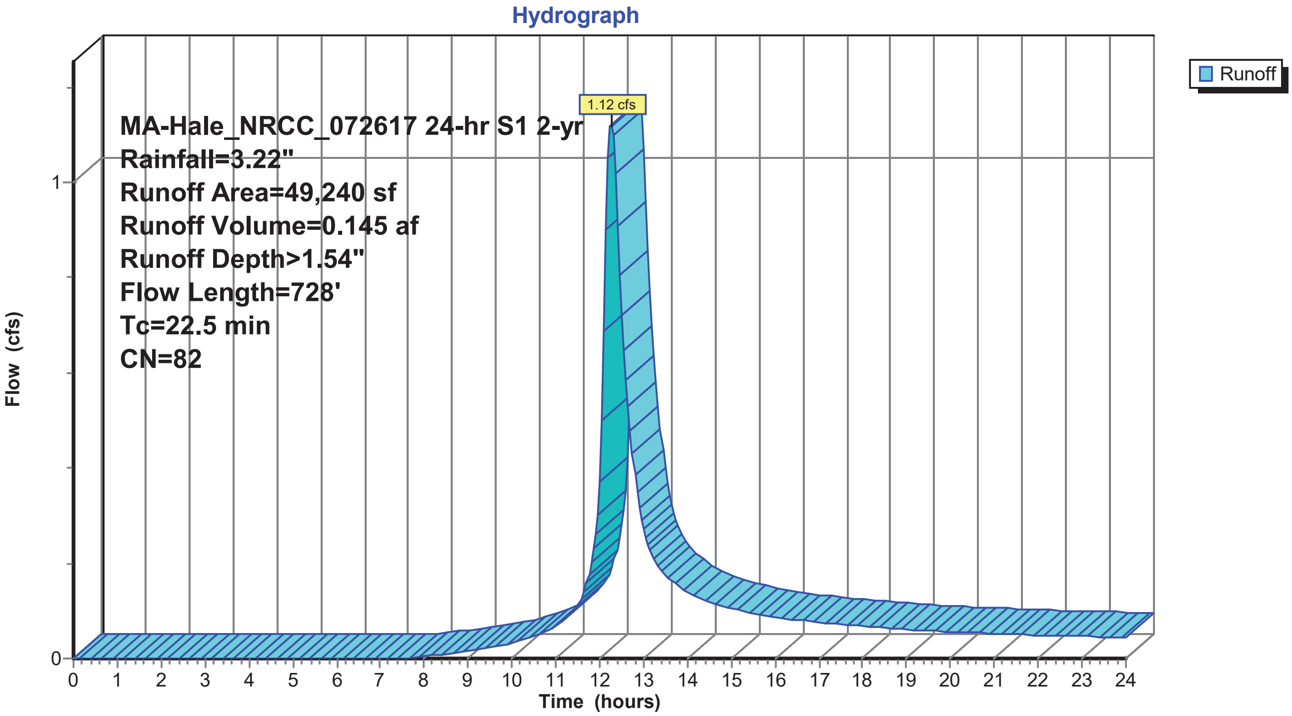
Runoff = 1.12 cfs @ 12.26 hrs, Volume= 0.145 af, Depth> 1.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
25,446	80	>75% Grass cover, Good, HSG D
2,734	89	<50% Grass cover, Poor, HSG D
454	98	Paved parking, HSG D
20,606	83	Brush, Poor, HSG D
49,240	82	Weighted Average
48,786		99.08% Pervious Area
454		0.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	25	0.0150	0.93		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.22"
3.3	25	0.0500	0.13		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 3.22"
18.2	593	0.0060	0.54		**Shallow Concentrated Flow, Grass Wetland** Short Grass Pasture Kv= 7.0 fps
0.6	85	0.0040	2.39	28.66	**Trap/Vee/Rect Channel Flow, Channel** Bot.W=5.00' D=1.50' Z= 2.0 '/' Top.W=11.00' n= 0.040 Earth, cobble bottom, clean sides
22.5	728	Total			

Subcatchment E3: Exist Field\Wetland



Summary for Subcatchment E4: Exist Parking Entrance Wet

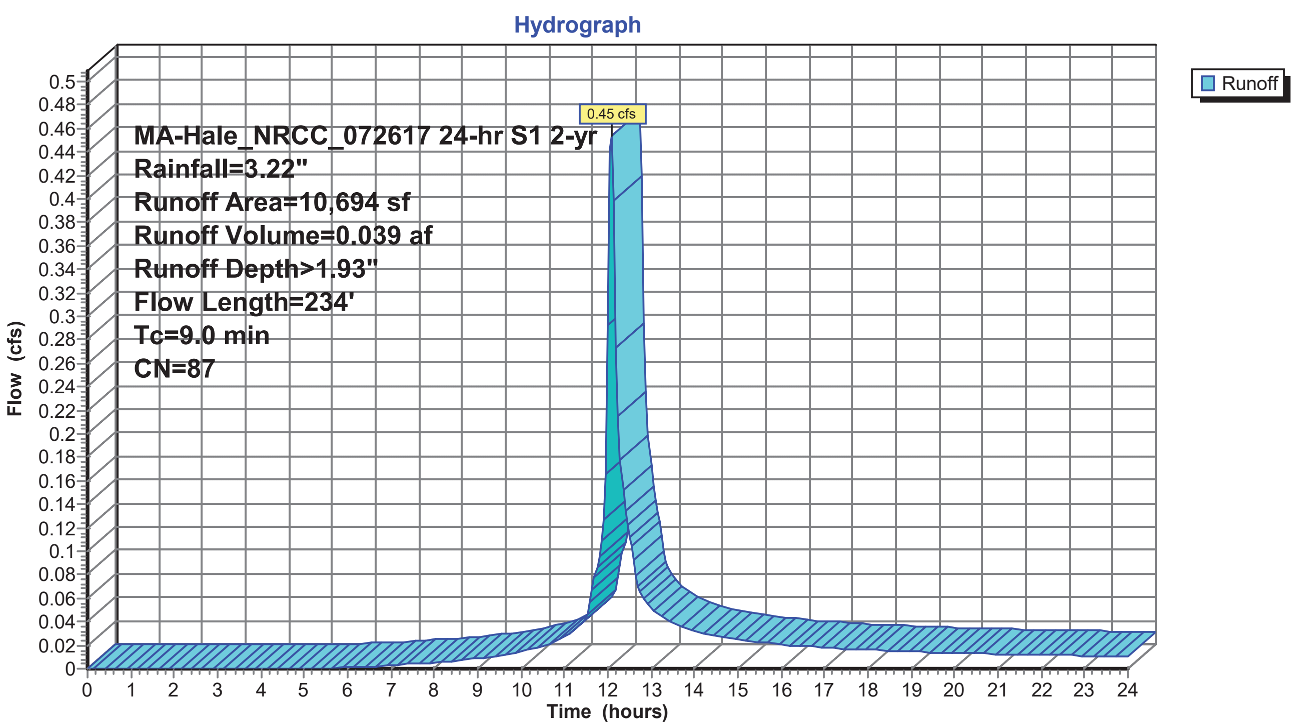
Runoff = 0.45 cfs @ 12.08 hrs, Volume= 0.039 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
2,215	80	>75% Grass cover, Good, HSG D
3,144	98	Paved parking, HSG D
5,335	83	Brush, Poor, HSG D
10,694	87	Weighted Average
7,550		70.60% Pervious Area
3,144		29.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	25	0.0250	1.14		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.22"
2.6	25	0.0900	0.16		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 3.22"
6.0	184	0.0010	0.51		**Shallow Concentrated Flow, Wetland** Unpaved Kv= 16.1 fps
9.0	234	Total			

Subcatchment E4: Exist Parking Entrance Wet



Summary for Subcatchment E5: Exist Parking NW Building

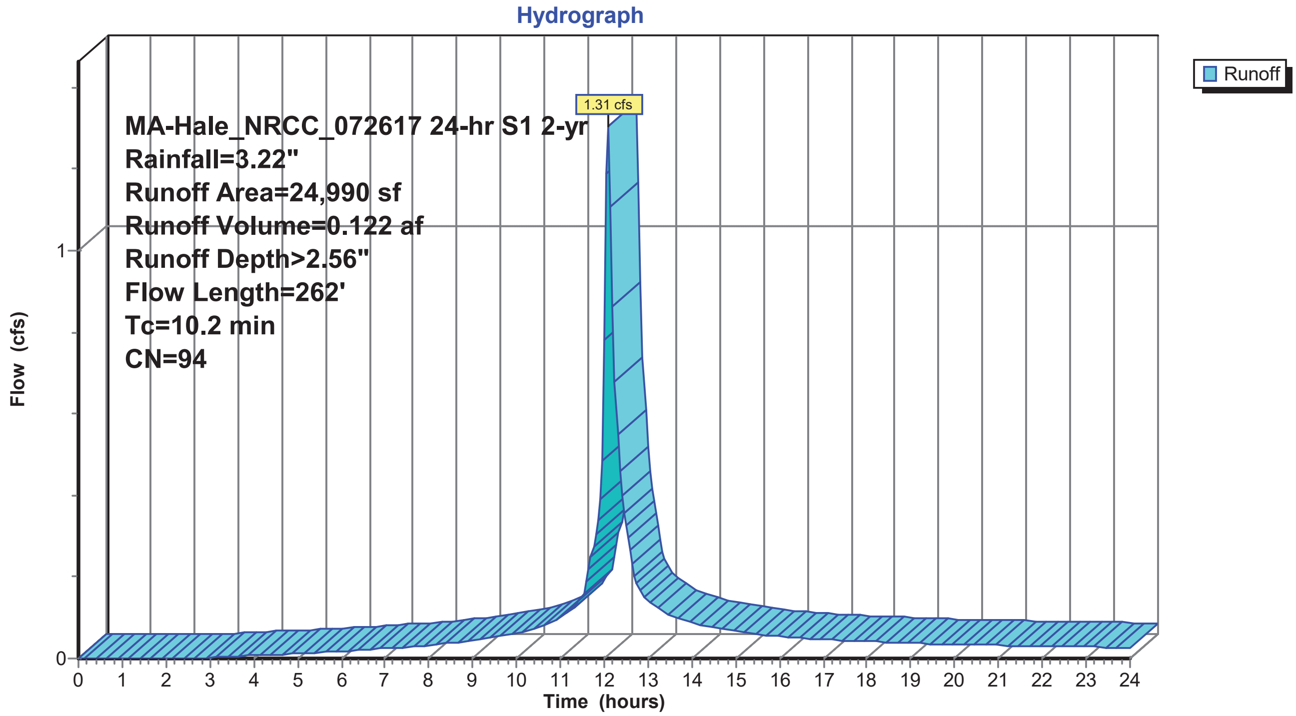
Runoff = 1.31 cfs @ 12.09 hrs, Volume= 0.122 af, Depth> 2.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
5,662	80	>75% Grass cover, Good, HSG D
375	84	50-75% Grass cover, Fair, HSG D
18,953	98	Paved parking, HSG D
24,990	94	Weighted Average
6,037		24.16% Pervious Area
18,953		75.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0170	0.10		**Sheet Flow, Lawn** Grass: Dense n= 0.240 P2= 3.22"
0.6	72	0.0170	1.96		**Shallow Concentrated Flow, Lawn** Grassed Waterway Kv= 15.0 fps
0.5	73	0.0170	2.65		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
0.4	67	0.0070	3.11	0.61	**Pipe Channel, 6" Pipe** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.010 PVC, smooth interior
10.2	262	Total			

Subcatchment E5: Exist Parking NW Building



Summary for Subcatchment E6: Exist Parking Building Entrance

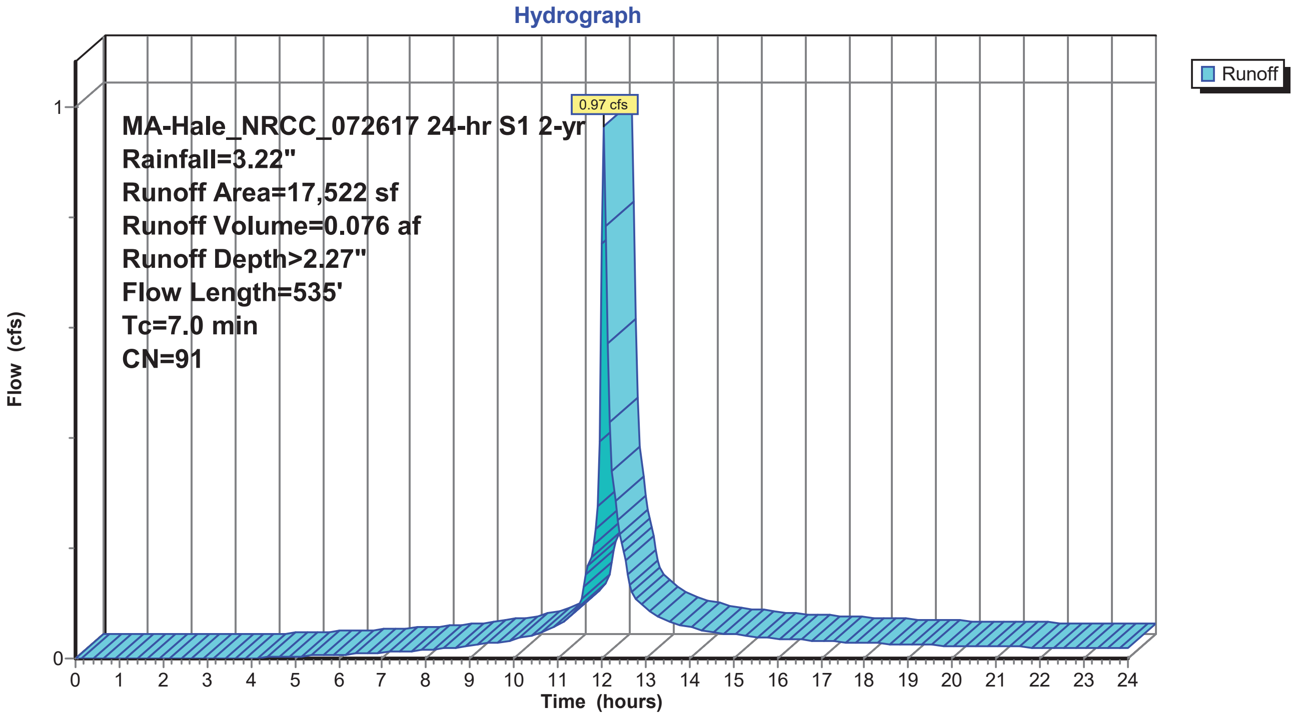
Runoff = 0.97 cfs @ 12.05 hrs, Volume= 0.076 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
7,102	80	>75% Grass cover, Good, HSG D
10,420	98	Paved parking, HSG D
17,522	91	Weighted Average
7,102		40.53% Pervious Area
10,420		59.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	17	0.0250	0.09		**Sheet Flow, Lawn** Grass: Dense n= 0.240 P2= 3.22"
0.7	33	0.0100	0.84		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.22"
0.5	87	0.0200	2.87		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
0.2	31	0.0300	2.60		**Shallow Concentrated Flow, Grass** Grassed Waterway Kv= 15.0 fps
0.4	75	0.0070	3.11	0.61	**Pipe Channel, 6" Pipe** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.010 PVC, smooth interior
2.0	292	0.0040	2.39	28.66	**Trap/Vee/Rect Channel Flow, Channel** Bot.W=5.00' D=1.50' Z= 2.0 '/' Top.W=11.00' n= 0.040 Earth, cobble bottom, clean sides
7.0	535	Total			

Subcatchment E6: Exist Parking Building Entrance

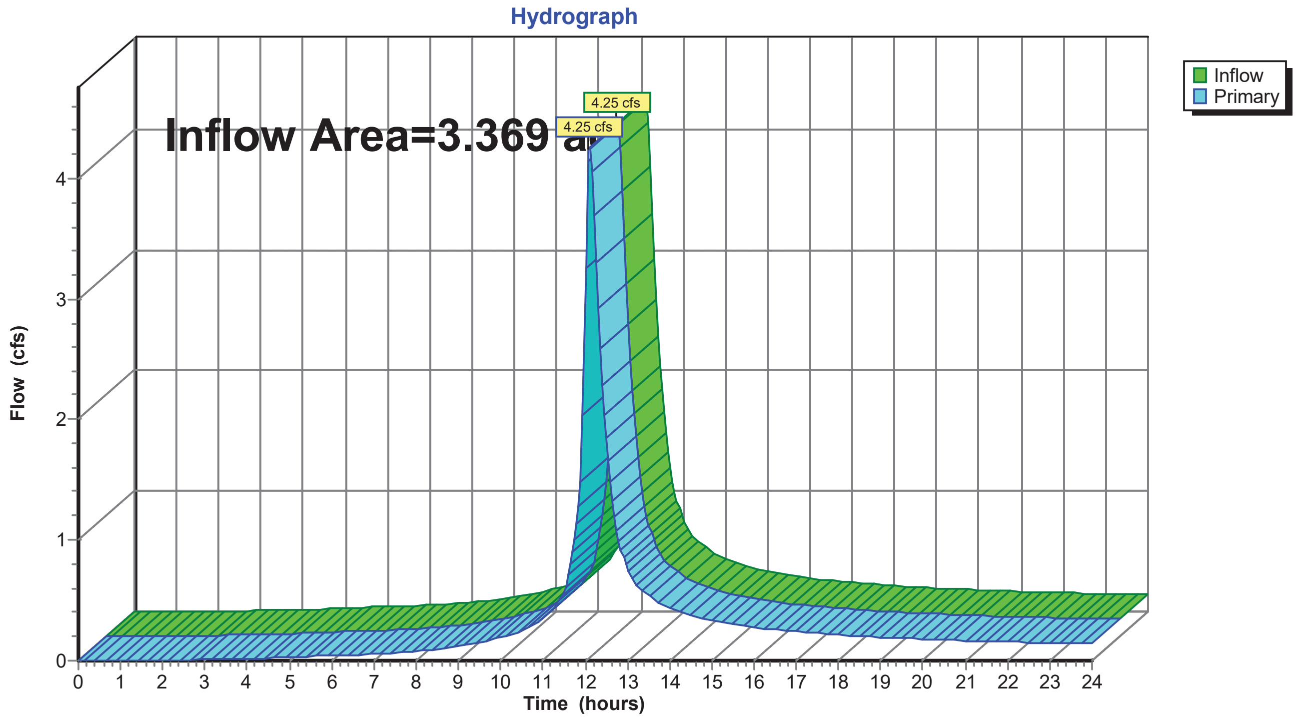


Summary for Link 1L: Southwesterly Flow

Inflow Area = 3.369 ac, 28.22% Impervious, Inflow Depth > 1.90" for 2-yr event
Inflow = 4.25 cfs @ 12.09 hrs, Volume= 0.532 af
Primary = 4.25 cfs @ 12.09 hrs, Volume= 0.532 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: Southwesterly Flow

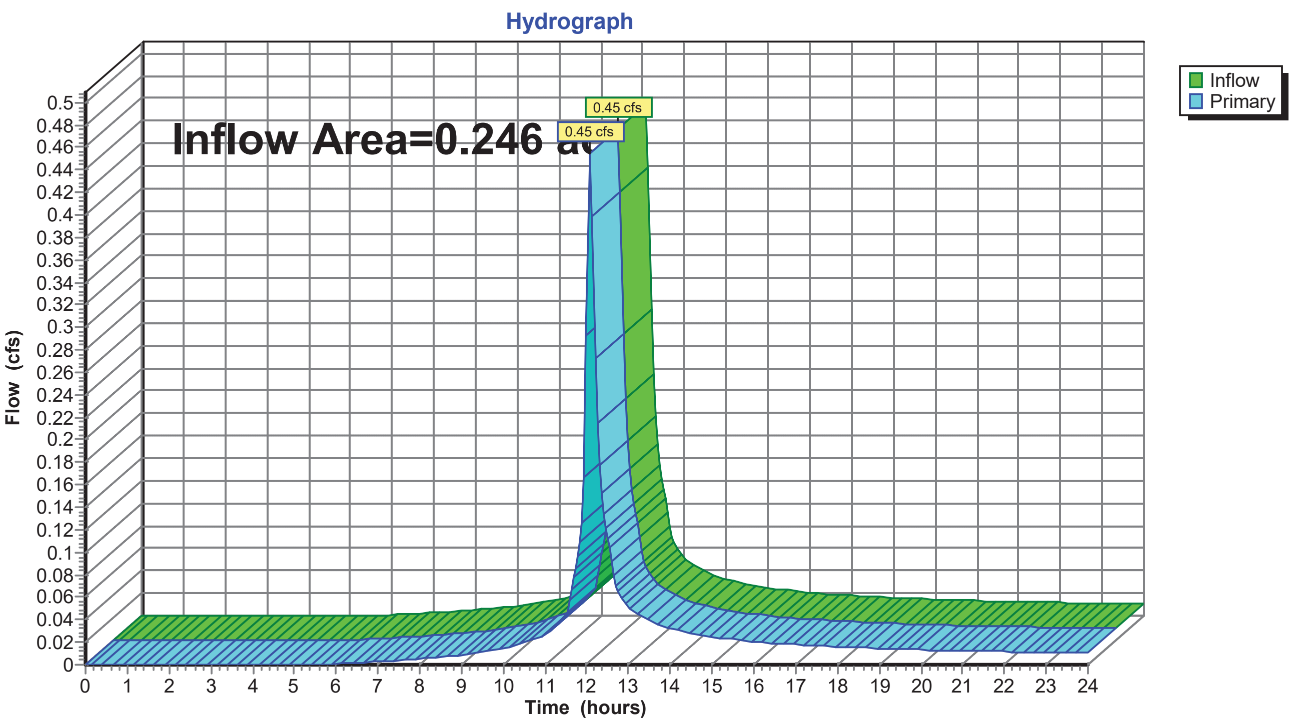


Summary for Link 2L: Southeasterly Flow

Inflow Area = 0.246 ac, 29.40% Impervious, Inflow Depth > 1.93" for 2-yr event
Inflow = 0.45 cfs @ 12.08 hrs, Volume= 0.039 af
Primary = 0.45 cfs @ 12.08 hrs, Volume= 0.039 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: Southeasterly Flow

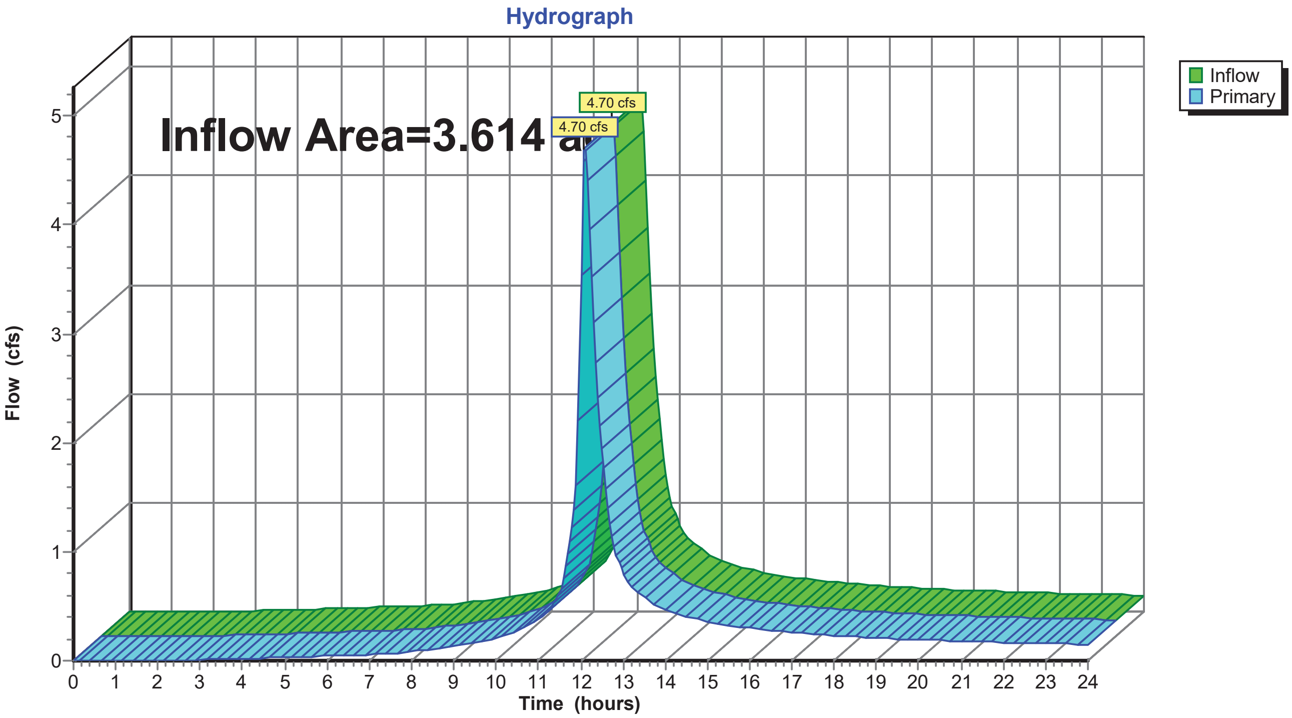


Summary for Link 3L: Pre Total

Inflow Area = 3.614 ac, 28.30% Impervious, Inflow Depth > 1.90" for 2-yr event
Inflow = 4.70 cfs @ 12.09 hrs, Volume= 0.571 af
Primary = 4.70 cfs @ 12.09 hrs, Volume= 0.571 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 3L: Pre Total



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Exist Parking Entrance Runoff Area=12,326 sf 94.00% Impervious Runoff Depth>4.59"
Flow Length=602' Tc=4.3 min CN=97 Runoff=1.23 cfs 0.108 af

Subcatchment E2: Exist Field Runoff Area=42,660 sf 0.00% Impervious Runoff Depth>2.93"
Flow Length=462' Tc=15.0 min CN=81 Runoff=2.03 cfs 0.239 af

Subcatchment E3: Exist Field\Wetland Runoff Area=49,240 sf 0.92% Impervious Runoff Depth>3.01"
Flow Length=728' Tc=22.5 min CN=82 Runoff=2.01 cfs 0.284 af

Subcatchment E4: Exist Parking Entrance Runoff Area=10,694 sf 29.40% Impervious Runoff Depth>3.51"
Flow Length=234' Tc=9.0 min CN=87 Runoff=0.74 cfs 0.072 af

Subcatchment E5: Exist Parking NW Runoff Area=24,990 sf 75.84% Impervious Runoff Depth>4.25"
Flow Length=262' Tc=10.2 min CN=94 Runoff=1.88 cfs 0.203 af

Subcatchment E6: Exist Parking Building Runoff Area=17,522 sf 59.47% Impervious Runoff Depth>3.93"
Flow Length=535' Tc=7.0 min CN=91 Runoff=1.44 cfs 0.132 af

Link 1L: Southwesterly Flow Inflow=6.88 cfs 0.966 af
Primary=6.88 cfs 0.966 af

Link 2L: Southeasterly Flow Inflow=0.74 cfs 0.072 af
Primary=0.74 cfs 0.072 af

Link 3L: Pre Total Inflow=7.59 cfs 1.038 af
Primary=7.59 cfs 1.038 af

Total Runoff Area = 3.614 ac Runoff Volume = 1.038 af Average Runoff Depth = 3.45"
71.70% Pervious = 2.591 ac 28.30% Impervious = 1.023 ac

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Exist Parking Entrance Runoff Area=12,326 sf 94.00% Impervious Runoff Depth>5.97"
Flow Length=602' Tc=4.3 min CN=97 Runoff=1.50 cfs 0.141 af

Subcatchment E2: Exist Field Runoff Area=42,660 sf 0.00% Impervious Runoff Depth>4.17"
Flow Length=462' Tc=15.0 min CN=81 Runoff=2.75 cfs 0.340 af

Subcatchment E3: Exist Field\Wetland Runoff Area=49,240 sf 0.92% Impervious Runoff Depth>4.26"
Flow Length=728' Tc=22.5 min CN=82 Runoff=2.71 cfs 0.401 af

Subcatchment E4: Exist Parking Entrance Runoff Area=10,694 sf 29.40% Impervious Runoff Depth>4.82"
Flow Length=234' Tc=9.0 min CN=87 Runoff=0.95 cfs 0.099 af

Subcatchment E5: Exist Parking NW Runoff Area=24,990 sf 75.84% Impervious Runoff Depth>5.61"
Flow Length=262' Tc=10.2 min CN=94 Runoff=2.33 cfs 0.268 af

Subcatchment E6: Exist Parking Building Runoff Area=17,522 sf 59.47% Impervious Runoff Depth>5.27"
Flow Length=535' Tc=7.0 min CN=91 Runoff=1.80 cfs 0.177 af

Link 1L: Southwesterly Flow Inflow=8.97 cfs 1.327 af
Primary=8.97 cfs 1.327 af

Link 2L: Southeasterly Flow Inflow=0.95 cfs 0.099 af
Primary=0.95 cfs 0.099 af

Link 3L: Pre Total Inflow=9.87 cfs 1.426 af
Primary=9.87 cfs 1.426 af

Total Runoff Area = 3.614 ac Runoff Volume = 1.426 af Average Runoff Depth = 4.73"
71.70% Pervious = 2.591 ac 28.30% Impervious = 1.023 ac

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Exist Parking Entrance Runoff Area=12,326 sf 94.00% Impervious Runoff Depth>8.82"
Flow Length=602' Tc=4.3 min CN=97 Runoff=2.00 cfs 0.208 af

Subcatchment E2: Exist Field Runoff Area=42,660 sf 0.00% Impervious Runoff Depth>6.84"
Flow Length=462' Tc=15.0 min CN=81 Runoff=4.13 cfs 0.558 af

Subcatchment E3: Exist Field\Wetland Runoff Area=49,240 sf 0.92% Impervious Runoff Depth>6.95"
Flow Length=728' Tc=22.5 min CN=82 Runoff=4.07 cfs 0.655 af

Subcatchment E4: Exist Parking Entrance Runoff Area=10,694 sf 29.40% Impervious Runoff Depth>7.59"
Flow Length=234' Tc=9.0 min CN=87 Runoff=1.35 cfs 0.155 af

Subcatchment E5: Exist Parking NW Runoff Area=24,990 sf 75.84% Impervious Runoff Depth>8.45"
Flow Length=262' Tc=10.2 min CN=94 Runoff=3.18 cfs 0.404 af

Subcatchment E6: Exist Parking Building Runoff Area=17,522 sf 59.47% Impervious Runoff Depth>8.09"
Flow Length=535' Tc=7.0 min CN=91 Runoff=2.49 cfs 0.271 af

Link 1L: Southwesterly Flow Inflow=13.03 cfs 2.096 af
Primary=13.03 cfs 2.096 af

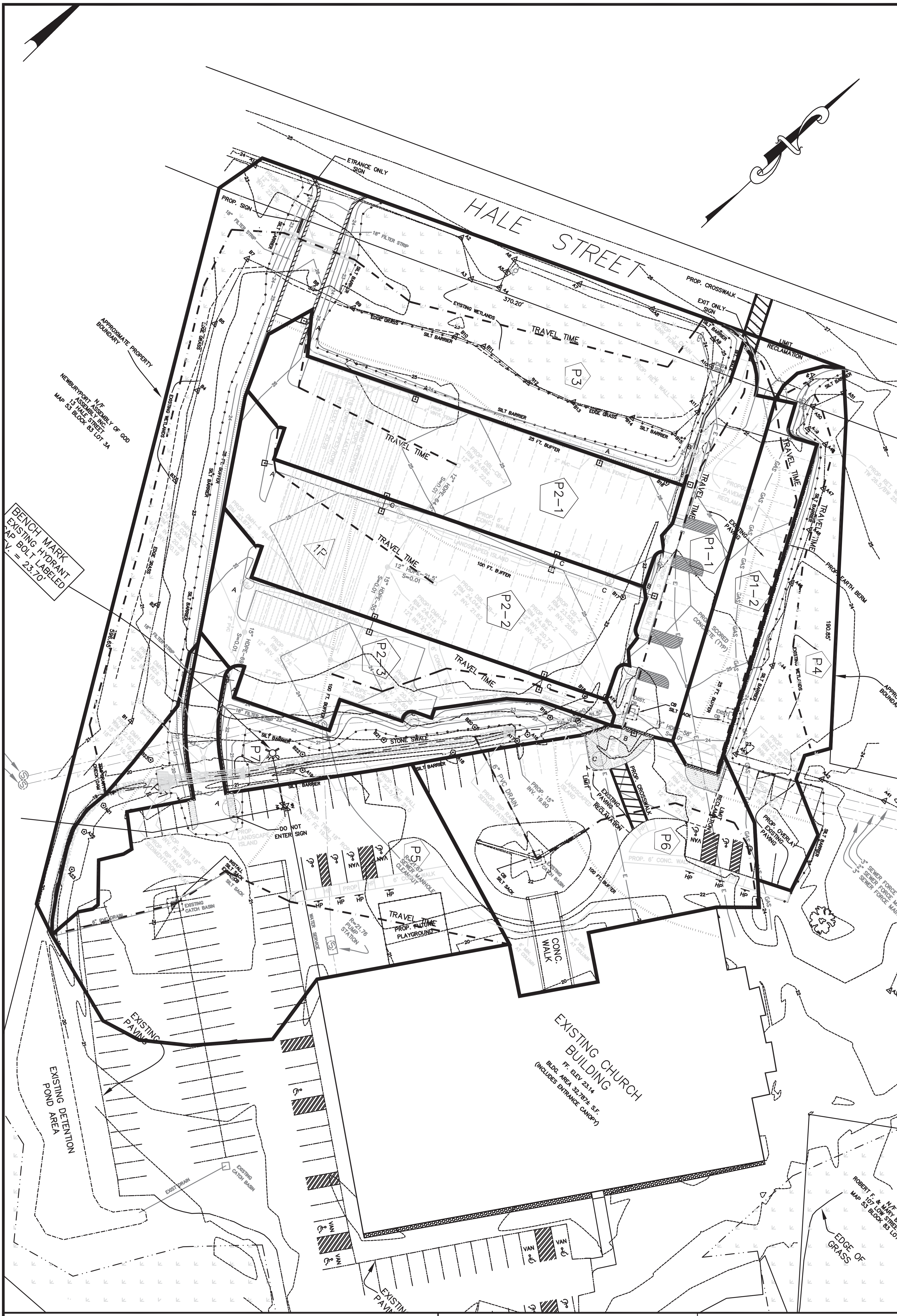
Link 2L: Southeasterly Flow Inflow=1.35 cfs 0.155 af
Primary=1.35 cfs 0.155 af

Link 3L: Pre Total Inflow=14.29 cfs 2.251 af
Primary=14.29 cfs 2.251 af

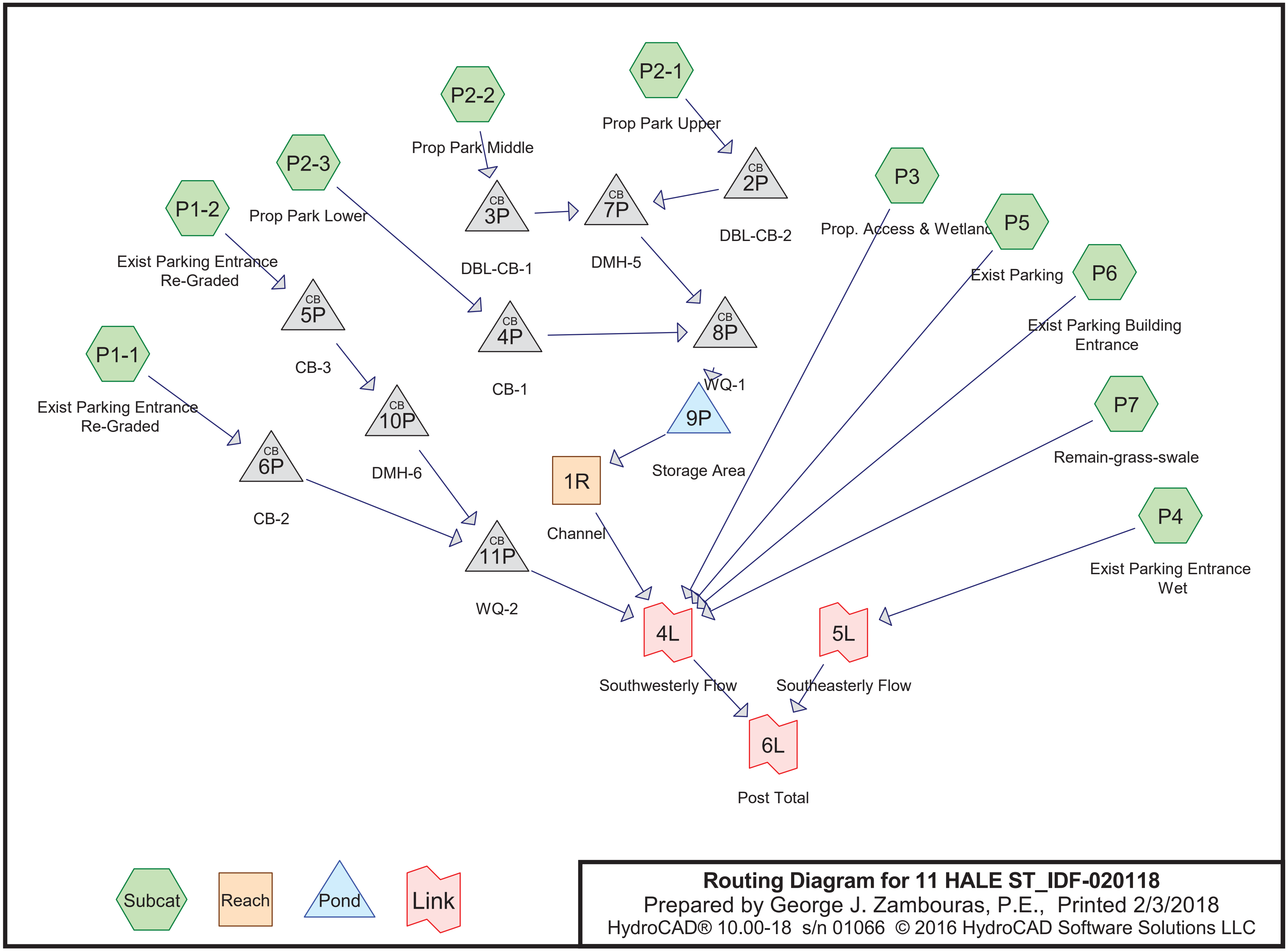
Total Runoff Area = 3.614 ac Runoff Volume = 2.251 af Average Runoff Depth = 7.48"
71.70% Pervious = 2.591 ac 28.30% Impervious = 1.023 ac

APPENDIX B

POST DEVELOPMENT CALCULATIONS



POST-DEVELOPMENT WATERSHED PARKING IMPROVEMENTS THE HOPE COMMUNITY CHURCH 11 HALE STREET NEWBURYPORT, MASSACHUSETTS	DATE: FEBRUARY 3, 2018	SCALE 1"= 50'
	ENGINEER: *ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.* 97 TENNEY STREET – – GEORGETOWN, MA 01833 PHONE: 978-352-7870 FAX: 978-352-9940	



Routing Diagram for 11 HALE ST_IDF-020118
Prepared by George J. Zambouras, P.E., Printed 2/3/2018
HydroCAD® 10.00-18 s/n 01066 © 2016 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.041	84	50-75% Grass cover, Fair, HSG D (P5, P7)
0.138	89	<50% Grass cover, Poor, HSG D (P3, P7)
0.873	80	>75% Grass cover, Good, HSG D (P1-1, P2-1, P2-2, P2-3, P3, P4, P5, P6, P7)
0.619	83	Brush, Poor, HSG D (P3, P4)
1.944	98	Paved parking, HSG D (P1-1, P1-2, P2-1, P2-2, P2-3, P3, P4, P5, P6)
3.614	**91**	**TOTAL AREA**

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	P5	0.00	0.00	67.0	0.0070	0.010	6.0	0.0	0.0
2	P6	0.00	0.00	75.0	0.0070	0.010	6.0	0.0	0.0
3	2P	22.05	21.40	64.5	0.0101	0.013	12.0	0.0	0.0
4	3P	21.62	21.40	21.5	0.0102	0.013	12.0	0.0	0.0
5	4P	20.88	20.85	5.0	0.0060	0.013	12.0	0.0	0.0
6	5P	21.16	21.12	6.5	0.0062	0.013	12.0	0.0	0.0
7	6P	20.85	20.77	8.0	0.0100	0.013	12.0	0.0	0.0
8	7P	21.15	20.60	55.0	0.0100	0.013	15.0	0.0	0.0
9	8P	20.33	20.28	4.0	0.0125	0.013	15.0	0.0	0.0
10	9P	19.90	19.45	74.0	0.0061	0.013	15.0	0.0	0.0
11	10P	21.12	20.77	58.0	0.0060	0.013	12.0	0.0	0.0
12	11P	20.42	19.90	51.5	0.0101	0.013	12.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1-1: Exist Parking Entrance Runoff Area=7,496 sf 90.02% Impervious Runoff Depth>2.76"
Flow Length=218' Slope=0.0125 '/' Tc=7.3 min CN=96 Runoff=0.47 cfs 0.040 af

Subcatchment P1-2: Exist Parking Runoff Area=5,685 sf 100.00% Impervious Runoff Depth>2.99"
Flow Length=215' Slope=0.0125 '/' Tc=2.1 min CN=98 Runoff=0.46 cfs 0.032 af

Subcatchment P2-1: Prop Park Upper Runoff Area=14,416 sf 97.93% Impervious Runoff Depth>2.98"
Flow Length=142' Tc=8.8 min CN=98 Runoff=0.87 cfs 0.082 af

Subcatchment P2-2: Prop Park Middle Runoff Area=15,655 sf 90.33% Impervious Runoff Depth>2.77"
Flow Length=132' Tc=6.1 min CN=96 Runoff=1.03 cfs 0.083 af

Subcatchment P2-3: Prop Park Lower Runoff Area=9,796 sf 77.12% Impervious Runoff Depth>2.56"
Flow Length=160' Tc=12.7 min CN=94 Runoff=0.47 cfs 0.048 af

Subcatchment P3: Prop. Access & Wetland Runoff Area=40,675 sf 5.69% Impervious Runoff Depth>1.61"
Flow Length=728' Tc=22.5 min CN=83 Runoff=0.97 cfs 0.126 af

Subcatchment P4: Exist Parking Entrance Runoff Area=9,994 sf 21.55% Impervious Runoff Depth>1.77"
Flow Length=230' Tc=9.0 min CN=85 Runoff=0.39 cfs 0.034 af

Subcatchment P5: Exist Parking Runoff Area=26,482 sf 79.57% Impervious Runoff Depth>2.56"
Flow Length=262' Tc=10.2 min CN=94 Runoff=1.39 cfs 0.130 af

Subcatchment P6: Exist Parking Building Runoff Area=17,458 sf 62.29% Impervious Runoff Depth>2.27"
Flow Length=535' Tc=7.0 min CN=91 Runoff=0.96 cfs 0.076 af

Subcatchment P7: Remain-grass-swale Runoff Area=9,774 sf 0.00% Impervious Runoff Depth>1.70"
Flow Length=364' Tc=7.5 min CN=84 Runoff=0.40 cfs 0.032 af

Reach 1R: Channel Avg. Flow Depth=0.19' Max Vel=0.73 fps Inflow=0.74 cfs 0.212 af
n=0.040 L=122.0' S=0.0040 '/' Capacity=28.72 cfs Outflow=0.74 cfs 0.211 af

Pond 2P: DBL-CB-2 Peak Elev=22.60' Inflow=0.87 cfs 0.082 af
12.0" Round Culvert n=0.013 L=64.5' S=0.0101 '/' Outflow=0.87 cfs 0.082 af

Pond 3P: DBL-CB-1 Peak Elev=22.25' Inflow=1.03 cfs 0.083 af
12.0" Round Culvert n=0.013 L=21.5' S=0.0102 '/' Outflow=1.03 cfs 0.083 af

Pond 4P: CB-1 Peak Elev=21.37' Inflow=0.47 cfs 0.048 af
12.0" Round Culvert n=0.013 L=5.0' S=0.0060 '/' Outflow=0.47 cfs 0.048 af

Pond 5P: CB-3 Peak Elev=21.63' Inflow=0.46 cfs 0.032 af
12.0" Round Culvert n=0.013 L=6.5' S=0.0062 '/' Outflow=0.46 cfs 0.032 af

Pond 6P: CB-2 Peak Elev=21.26' Inflow=0.47 cfs 0.040 af
12.0" Round Culvert n=0.013 L=8.0' S=0.0100 '/' Outflow=0.47 cfs 0.040 af

Pond 7P: DMH-5
Peak Elev=21.92' Inflow=1.87 cfs 0.165 af
15.0" Round Culvert n=0.013 L=55.0' S=0.0100 '/' Outflow=1.87 cfs 0.165 af

Pond 8P: WQ-1
Peak Elev=21.29' Inflow=2.25 cfs 0.213 af
15.0" Round Culvert n=0.013 L=4.0' S=0.0125 '/' Outflow=2.25 cfs 0.213 af

Pond 9P: Storage Area
Peak Elev=20.86' Storage=2,316 cf Inflow=2.25 cfs 0.213 af
Outflow=0.74 cfs 0.212 af

Pond 10P: DMH-6
Peak Elev=21.51' Inflow=0.46 cfs 0.032 af
12.0" Round Culvert n=0.013 L=58.0' S=0.0060 '/' Outflow=0.46 cfs 0.032 af

Pond 11P: WQ-2
Peak Elev=20.95' Inflow=0.82 cfs 0.072 af
12.0" Round Culvert n=0.013 L=51.5' S=0.0101 '/' Outflow=0.82 cfs 0.072 af

Link 4L: Southwesterly Flow
Inflow=4.17 cfs 0.646 af
Primary=4.17 cfs 0.646 af

Link 5L: Southeasterly Flow
Inflow=0.39 cfs 0.034 af
Primary=0.39 cfs 0.034 af

Link 6L: Post Total
Inflow=4.56 cfs 0.680 af
Primary=4.56 cfs 0.680 af

Total Runoff Area = 3.614 ac Runoff Volume = 0.682 af Average Runoff Depth = 2.26"
46.22% Pervious = 1.671 ac 53.78% Impervious = 1.944 ac

Summary for Subcatchment P1-1: Exist Parking Entrance Re-Graded

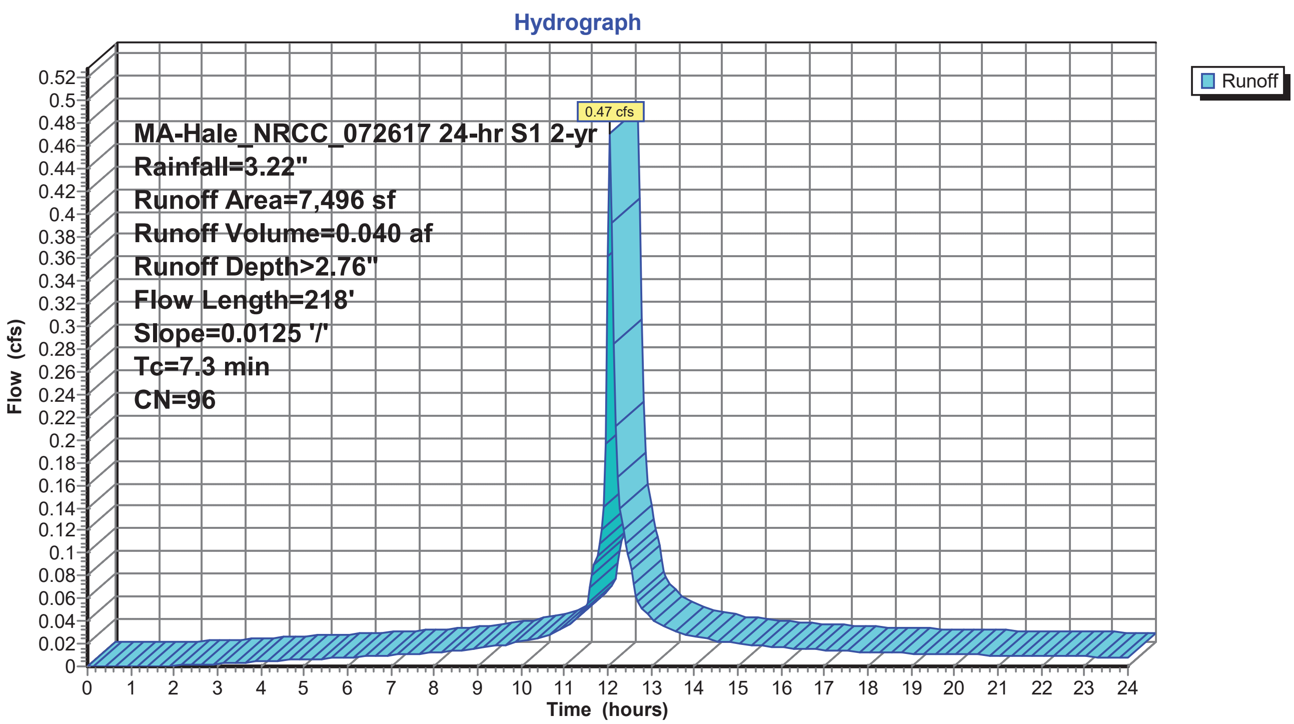
Runoff = 0.47 cfs @ 12.05 hrs, Volume= 0.040 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
748	80	>75% Grass cover, Good, HSG D
1,142	98	Paved parking, HSG D
5,606	98	Paved parking, HSG D
7,496	96	Weighted Average
748		9.98% Pervious Area
6,748		90.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	43	0.0125	0.12		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 3.22"
1.3	175	0.0125	2.27		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
7.3	218	Total			

Subcatchment P1-1: Exist Parking Entrance Re-Graded



Summary for Subcatchment P1-2: Exist Parking Entrance Re-Graded

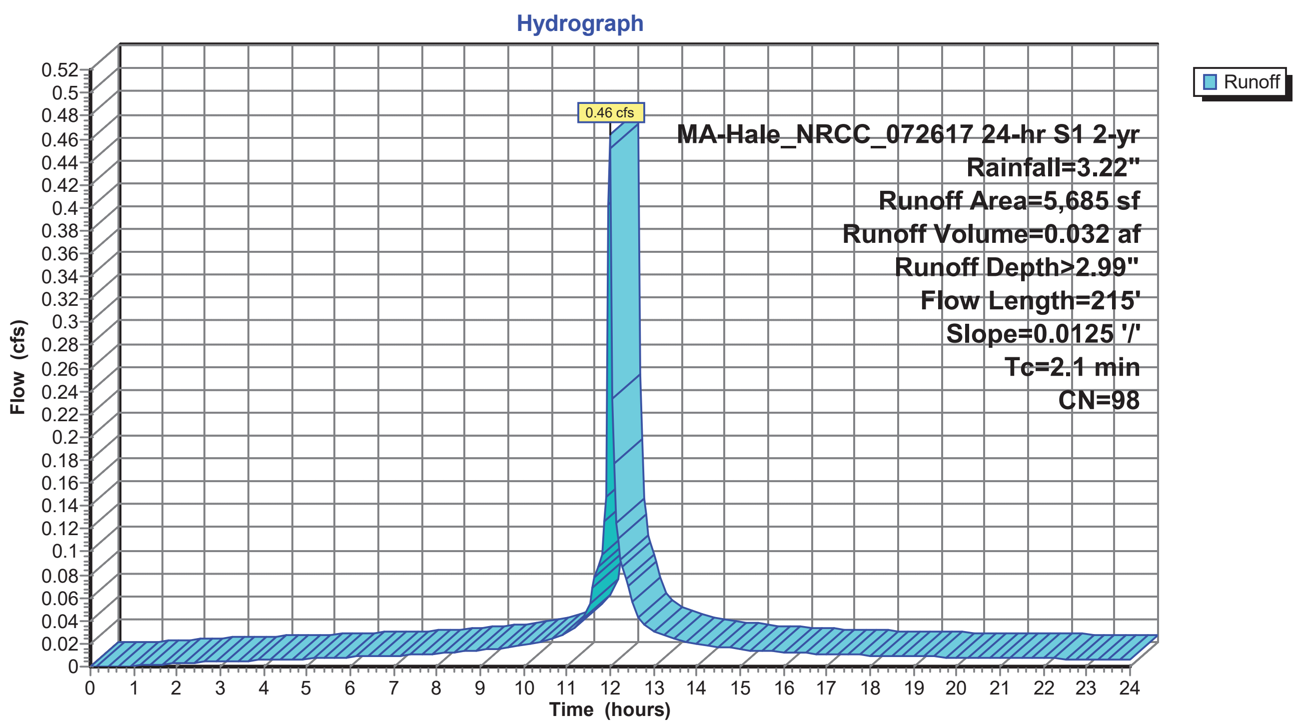
Runoff = 0.46 cfs @ 11.98 hrs, Volume= 0.032 af, Depth> 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
5,685	98	Paved parking, HSG D
5,685		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	60	0.0125	1.03		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.22"
1.1	155	0.0125	2.27		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.1	215	Total			

Subcatchment P1-2: Exist Parking Entrance Re-Graded



Summary for Subcatchment P2-1: Prop Park Upper

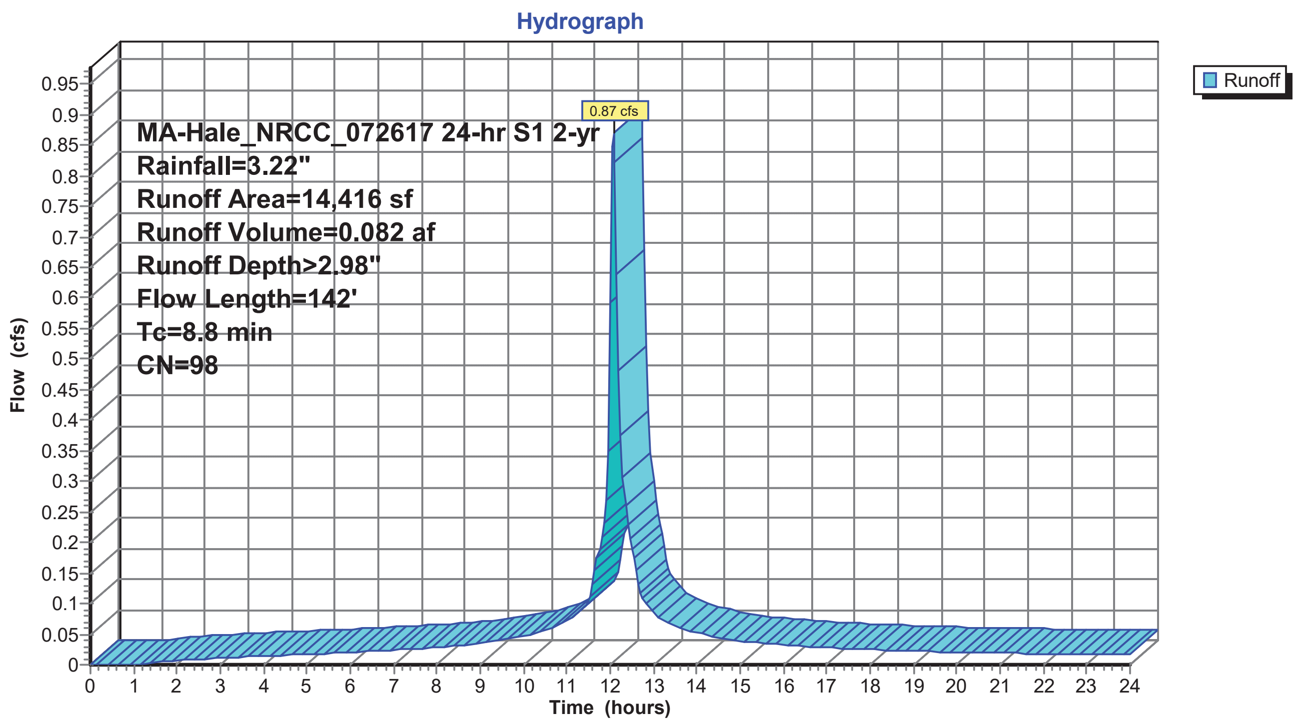
Runoff = 0.87 cfs @ 12.07 hrs, Volume= 0.082 af, Depth> 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
298	80	>75% Grass cover, Good, HSG D
14,118	98	Paved parking, HSG D
14,416	98	Weighted Average
298		2.07% Pervious Area
14,118		97.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	44	0.0070	0.10		**Sheet Flow, Island** Grass: Short n= 0.150 P2= 3.22"
0.5	25	0.0100	0.79		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.22"
0.6	73	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
8.8	142	Total			

Subcatchment P2-1: Prop Park Upper



Summary for Subcatchment P2-2: Prop Park Middle

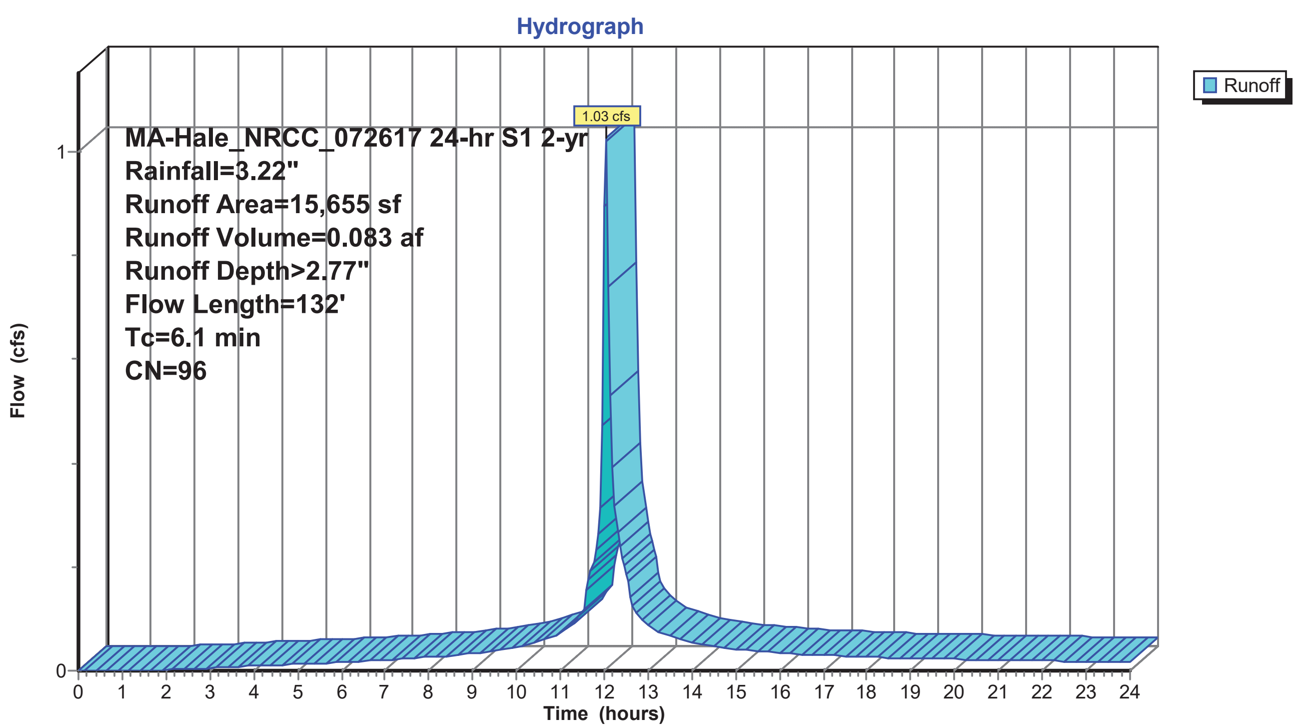
Runoff = 1.03 cfs @ 12.04 hrs, Volume= 0.083 af, Depth> 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
1,514	80	>75% Grass cover, Good, HSG D
14,141	98	Paved parking, HSG D
15,655	96	Weighted Average
1,514		9.67% Pervious Area
14,141		90.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	25	0.0070	0.08		**Sheet Flow, Island** Grass: Short n= 0.150 P2= 3.22"
0.5	25	0.0100	0.79		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.22"
0.7	82	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
6.1	132	Total			

Subcatchment P2-2: Prop Park Middle



Summary for Subcatchment P2-3: Prop Park Lower

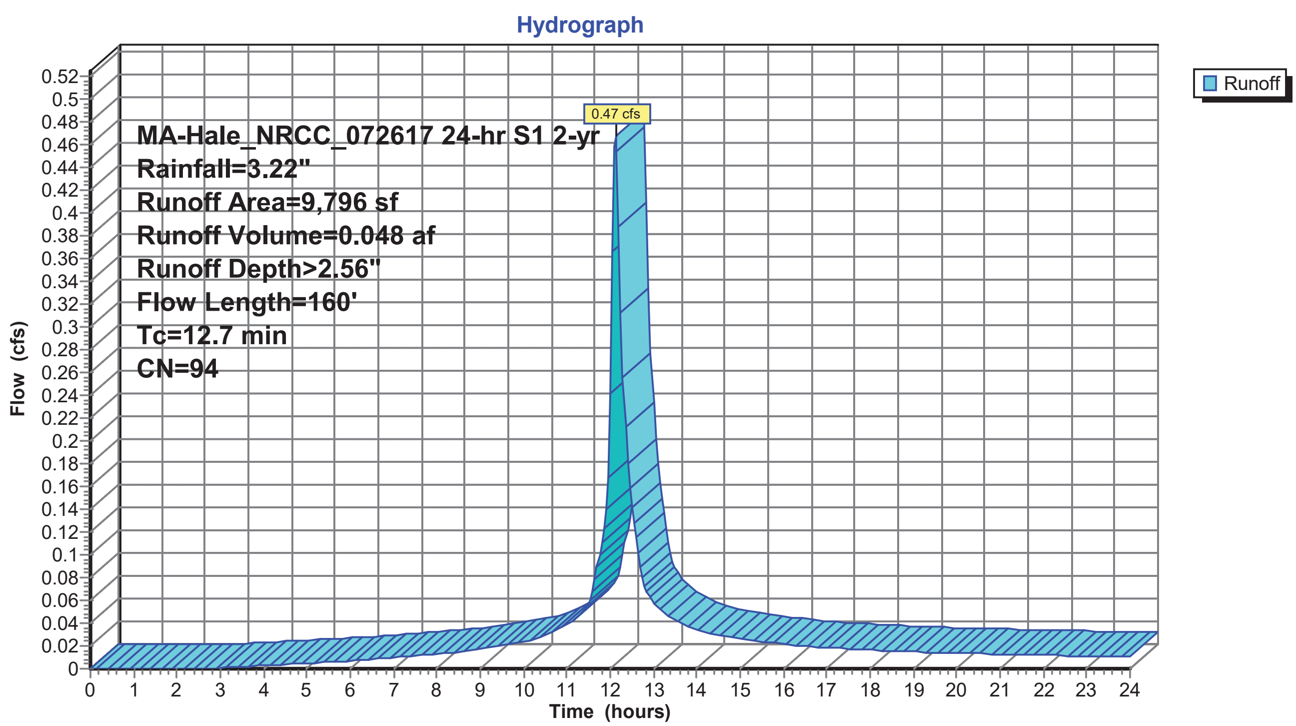
Runoff = 0.47 cfs @ 12.12 hrs, Volume= 0.048 af, Depth> 2.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
2,241	80	>75% Grass cover, Good, HSG D
808	98	Paved parking, HSG D
6,747	98	Paved parking, HSG D
9,796	94	Weighted Average
2,241		22.88% Pervious Area
7,555		77.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	75	0.0070	0.11		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 3.22"
0.4	30	0.0070	1.35		**Shallow Concentrated Flow, Pavement** Unpaved Kv= 16.1 fps
0.5	55	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
12.7	160	Total			

Subcatchment P2-3: Prop Park Lower



Summary for Subcatchment P3: Prop. Access & Wetland

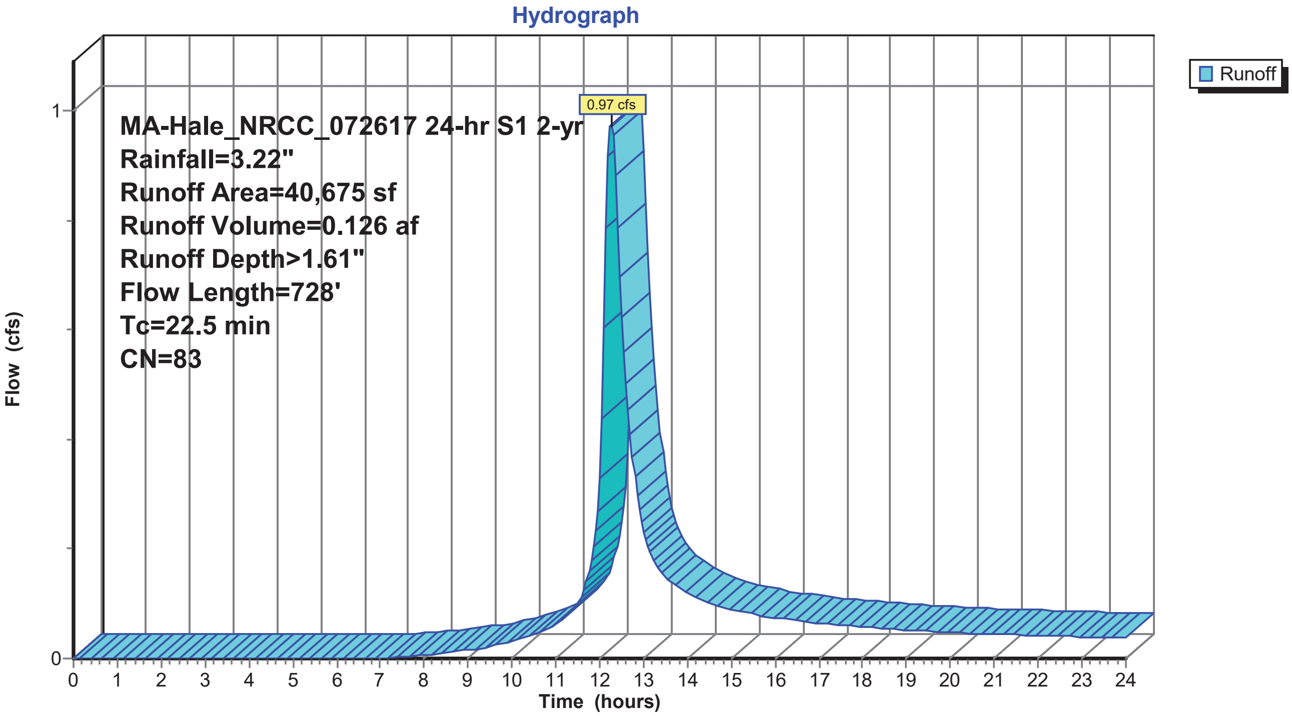
Runoff = 0.97 cfs @ 12.26 hrs, Volume= 0.126 af, Depth> 1.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
14,795	80	>75% Grass cover, Good, HSG D
1,940	89	<50% Grass cover, Poor, HSG D
2,314	98	Paved parking, HSG D
18,726	83	Brush, Poor, HSG D
2,900	83	Brush, Poor, HSG D
40,675	83	Weighted Average
38,361		94.31% Pervious Area
2,314		5.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	25	0.0150	0.93		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.22"
3.3	25	0.0500	0.13		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 3.22"
18.2	593	0.0060	0.54		**Shallow Concentrated Flow, Grass Wetland** Short Grass Pasture Kv= 7.0 fps
0.6	85	0.0040	2.39	28.66	**Trap/Vee/Rect Channel Flow, Channel** Bot.W=5.00' D=1.50' Z= 2.0 '/' Top.W=11.00' n= 0.040 Earth, cobble bottom, clean sides
22.5	728	Total			

Subcatchment P3: Prop. Access & Wetland



Summary for Subcatchment P4: Exist Parking Entrance Wet

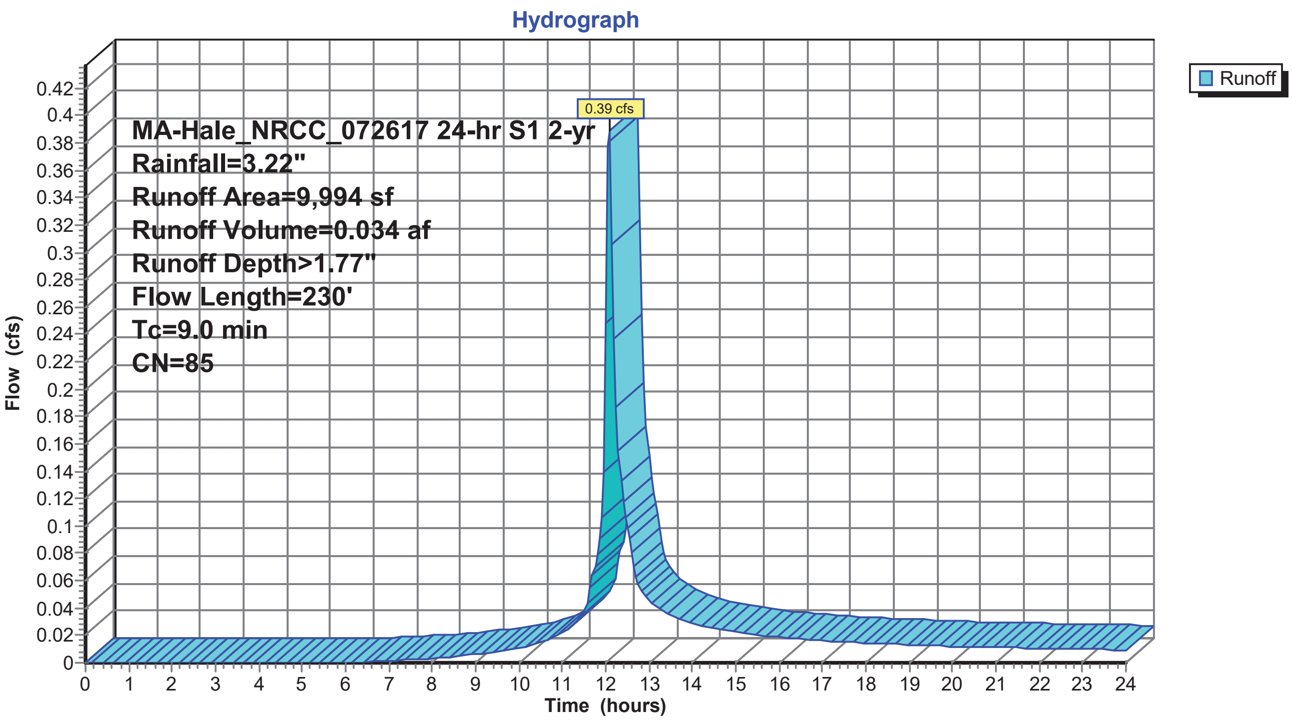
Runoff = 0.39 cfs @ 12.08 hrs, Volume= 0.034 af, Depth> 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
2,505	80	>75% Grass cover, Good, HSG D
5,335	83	Brush, Poor, HSG D
2,154	98	Paved parking, HSG D
9,994	85	Weighted Average
7,840		78.45% Pervious Area
2,154		21.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	20	0.0150	0.89		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.22"
2.2	15	0.0500	0.12		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 3.22"
6.4	195	0.0010	0.51		**Shallow Concentrated Flow, Wetland** Unpaved Kv= 16.1 fps
9.0	230	Total			

Subcatchment P4: Exist Parking Entrance Wet



Summary for Subcatchment P5: Exist Parking

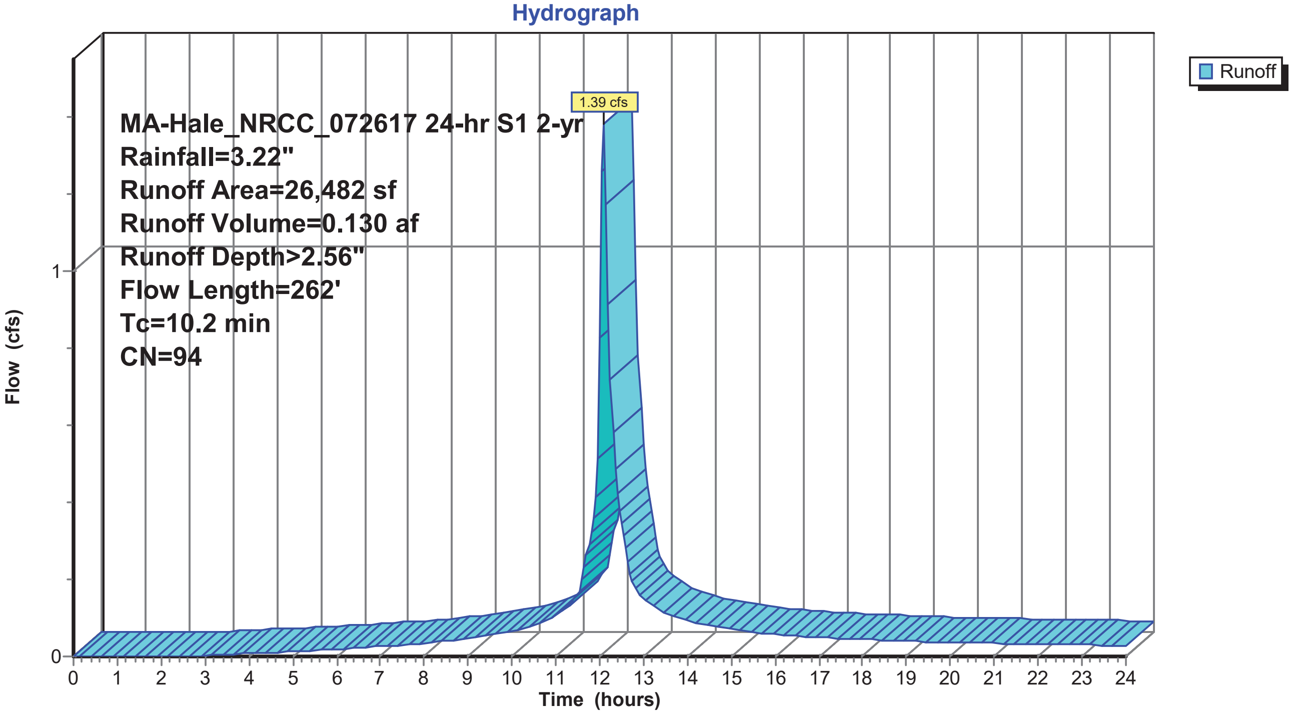
Runoff = 1.39 cfs @ 12.09 hrs, Volume= 0.130 af, Depth> 2.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
5,035	80	>75% Grass cover, Good, HSG D
375	84	50-75% Grass cover, Fair, HSG D
21,072	98	Paved parking, HSG D
26,482	94	Weighted Average
5,410		20.43% Pervious Area
21,072		79.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0170	0.10		**Sheet Flow, Lawn** Grass: Dense n= 0.240 P2= 3.22"
0.6	72	0.0170	1.96		**Shallow Concentrated Flow, Lawn** Grassed Waterway Kv= 15.0 fps
0.5	73	0.0170	2.65		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
0.4	67	0.0070	3.11	0.61	**Pipe Channel, 6" Pipe** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.010 PVC, smooth interior
10.2	262	Total			

Subcatchment P5: Exist Parking



Summary for Subcatchment P6: Exist Parking Building Entrance

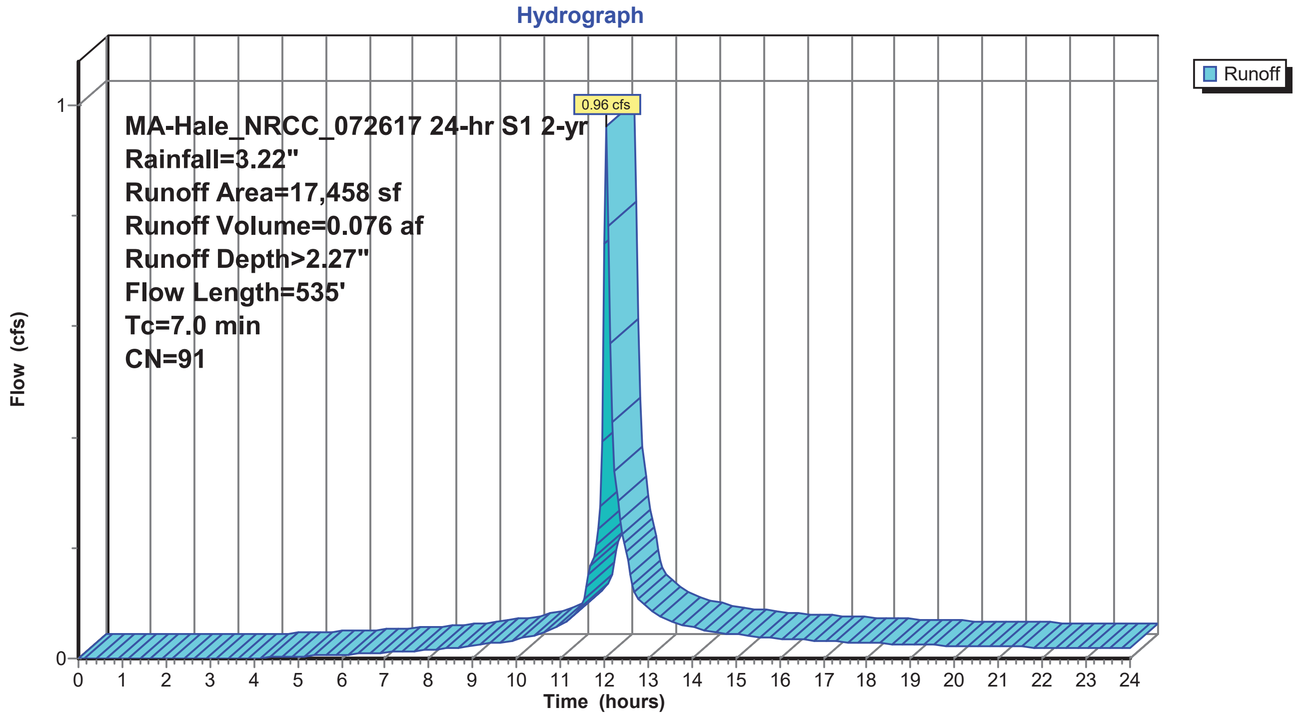
Runoff = 0.96 cfs @ 12.05 hrs, Volume= 0.076 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
6,583	80	>75% Grass cover, Good, HSG D
10,875	98	Paved parking, HSG D
17,458	91	Weighted Average
6,583		37.71% Pervious Area
10,875		62.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	17	0.0250	0.09		**Sheet Flow, Lawn** Grass: Dense n= 0.240 P2= 3.22"
0.7	33	0.0100	0.84		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.22"
0.5	87	0.0200	2.87		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
0.2	31	0.0300	2.60		**Shallow Concentrated Flow, Grass** Grassed Waterway Kv= 15.0 fps
0.4	75	0.0070	3.11	0.61	**Pipe Channel, 6" Pipe** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.010 PVC, smooth interior
2.0	292	0.0040	2.39	28.66	**Trap/Vee/Rect Channel Flow, Channel** Bot.W=5.00' D=1.50' Z= 2.0 '/' Top.W=11.00' n= 0.040 Earth, cobble bottom, clean sides
7.0	535	Total			

Subcatchment P6: Exist Parking Building Entrance



Summary for Subcatchment P7: Remain-grass-swale

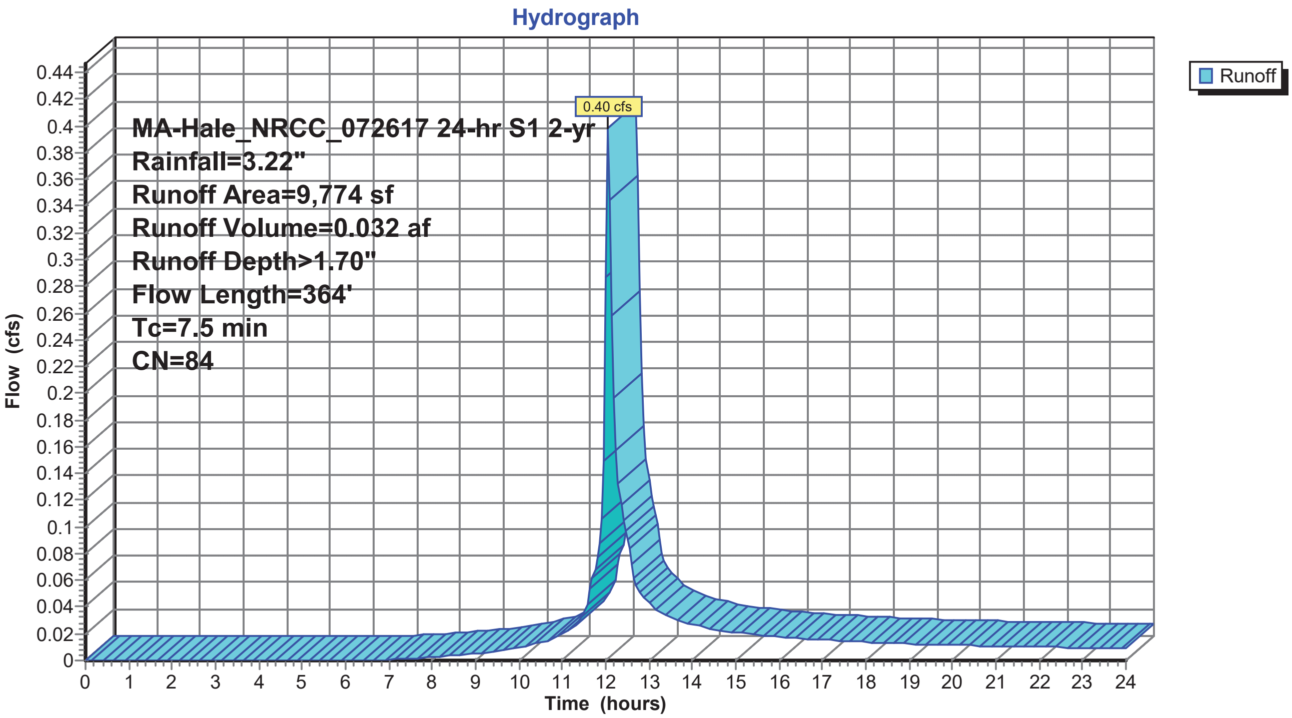
Runoff = 0.40 cfs @ 12.06 hrs, Volume= 0.032 af, Depth> 1.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MA-Hale_NRCC_072617 24-hr S1 2-yr Rainfall=3.22"

Area (sf)	CN	Description
4,329	80	>75% Grass cover, Good, HSG D
1,395	84	50-75% Grass cover, Fair, HSG D
4,050	89	<50% Grass cover, Poor, HSG D
9,774	84	Weighted Average
9,774		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0600	0.16		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 3.22"
2.2	314	0.0040	2.39	28.66	**Trap/Vee/Rect Channel Flow, Channel** Bot.W=5.00' D=1.50' Z= 2.0 '/' Top.W=11.00' n= 0.040 Earth, cobble bottom, clean sides
7.5	364	Total			

Subcatchment P7: Remain-grass-swale



Summary for Reach 1R: Channel

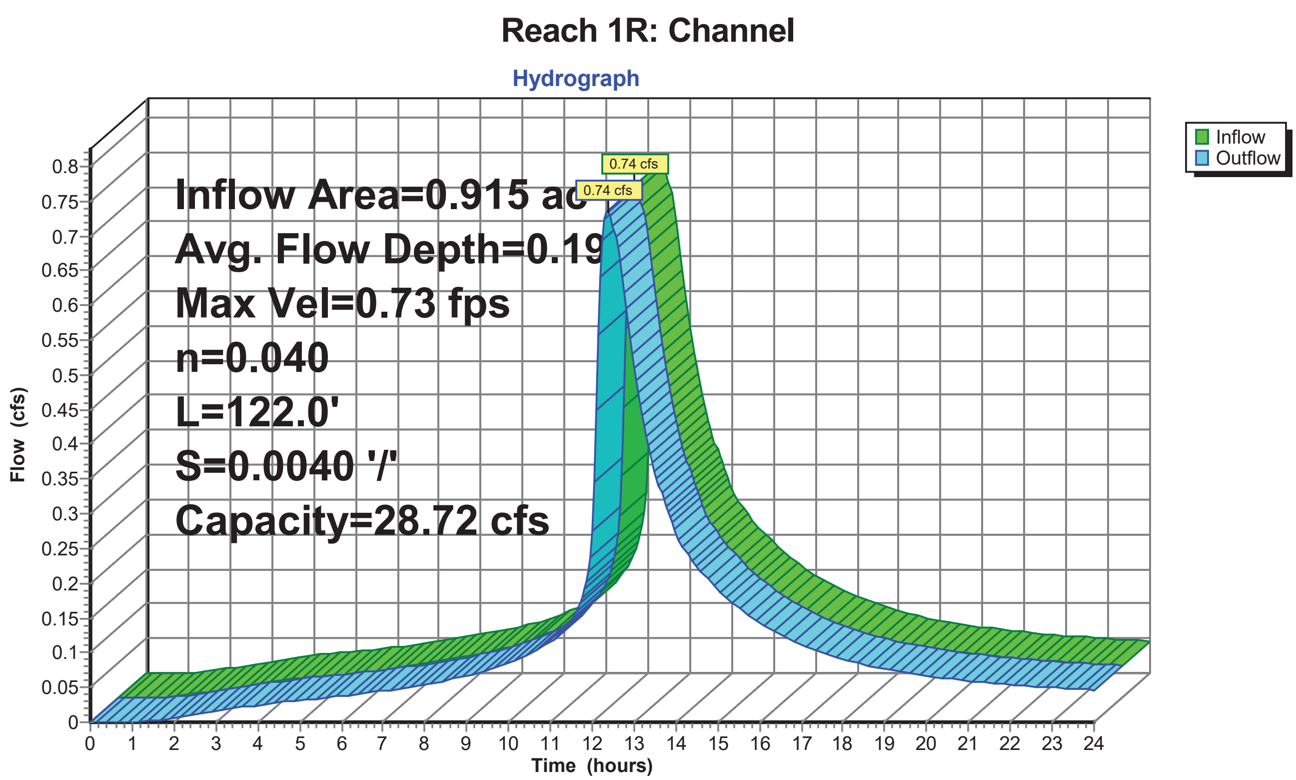
Inflow Area = 0.915 ac, 89.83% Impervious, Inflow Depth > 2.78" for 2-yr event
Inflow = 0.74 cfs @ 12.34 hrs, Volume= 0.212 af
Outflow = 0.74 cfs @ 12.37 hrs, Volume= 0.211 af, Atten= 0%, Lag= 1.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 0.73 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 0.32 fps, Avg. Travel Time= 6.4 min

Peak Storage= 123 cf @ 12.37 hrs
Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 1.50' Flow Area= 12.0 sf, Capacity= 28.72 cfs

5.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 122.0' Slope= 0.0040 '/'
Inlet Invert= 18.91', Outlet Invert= 18.42'

‡



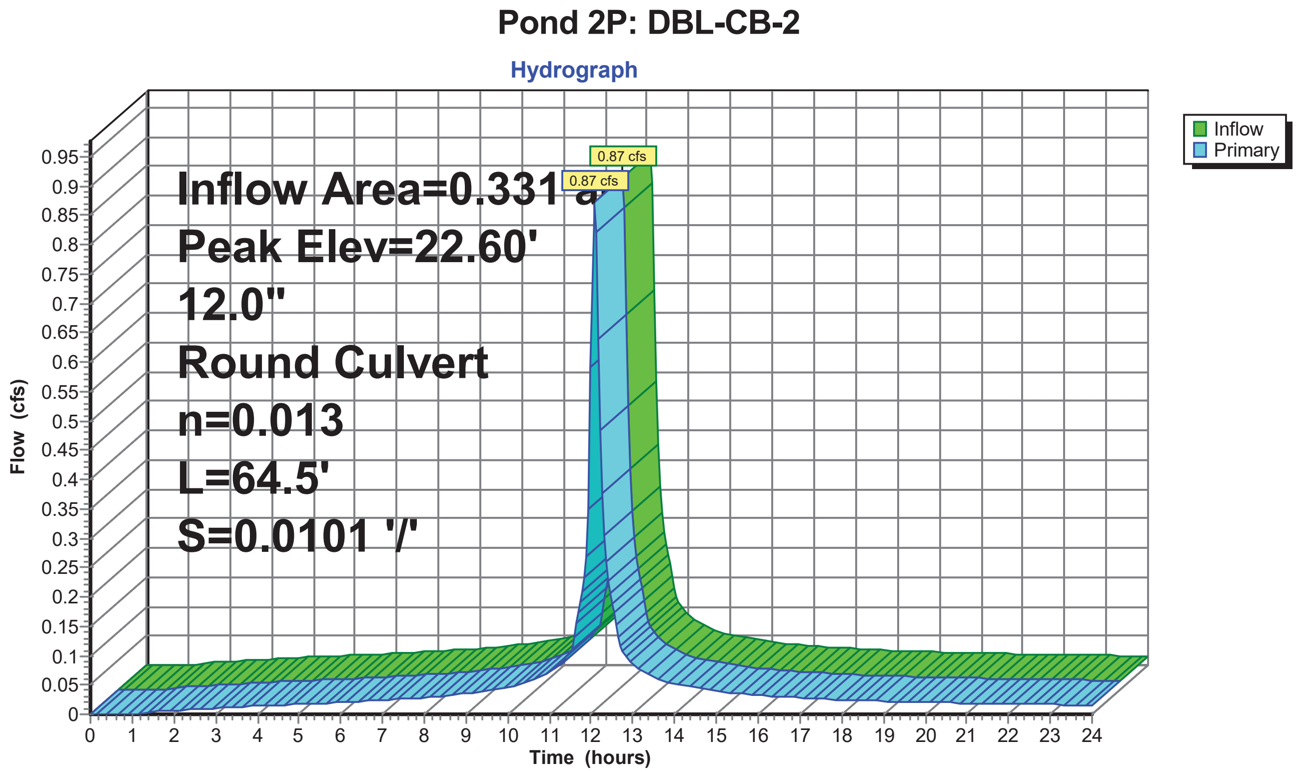
Summary for Pond 2P: DBL-CB-2

Inflow Area = 0.331 ac, 97.93% Impervious, Inflow Depth > 2.98" for 2-yr event
Inflow = 0.87 cfs @ 12.07 hrs, Volume= 0.082 af
Outflow = 0.87 cfs @ 12.07 hrs, Volume= 0.082 af, Atten= 0%, Lag= 0.0 min
Primary = 0.87 cfs @ 12.07 hrs, Volume= 0.082 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 22.60' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	22.05'	**12.0" Round Culvert** L= 64.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 22.05' / 21.40' S= 0.0101 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.84 cfs @ 12.07 hrs HW=22.58' TW=21.89' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.84 cfs @ 1.96 fps)



Summary for Pond 3P: DBL-CB-1

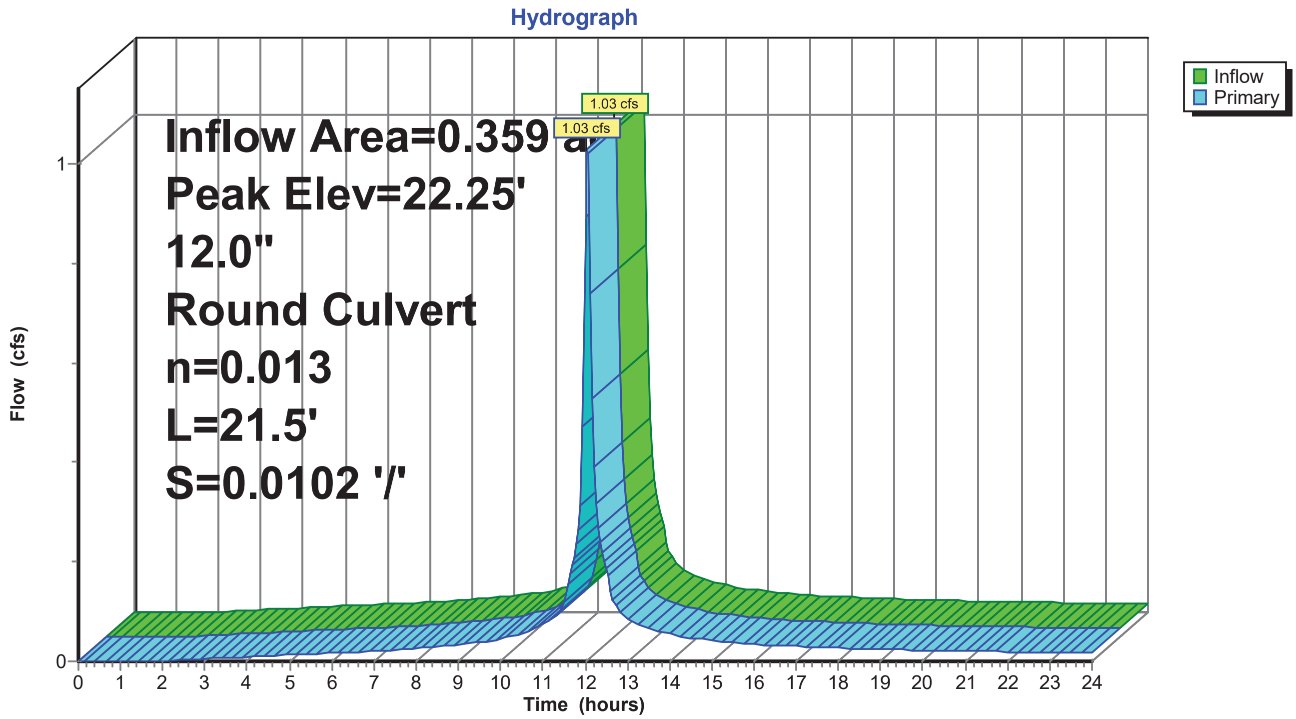
Inflow Area = 0.359 ac, 90.33% Impervious, Inflow Depth > 2.77" for 2-yr event
Inflow = 1.03 cfs @ 12.04 hrs, Volume= 0.083 af
Outflow = 1.03 cfs @ 12.04 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min
Primary = 1.03 cfs @ 12.04 hrs, Volume= 0.083 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 22.25' @ 12.04 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	21.62'	**12.0" Round Culvert** L= 21.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 21.62' / 21.40' S= 0.0102 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.00 cfs @ 12.04 hrs HW=22.23' TW=21.90' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.00 cfs @ 2.84 fps)

Pond 3P: DBL-CB-1



Summary for Pond 4P: CB-1

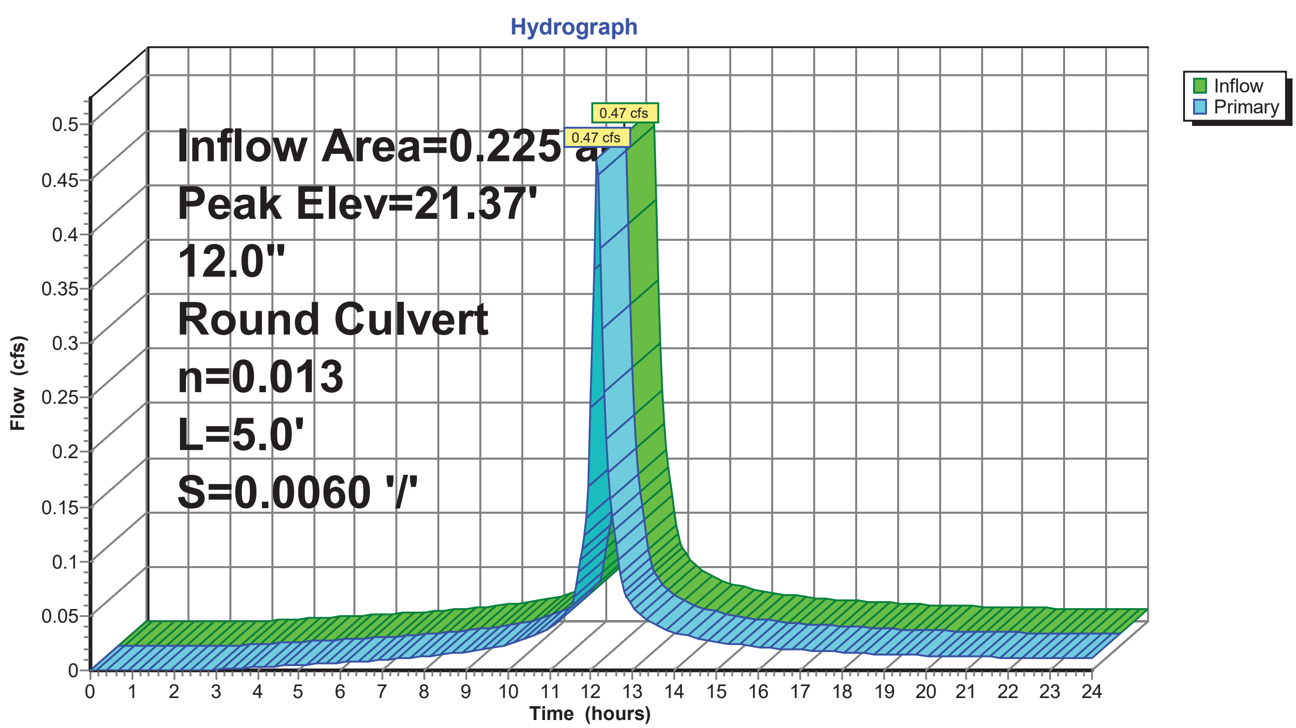
Inflow Area = 0.225 ac, 77.12% Impervious, Inflow Depth > 2.56" for 2-yr event
Inflow = 0.47 cfs @ 12.12 hrs, Volume= 0.048 af
Outflow = 0.47 cfs @ 12.12 hrs, Volume= 0.048 af, Atten= 0%, Lag= 0.0 min
Primary = 0.47 cfs @ 12.12 hrs, Volume= 0.048 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.37' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	20.88'	**12.0" Round Culvert** L= 5.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 20.88' / 20.85' S= 0.0060 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.49 cfs @ 12.12 hrs HW=21.33' TW=21.18' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.49 cfs @ 2.08 fps)

Pond 4P: CB-1



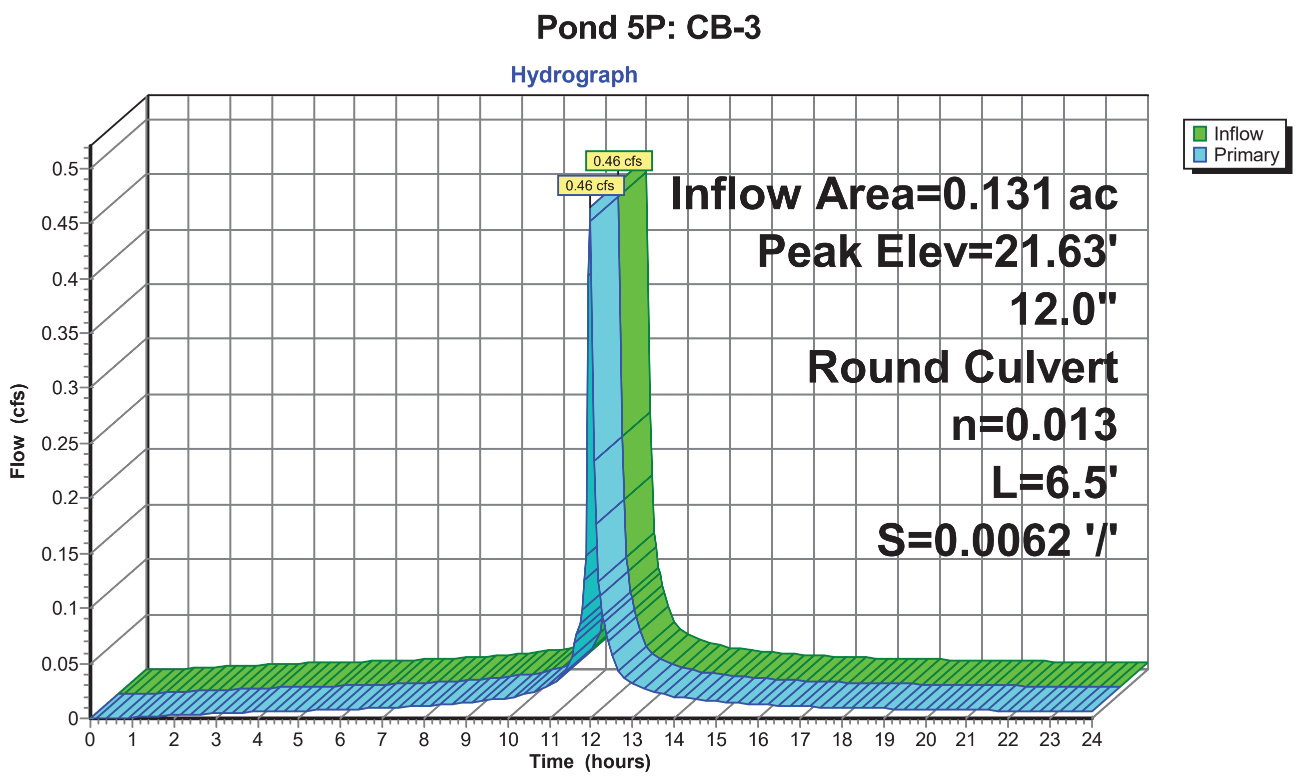
Summary for Pond 5P: CB-3

Inflow Area = 0.131 ac,100.00% Impervious, Inflow Depth > 2.99" for 2-yr event
Inflow = 0.46 cfs @ 11.98 hrs, Volume= 0.032 af
Outflow = 0.46 cfs @ 11.98 hrs, Volume= 0.032 af, Atten= 0%, Lag= 0.0 min
Primary = 0.46 cfs @ 11.98 hrs, Volume= 0.032 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.63' @ 11.98 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	21.16'	**12.0" Round Culvert** L= 6.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 21.16' / 21.12' S= 0.0062 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.44 cfs @ 11.98 hrs HW=21.61' TW=21.50' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.44 cfs @ 1.84 fps)



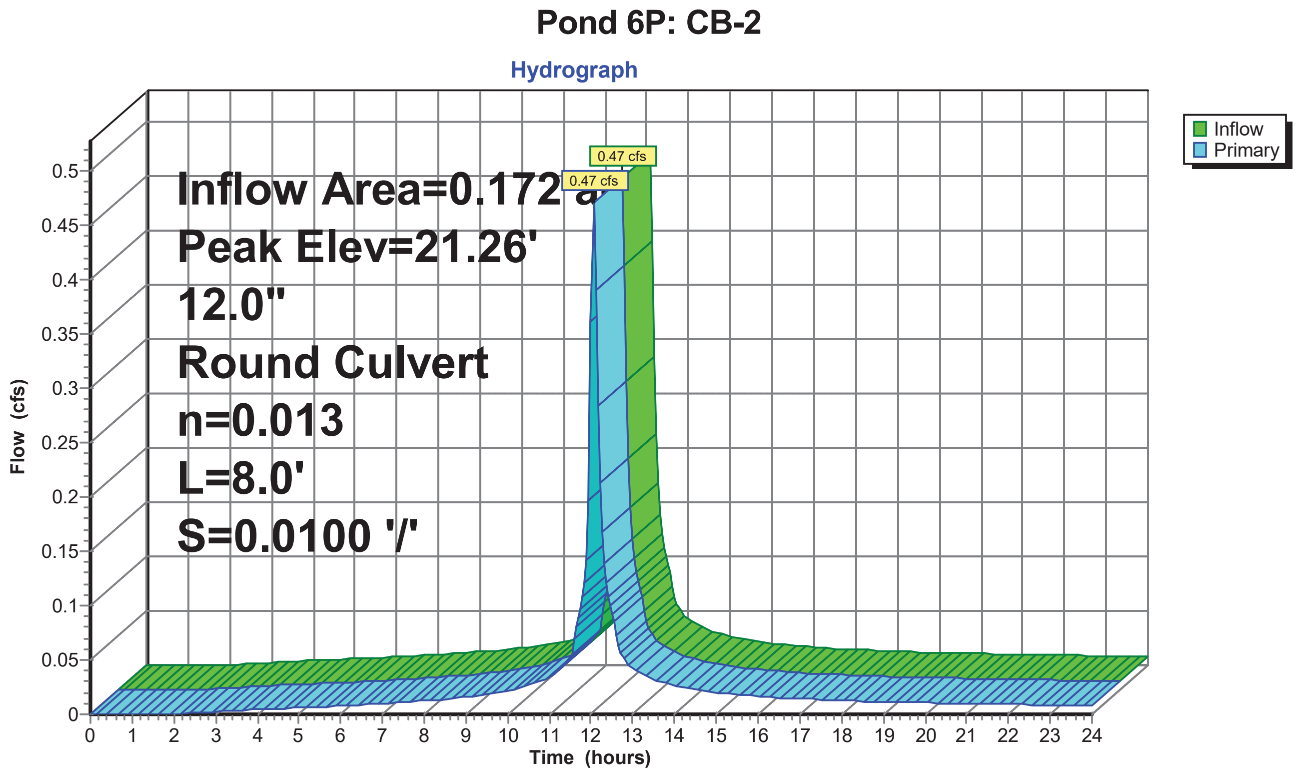
Summary for Pond 6P: CB-2

Inflow Area = 0.172 ac, 90.02% Impervious, Inflow Depth > 2.76" for 2-yr event
Inflow = 0.47 cfs @ 12.05 hrs, Volume= 0.040 af
Outflow = 0.47 cfs @ 12.05 hrs, Volume= 0.040 af, Atten= 0%, Lag= 0.0 min
Primary = 0.47 cfs @ 12.05 hrs, Volume= 0.040 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.26' @ 12.05 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	20.85'	**12.0" Round Culvert** L= 8.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 20.85' / 20.77' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.46 cfs @ 12.05 hrs HW=21.26' TW=20.90' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.46 cfs @ 2.26 fps)



Summary for Pond 7P: DMH-5

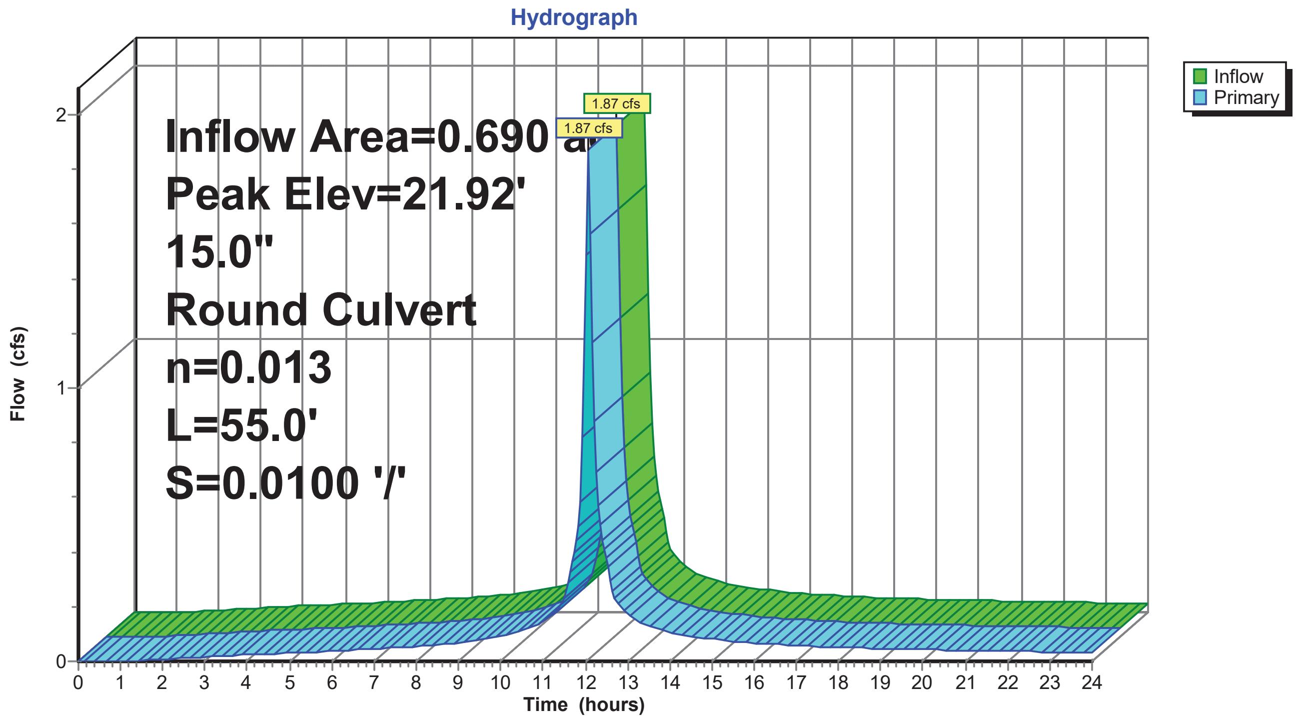
Inflow Area = 0.690 ac, 93.97% Impervious, Inflow Depth > 2.87" for 2-yr event
Inflow = 1.87 cfs @ 12.05 hrs, Volume= 0.165 af
Outflow = 1.87 cfs @ 12.05 hrs, Volume= 0.165 af, Atten= 0%, Lag= 0.0 min
Primary = 1.87 cfs @ 12.05 hrs, Volume= 0.165 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.92' @ 12.05 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	21.15'	**15.0" Round Culvert** L= 55.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 21.15' / 20.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=1.85 cfs @ 12.05 hrs HW=21.92' TW=21.28' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 1.85 cfs @ 2.35 fps)

Pond 7P: DMH-5



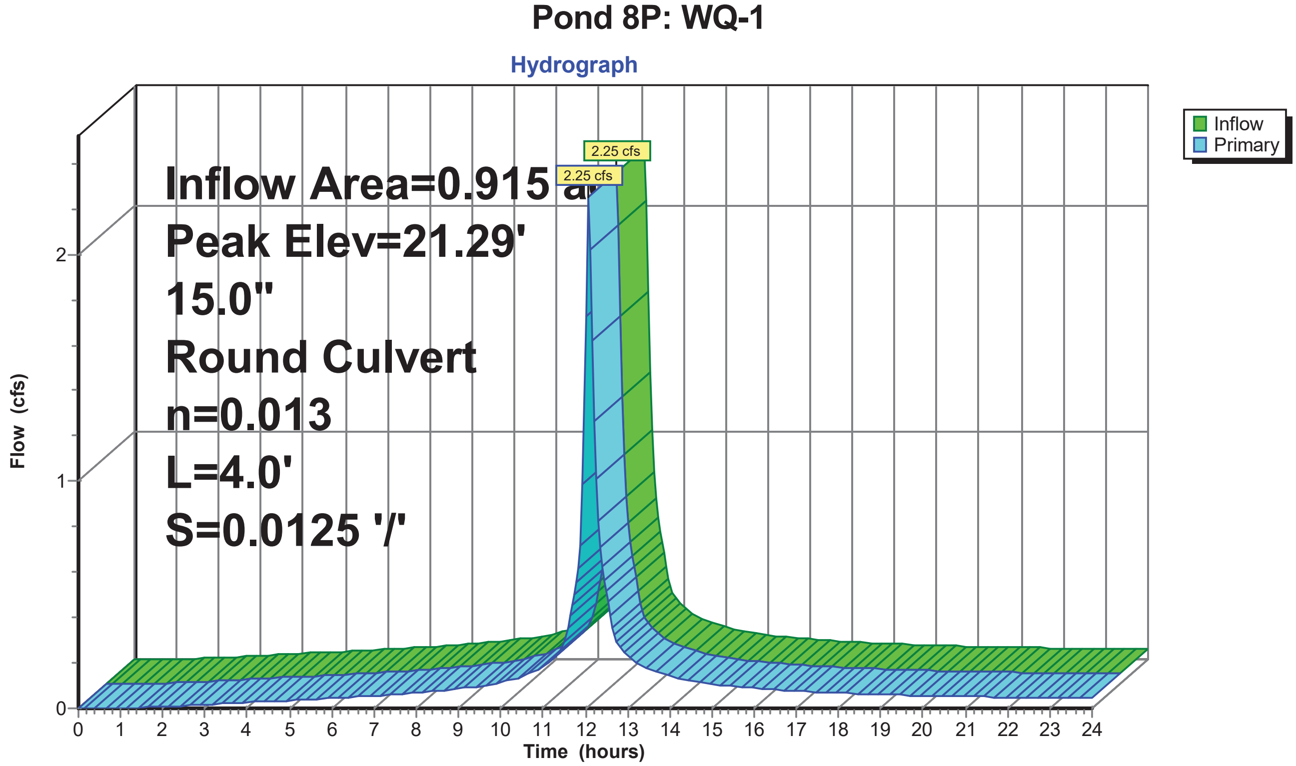
Summary for Pond 8P: WQ-1

Inflow Area =	0.915 ac,	89.83% Impervious,	Inflow Depth >	2.79"	for 2-yr event
Inflow =	2.25 cfs @	12.06 hrs,	Volume=	0.213 af	
Outflow =	2.25 cfs @	12.06 hrs,	Volume=	0.213 af,	Atten= 0%, Lag= 0.0 min
Primary =	2.25 cfs @	12.06 hrs,	Volume=	0.213 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.29' @ 12.06 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	20.33'	**15.0" Round Culvert** L= 4.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 20.33' / 20.28' S= 0.0125 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=2.19 cfs @ 12.06 hrs HW=21.28' TW=20.68' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 2.19 cfs @ 3.05 fps)



Summary for Pond 9P: Storage Area

Inflow Area = 0.915 ac, 89.83% Impervious, Inflow Depth > 2.79" for 2-yr event
Inflow = 2.25 cfs @ 12.06 hrs, Volume= 0.213 af
Outflow = 0.74 cfs @ 12.34 hrs, Volume= 0.212 af, Atten= 67%, Lag= 16.9 min
Primary = 0.74 cfs @ 12.34 hrs, Volume= 0.212 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 20.86' @ 12.34 hrs Surf.Area= 7,737 sf Storage= 2,316 cf

Plug-Flow detention time= 49.6 min calculated for 0.211 af (99% of inflow)
Center-of-Mass det. time= 45.7 min (823.9 - 778.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	19.50'	0 cf	**53.27'W x 145.00'L x 2.75'H Field A** 21,245 cf Overall - 5,841 cf Embedded = 15,404 cf x 0.0% Voids
#2A	20.00'	4,722 cf	**ADS N-12 18** x 126 Inside #1 Inside= 18.2"W x 18.2"H => 1.80 sf x 20.00'L = 36.0 cf Outside= 21.0"W x 21.0"H => 2.23 sf x 20.00'L = 44.5 cf 18 Rows of 7 Chambers 51.77' Header x 1.80 sf x 2 = 186.4 cf Inside
#3	19.99'	46 cf	**4.00'D x 3.65'H Vertical Cone/Cylinder**
#4	23.70'	2,397 cf	**Lower Parking Lot (Prismatic)** Listed below (Recalc)
		7,165 cf	Total Available Storage

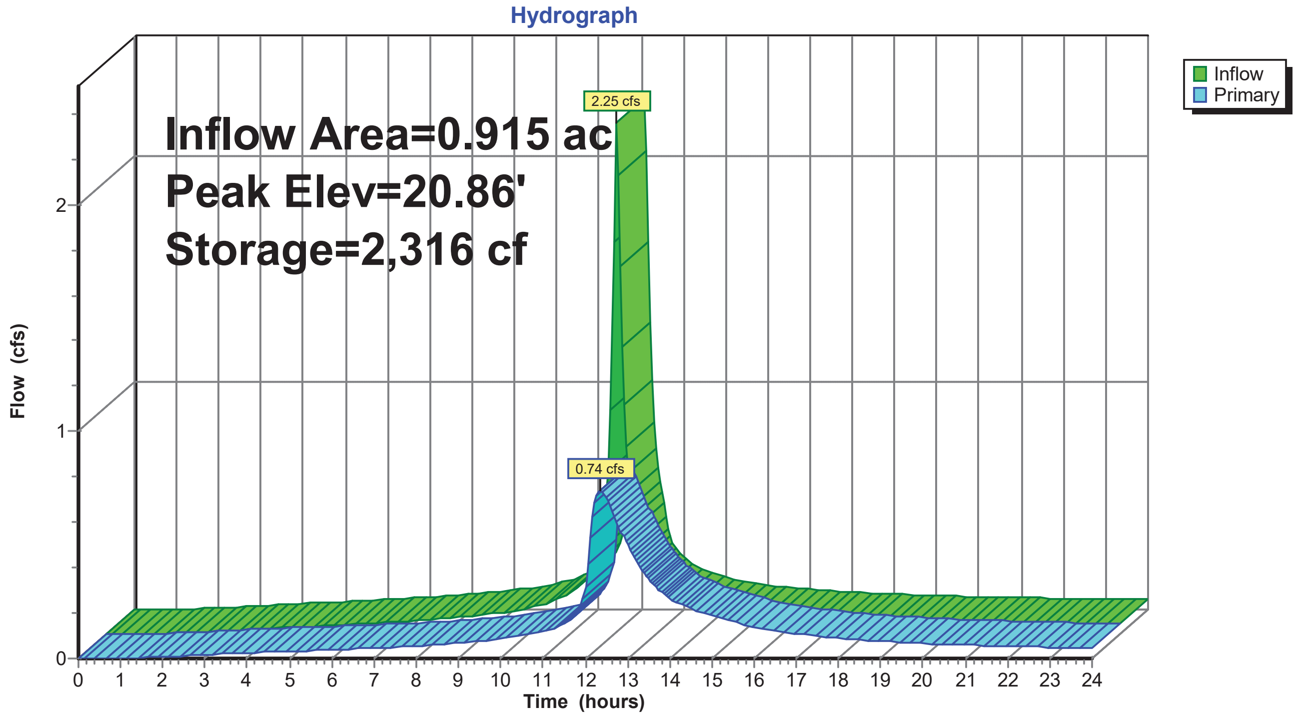
Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
23.70	2	0	0
24.00	1,764	265	265
25.00	2,500	2,132	2,397

Device	Routing	Invert	Outlet Devices
#1	Primary	19.90'	**15.0" Round Culvert** L= 74.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 19.90' / 19.45' S= 0.0061 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	20.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 0.50 3.00 3.00 3.50 Width (feet) 0.20 0.20 0.50 0.50 4.00 4.00

Primary OutFlow Max=0.74 cfs @ 12.34 hrs HW=20.86' TW=19.10' (Dynamic Tailwater)
└1=Culvert (Passes 0.74 cfs of 2.63 cfs potential flow)
  └2=Custom Weir/Orifice (Weir Controls 0.74 cfs @ 2.62 fps)

Pond 9P: Storage Area



Summary for Pond 10P: DMH-6

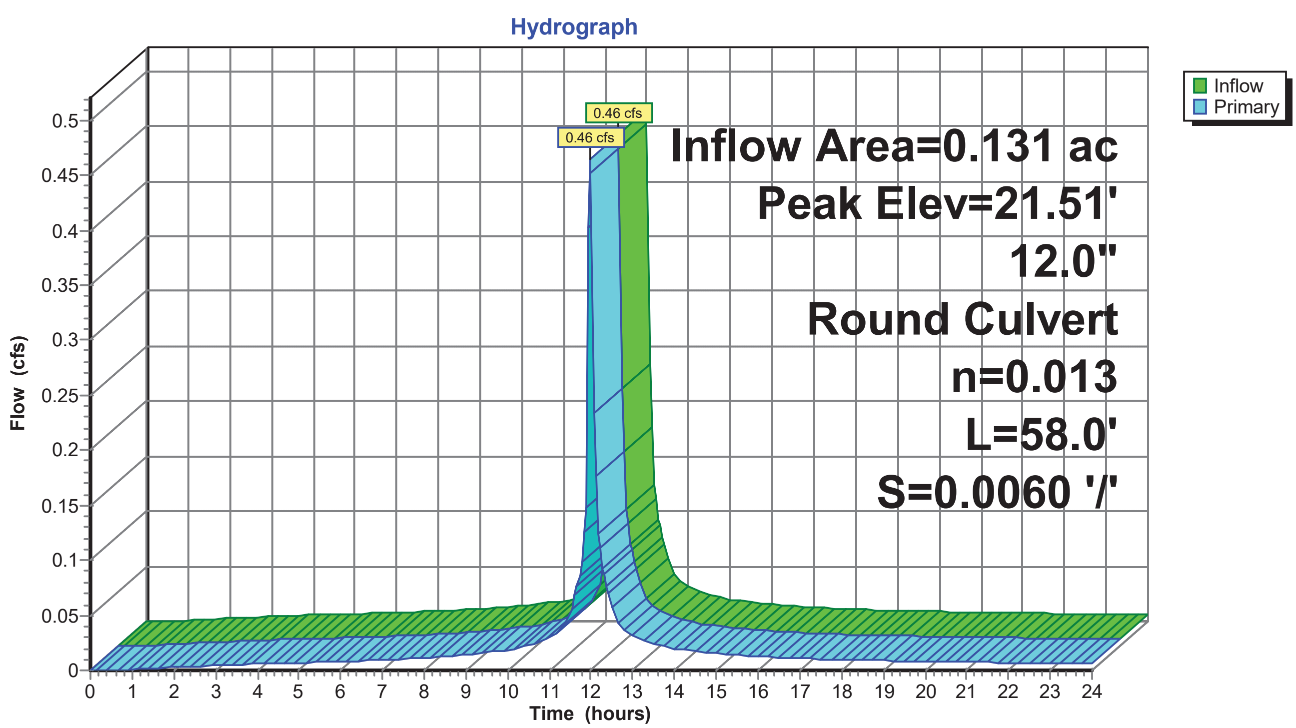
Inflow Area = 0.131 ac,100.00% Impervious, Inflow Depth > 2.99" for 2-yr event
Inflow = 0.46 cfs @ 11.98 hrs, Volume= 0.032 af
Outflow = 0.46 cfs @ 11.98 hrs, Volume= 0.032 af, Atten= 0%, Lag= 0.0 min
Primary = 0.46 cfs @ 11.98 hrs, Volume= 0.032 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.51' @ 11.98 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	21.12'	**12.0" Round Culvert** L= 58.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 21.12' / 20.77' S= 0.0060 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.44 cfs @ 11.98 hrs HW=21.50' TW=20.92' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.44 cfs @ 2.37 fps)

Pond 10P: DMH-6



Summary for Pond 11P: WQ-2

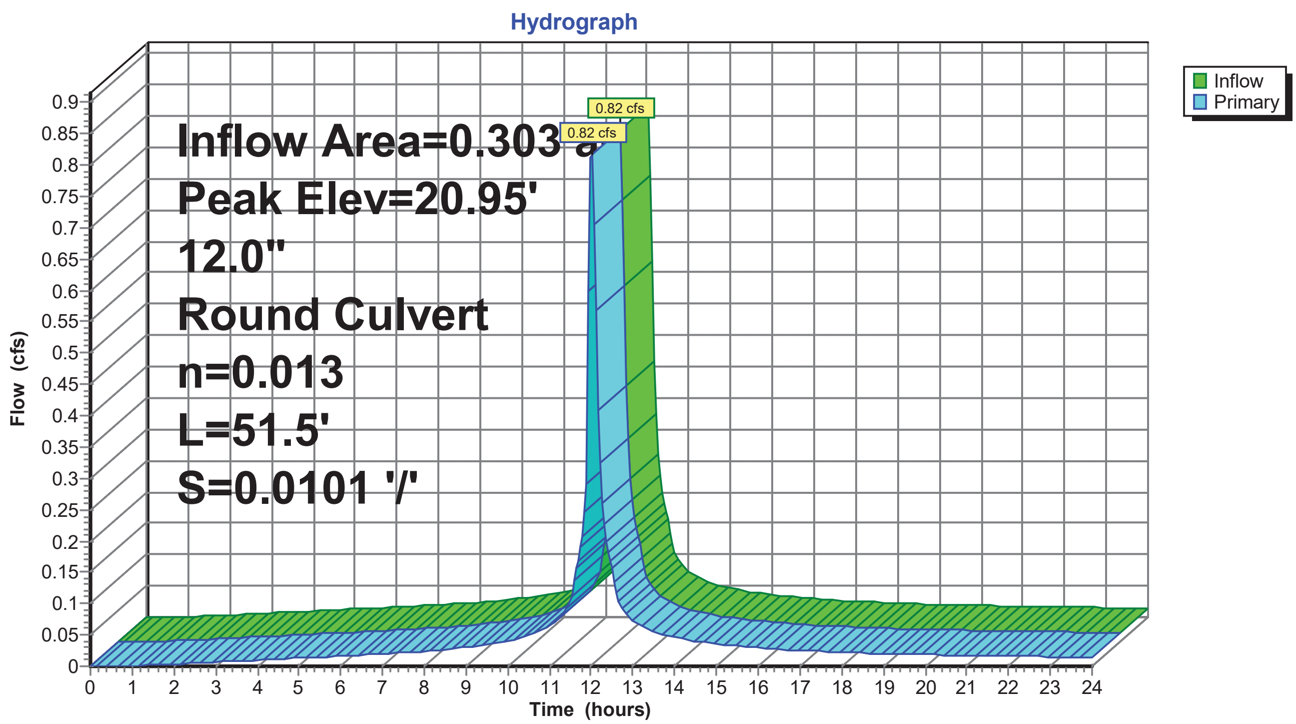
Inflow Area = 0.303 ac, 94.33% Impervious, Inflow Depth > 2.86" for 2-yr event
Inflow = 0.82 cfs @ 12.01 hrs, Volume= 0.072 af
Outflow = 0.82 cfs @ 12.01 hrs, Volume= 0.072 af, Atten= 0%, Lag= 0.0 min
Primary = 0.82 cfs @ 12.01 hrs, Volume= 0.072 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 20.95' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	20.42'	**12.0" Round Culvert** L= 51.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 20.42' / 19.90' S= 0.0101 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.79 cfs @ 12.01 hrs HW=20.94' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.79 cfs @ 1.93 fps)

Pond 11P: WQ-2

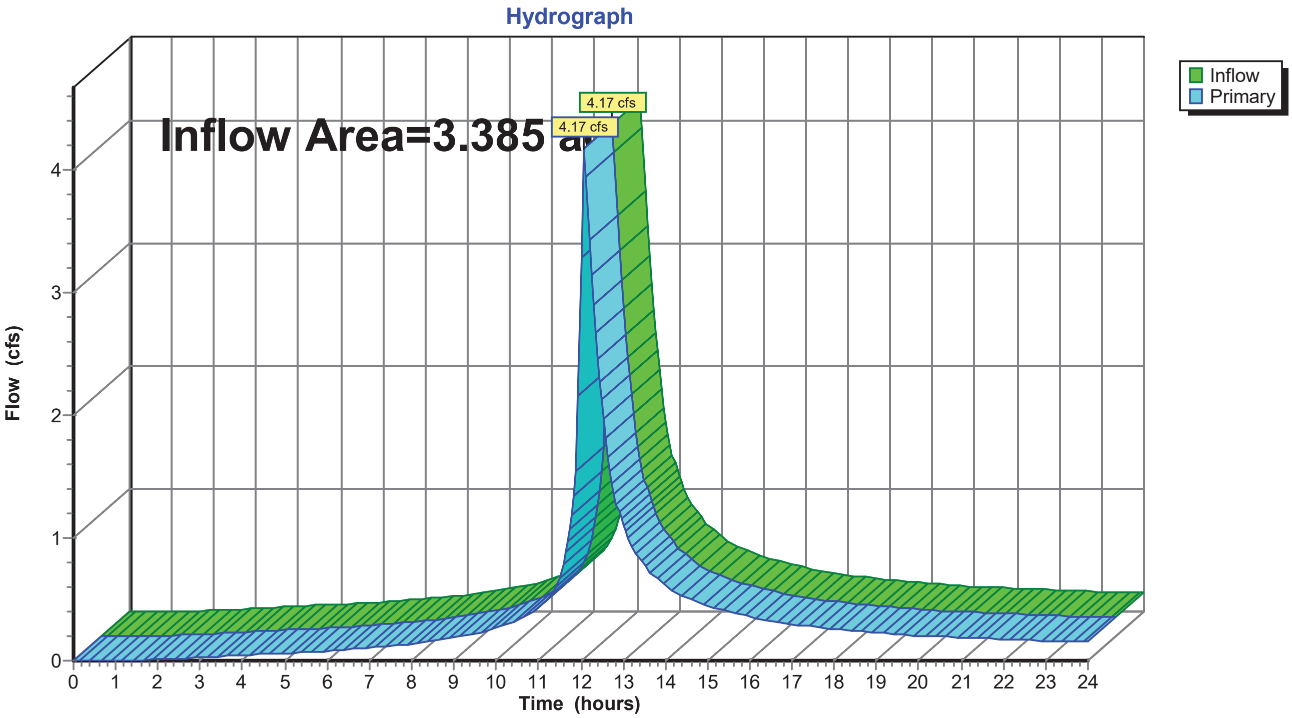


Summary for Link 4L: Southwesterly Flow

Inflow Area = 3.385 ac, 55.96% Impervious, Inflow Depth > 2.29" for 2-yr event
Inflow = 4.17 cfs @ 12.08 hrs, Volume= 0.646 af
Primary = 4.17 cfs @ 12.08 hrs, Volume= 0.646 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 4L: Southwesterly Flow

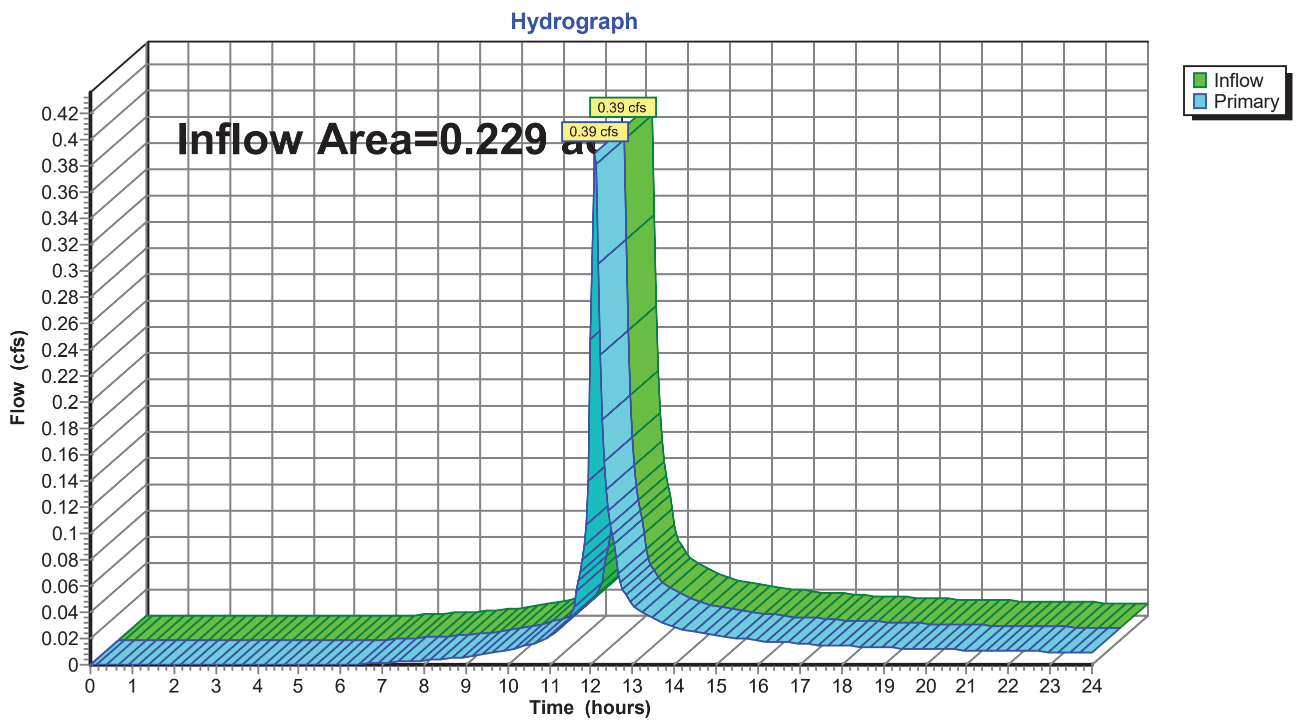


Summary for Link 5L: Southeasterly Flow

Inflow Area =	0.229 ac, 21.55% Impervious, Inflow Depth > 1.77"	for 2-yr event	
Inflow =	0.39 cfs @ 12.08 hrs, Volume=	0.034 af	
Primary =	0.39 cfs @ 12.08 hrs, Volume=	0.034 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 5L: Southeasterly Flow

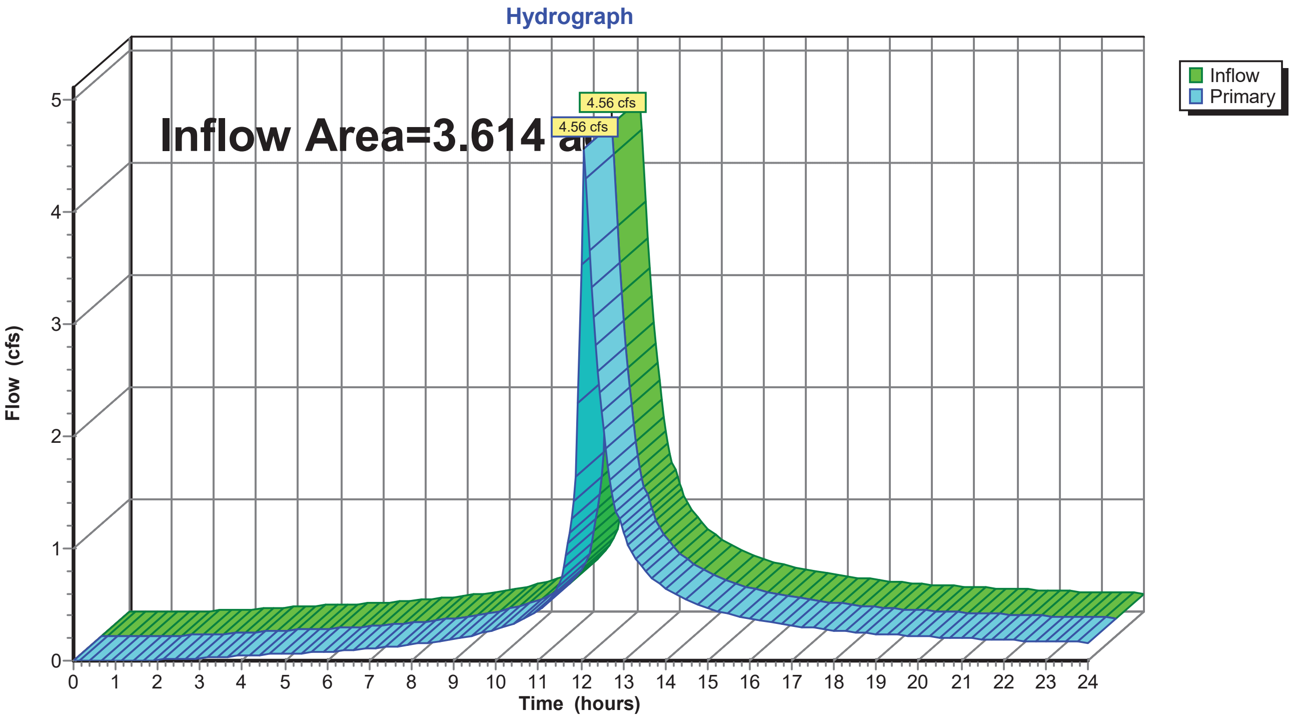


Summary for Link 6L: Post Total

Inflow Area = 3.614 ac, 53.78% Impervious, Inflow Depth > 2.26" for 2-yr event
Inflow = 4.56 cfs @ 12.08 hrs, Volume= 0.680 af
Primary = 4.56 cfs @ 12.08 hrs, Volume= 0.680 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 6L: Post Total



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1-1: Exist Parking Entrance Runoff Area=7,496 sf 90.02% Impervious Runoff Depth>4.48"
Flow Length=218' Slope=0.0125 '/' Tc=7.3 min CN=96 Runoff=0.66 cfs 0.064 af

Subcatchment P1-2: Exist Parking Runoff Area=5,685 sf 100.00% Impervious Runoff Depth>4.71"
Flow Length=215' Slope=0.0125 '/' Tc=2.1 min CN=98 Runoff=0.63 cfs 0.051 af

Subcatchment P2-1: Prop Park Upper Runoff Area=14,416 sf 97.93% Impervious Runoff Depth>4.70"
Flow Length=142' Tc=8.8 min CN=98 Runoff=1.20 cfs 0.130 af

Subcatchment P2-2: Prop Park Middle Runoff Area=15,655 sf 90.33% Impervious Runoff Depth>4.48"
Flow Length=132' Tc=6.1 min CN=96 Runoff=1.43 cfs 0.134 af

Subcatchment P2-3: Prop Park Lower Runoff Area=9,796 sf 77.12% Impervious Runoff Depth>4.25"
Flow Length=160' Tc=12.7 min CN=94 Runoff=0.68 cfs 0.080 af

Subcatchment P3: Prop. Access & Wetland Runoff Area=40,675 sf 5.69% Impervious Runoff Depth>3.11"
Flow Length=728' Tc=22.5 min CN=83 Runoff=1.71 cfs 0.242 af

Subcatchment P4: Exist Parking Entrance Runoff Area=9,994 sf 21.55% Impervious Runoff Depth>3.31"
Flow Length=230' Tc=9.0 min CN=85 Runoff=0.64 cfs 0.063 af

Subcatchment P5: Exist Parking Runoff Area=26,482 sf 79.57% Impervious Runoff Depth>4.25"
Flow Length=262' Tc=10.2 min CN=94 Runoff=1.99 cfs 0.215 af

Subcatchment P6: Exist Parking Building Runoff Area=17,458 sf 62.29% Impervious Runoff Depth>3.93"
Flow Length=535' Tc=7.0 min CN=91 Runoff=1.43 cfs 0.131 af

Subcatchment P7: Remain-grass-swale Runoff Area=9,774 sf 0.00% Impervious Runoff Depth>3.22"
Flow Length=364' Tc=7.5 min CN=84 Runoff=0.67 cfs 0.060 af

Reach 1R: Channel Avg. Flow Depth=0.26' Max Vel=0.88 fps Inflow=1.25 cfs 0.339 af
n=0.040 L=122.0' S=0.0040 '/' Capacity=28.72 cfs Outflow=1.25 cfs 0.339 af

Pond 2P: DBL-CB-2 Peak Elev=22.71' Inflow=1.20 cfs 0.130 af
12.0" Round Culvert n=0.013 L=64.5' S=0.0101 '/' Outflow=1.20 cfs 0.130 af

Pond 3P: DBL-CB-1 Peak Elev=22.42' Inflow=1.43 cfs 0.134 af
12.0" Round Culvert n=0.013 L=21.5' S=0.0102 '/' Outflow=1.43 cfs 0.134 af

Pond 4P: CB-1 Peak Elev=21.58' Inflow=0.68 cfs 0.080 af
12.0" Round Culvert n=0.013 L=5.0' S=0.0060 '/' Outflow=0.68 cfs 0.080 af

Pond 5P: CB-3 Peak Elev=21.72' Inflow=0.63 cfs 0.051 af
12.0" Round Culvert n=0.013 L=6.5' S=0.0062 '/' Outflow=0.63 cfs 0.051 af

Pond 6P: CB-2 Peak Elev=21.35' Inflow=0.66 cfs 0.064 af
12.0" Round Culvert n=0.013 L=8.0' S=0.0100 '/' Outflow=0.66 cfs 0.064 af

Pond 7P: DMH-5 Peak Elev=22.11' Inflow=2.59 cfs 0.264 af
15.0" Round Culvert n=0.013 L=55.0' S=0.0100 '/' Outflow=2.59 cfs 0.264 af

Pond 8P: WQ-1 Peak Elev=21.52' Inflow=3.15 cfs 0.343 af
15.0" Round Culvert n=0.013 L=4.0' S=0.0125 '/' Outflow=3.15 cfs 0.343 af

Pond 9P: Storage Area Peak Elev=21.12' Storage=3,327 cf Inflow=3.15 cfs 0.343 af
Outflow=1.25 cfs 0.339 af

Pond 10P: DMH-6 Peak Elev=21.58' Inflow=0.63 cfs 0.051 af
12.0" Round Culvert n=0.013 L=58.0' S=0.0060 '/' Outflow=0.63 cfs 0.051 af

Pond 11P: WQ-2 Peak Elev=21.06' Inflow=1.13 cfs 0.115 af
12.0" Round Culvert n=0.013 L=51.5' S=0.0101 '/' Outflow=1.13 cfs 0.115 af

Link 4L: Southwesterly Flow Inflow=6.56 cfs 1.102 af
Primary=6.56 cfs 1.102 af

Link 5L: Southeasterly Flow Inflow=0.64 cfs 0.063 af
Primary=0.64 cfs 0.063 af

Link 6L: Post Total Inflow=7.20 cfs 1.166 af
Primary=7.20 cfs 1.166 af

Total Runoff Area = 3.614 ac Runoff Volume = 1.171 af Average Runoff Depth = 3.89"
46.22% Pervious = 1.671 ac 53.78% Impervious = 1.944 ac

Summary for Pond 2P: DBL-CB-2

Inflow Area = 0.331 ac, 97.93% Impervious, Inflow Depth > 4.70" for 10-yr event
Inflow = 1.20 cfs @ 12.07 hrs, Volume= 0.130 af
Outflow = 1.20 cfs @ 12.07 hrs, Volume= 0.130 af, Atten= 0%, Lag= 0.0 min
Primary = 1.20 cfs @ 12.07 hrs, Volume= 0.130 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 22.71' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	22.05'	**12.0" Round Culvert** L= 64.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 22.05' / 21.40' S= 0.0101 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.15 cfs @ 12.07 hrs HW=22.69' TW=22.07' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 1.15 cfs @ 2.16 fps)

Summary for Pond 3P: DBL-CB-1

Inflow Area = 0.359 ac, 90.33% Impervious, Inflow Depth > 4.48" for 10-yr event
Inflow = 1.43 cfs @ 12.04 hrs, Volume= 0.134 af
Outflow = 1.43 cfs @ 12.04 hrs, Volume= 0.134 af, Atten= 0%, Lag= 0.0 min
Primary = 1.43 cfs @ 12.04 hrs, Volume= 0.134 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 22.42' @ 12.05 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	21.62'	**12.0" Round Culvert** L= 21.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 21.62' / 21.40' S= 0.0102 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.36 cfs @ 12.04 hrs HW=22.40' TW=22.08' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.36 cfs @ 2.86 fps)

Summary for Pond 4P: CB-1

Inflow Area = 0.225 ac, 77.12% Impervious, Inflow Depth > 4.25" for 10-yr event
Inflow = 0.68 cfs @ 12.12 hrs, Volume= 0.080 af
Outflow = 0.68 cfs @ 12.12 hrs, Volume= 0.080 af, Atten= 0%, Lag= 0.0 min
Primary = 0.68 cfs @ 12.12 hrs, Volume= 0.080 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.58' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	20.88'	**12.0" Round Culvert**

L= 5.0' CPP, projecting, no headwall, Ke= 0.900
Inlet / Outlet Invert= 20.88' / 20.85' S= 0.0060 '/' Cc= 0.900
n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.61 cfs @ 12.12 hrs HW=21.50' TW=21.41' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.61 cfs @ 1.18 fps)

Summary for Pond 5P: CB-3

Inflow Area =	0.131 ac,100.00% Impervious,	Inflow Depth > 4.71"	for 10-yr event	
Inflow =	0.63 cfs @	11.98 hrs, Volume=	0.051 af	
Outflow =	0.63 cfs @	11.98 hrs, Volume=	0.051 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.63 cfs @	11.98 hrs, Volume=	0.051 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.72' @ 11.98 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	21.16'	**12.0" Round Culvert** L= 6.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 21.16' / 21.12' S= 0.0062 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.59 cfs @ 11.98 hrs HW=21.70' TW=21.57' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.59 cfs @ 1.98 fps)

Summary for Pond 6P: CB-2

Inflow Area =	0.172 ac, 90.02% Impervious,	Inflow Depth > 4.48"	for 10-yr event	
Inflow =	0.66 cfs @	12.05 hrs, Volume=	0.064 af	
Outflow =	0.66 cfs @	12.05 hrs, Volume=	0.064 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.66 cfs @	12.05 hrs, Volume=	0.064 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.35' @ 12.05 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	20.85'	**12.0" Round Culvert** L= 8.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 20.85' / 20.77' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.65 cfs @ 12.05 hrs HW=21.35' TW=21.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.65 cfs @ 2.43 fps)

Summary for Pond 7P: DMH-5

Inflow Area = 0.690 ac, 93.97% Impervious, Inflow Depth > 4.59" for 10-yr event
Inflow = 2.59 cfs @ 12.05 hrs, Volume= 0.264 af
Outflow = 2.59 cfs @ 12.05 hrs, Volume= 0.264 af, Atten= 0%, Lag= 0.0 min
Primary = 2.59 cfs @ 12.05 hrs, Volume= 0.264 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 22.11' @ 12.05 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	21.15'	**15.0" Round Culvert** L= 55.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 21.15' / 20.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=2.56 cfs @ 12.05 hrs HW=22.10' TW=21.51' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 2.56 cfs @ 3.54 fps)

Summary for Pond 8P: WQ-1

Inflow Area = 0.915 ac, 89.83% Impervious, Inflow Depth > 4.50" for 10-yr event
Inflow = 3.15 cfs @ 12.06 hrs, Volume= 0.343 af
Outflow = 3.15 cfs @ 12.06 hrs, Volume= 0.343 af, Atten= 0%, Lag= 0.0 min
Primary = 3.15 cfs @ 12.06 hrs, Volume= 0.343 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.52' @ 12.06 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	20.33'	**15.0" Round Culvert** L= 4.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 20.33' / 20.28' S= 0.0125 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=3.07 cfs @ 12.06 hrs HW=21.50' TW=20.90' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 3.07 cfs @ 3.34 fps)

Summary for Pond 9P: Storage Area

Inflow Area = 0.915 ac, 89.83% Impervious, Inflow Depth > 4.50" for 10-yr event
Inflow = 3.15 cfs @ 12.06 hrs, Volume= 0.343 af
Outflow = 1.25 cfs @ 12.31 hrs, Volume= 0.339 af, Atten= 60%, Lag= 14.7 min
Primary = 1.25 cfs @ 12.31 hrs, Volume= 0.339 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.12' @ 12.31 hrs Surf.Area= 7,737 sf Storage= 3,327 cf

Plug-Flow detention time= 52.6 min calculated for 0.339 af (99% of inflow)
Center-of-Mass det. time= 44.7 min (810.6 - 765.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	19.50'	0 cf	**53.27'W x 145.00'L x 2.75'H Field A** 21,245 cf Overall - 5,841 cf Embedded = 15,404 cf x 0.0% Voids
#2A	20.00'	4,722 cf	**ADS N-12 18** x 126 Inside #1 Inside= 18.2"W x 18.2"H => 1.80 sf x 20.00'L = 36.0 cf Outside= 21.0"W x 21.0"H => 2.23 sf x 20.00'L = 44.5 cf 18 Rows of 7 Chambers 51.77' Header x 1.80 sf x 2 = 186.4 cf Inside
#3	19.99'	46 cf	**4.00'D x 3.65'H Vertical Cone/Cylinder**
#4	23.70'	2,397 cf	**Lower Parking Lot (Prismatic)** Listed below (Recalc)
		7,165 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
23.70	2	0	0
24.00	1,764	265	265
25.00	2,500	2,132	2,397

Device	Routing	Invert	Outlet Devices
#1	Primary	19.90'	**15.0" Round Culvert** L= 74.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 19.90' / 19.45' S= 0.0061 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	20.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 0.50 3.00 3.00 3.50 Width (feet) 0.20 0.20 0.50 0.50 4.00 4.00

Primary OutFlow Max=1.25 cfs @ 12.31 hrs HW=21.12' TW=19.17' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.25 cfs of 3.62 cfs potential flow)
  └─**2=Custom Weir/Orifice** (Weir Controls 1.25 cfs @ 3.06 fps)

Summary for Pond 10P: DMH-6

Inflow Area = 0.131 ac,100.00% Impervious, Inflow Depth > 4.71" for 10-yr event
Inflow = 0.63 cfs @ 11.98 hrs, Volume= 0.051 af
Outflow = 0.63 cfs @ 11.98 hrs, Volume= 0.051 af, Atten= 0%, Lag= 0.0 min
Primary = 0.63 cfs @ 11.98 hrs, Volume= 0.051 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.58' @ 11.98 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	21.12'	**12.0" Round Culvert** L= 58.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 21.12' / 20.77' S= 0.0060 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.59 cfs @ 11.98 hrs HW=21.57' TW=21.02' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.59 cfs @ 2.55 fps)

Summary for Pond 11P: WQ-2

Inflow Area = 0.303 ac, 94.33% Impervious, Inflow Depth > 4.58" for 10-yr event
Inflow = 1.13 cfs @ 12.01 hrs, Volume= 0.115 af
Outflow = 1.13 cfs @ 12.01 hrs, Volume= 0.115 af, Atten= 0%, Lag= 0.0 min
Primary = 1.13 cfs @ 12.01 hrs, Volume= 0.115 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 21.06' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	20.42'	**12.0" Round Culvert** L= 51.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 20.42' / 19.90' S= 0.0101 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.10 cfs @ 12.01 hrs HW=21.05' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 1.10 cfs @ 2.13 fps)

Summary for Link 4L: Southwesterly Flow

Inflow Area = 3.385 ac, 55.96% Impervious, Inflow Depth > 3.91" for 10-yr event
Inflow = 6.56 cfs @ 12.08 hrs, Volume= 1.102 af
Primary = 6.56 cfs @ 12.08 hrs, Volume= 1.102 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Link 5L: Southeasterly Flow

Inflow Area = 0.229 ac, 21.55% Impervious, Inflow Depth > 3.31" for 10-yr event
Inflow = 0.64 cfs @ 12.08 hrs, Volume= 0.063 af
Primary = 0.64 cfs @ 12.08 hrs, Volume= 0.063 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Link 6L: Post Total

Inflow Area = 3.614 ac, 53.78% Impervious, Inflow Depth > 3.87" for 10-yr event
Inflow = 7.20 cfs @ 12.08 hrs, Volume= 1.166 af
Primary = 7.20 cfs @ 12.08 hrs, Volume= 1.166 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Lime spanT0.00-24.00 hrs, dtT0.0= hrs, 481 points 5 2
x uno$$by ©C© Lx -20 method, RHT©C©, U eighted-CW
x each routing by Dyn-©tor-Nd method - Pond routing by Dyn-©tor-Nd method

Subcatchment P1-1: Exist Parking Entrance x uno$$3reaTl ,47®sS 70.029 Nnpervious x uno$$Depth%=.8=>
" lof wengthT218F ©lopeT0.012= FF LcTl .' min CWT7® x uno$T0.80 c$ 0.084 aS

Subcatchment P1-2: Exist Parking x uno$$3reaT=,®8= sS 100.009 Nnpervious x uno$$Depth%®.07>
" lof wengthT21=F ©lopeT0.012= FF LcT2.1 min CWT78 x uno$T0.l ®c$ 0.0®®aS

Subcatchment P2-1: Prop Park Upper x uno$$3reaT14,41®sS 7l .7' 9 Nnpervious x uno$$Depth%®.08>
" lof wengthT142F LcT8.8 min CWT78 x uno$T1.4®c$ 0.1®8 aS

Subcatchment P2-2: Prop Park Middle x uno$$3reaT1=,®== sS 70.' ' 9 Nnpervious x uno$$Depth%=.8=>
" lof wengthT1' 2F LcT®.1 min CWT7® x uno$T1.l = c$ 0.1l = aS

Subcatchment P2-3: Prop Park Lower x uno$$3reaT7,l 7®sS l l .129 Nnpervious x uno$$Depth%=.®1>
" lof wengthT1®0F LcT12.l min CWT74 x uno$T0.84 c$ 0.10= aS

Subcatchment P3: Prop. Access & Wetland x uno$$3reaT40,®l = sS =.®79 Nnpervious x uno$$Depth%4.' l >
" lof wengthTl 28F LcT22.= min CWT8' x uno$T2.27 c$ 0.' 40 aS

Subcatchment P4: Exist Parking Entrance x uno$$3reaT7,774 sS 21.==9 Nnpervious x uno$$Depth%4.®0>
" lof wengthT2' 0F LcT7.0 min CWT8= x uno$T0.8= c$ 0.088 aS

Subcatchment P5: Exist Parking x uno$$3reaT2®,482 sS l 7.=l 9 Nnpervious x uno$$Depth%=.®1>
" lof wengthT2®2F LcT10.2 min CWT74 x uno$T2.4l c$ 0.284 aS

Subcatchment P6: Exist Parking Building x uno$$3reaT1l ,4=8 sS ®2.279 Nnpervious x uno$$Depth%=.2l >
" lof wengthT=' =F LcTl .0 min CWT71 x uno$T1.80 c$ 0.1l ®aS

Subcatchment P7: Remain-grass-swale x uno$$3reaT7,l l 4 sS 0.009 Nnpervious x uno$$Depth%4.=0>
" lof wengthT' ®4F LcTl .= min CWT84 x uno$T0.88 c$ 0.084 aS

Reach 1R: Channel 3vg. " lof DepthT0.' 1F Ma5 VelT0.77 $ps N$of T1.l 1 c$ 0.441 aS
nT0.040 wT122.0F ©T0.0040 FF CapacityT28.l 2 c$ Out$of T1.l 0 c$ 0.440 aS

Pond 2P: DBL-CB-2 Peak ElevT22.81F N$of T1.4®c$ 0.1®8 aS
12.0> x ound Culvert nT0.01' wT®4.=F ©T0.0101 FF Out$of T1.4®c$ 0.1®8 aS

Pond 3P: DBL-CB-1 Peak ElevT22.=8F N$of T1.l = c$ 0.1l = aS
12.0> x ound Culvert nT0.01' wT21.=F ©T0.0102 FF Out$of T1.l = c$ 0.1l = aS

Pond 4P: CB-1 Peak ElevT21.l ®F N$of T0.84 c$ 0.10= aS
12.0> x ound Culvert nT0.01' wT=.0F ©T0.00®0 FF Out$of T0.84 c$ 0.10= aS

Pond 5P: CB-3 Peak ElevT21.l 7F N$of T0.l ®c$ 0.0®®aS
12.0> x ound Culvert nT0.01' wT®.=F ©T0.00®2 FF Out$of T0.l ®c$ 0.0®®aS

Pond 6P: CB-2 Peak ElevT21.41F N$of T0.80 c$ 0.084 aS
12.0> x ound Culvert nT0.01' wT8.0F ©T0.0100 FF Out$of T0.80 c$ 0.084 aS

Pond 7P: DMH-5 Peak ElevT22.28F Nn$of T' .1®cSs 0.' 4' aS
1=.0> x ound Culvert nT0.01' wT==.0F ©T0.0100 FF Out$of T' .1®cSs 0.' 4' aS

Pond 8P: WQ-1 Peak ElevT21.I 2F Nn$of T' .8= cSs 0.448 aS
1=.0> x ound Culvert nT0.01' wT4.0F ©T0.012= FF Out$of T' .8= cSs 0.448 aS

Pond 9P: Storage Area Peak ElevT21.' 1F ©torageT4,014 cS Nn$of T' .8= cSs 0.448 aS
Out$of T1.I 1 cSs 0.441 aS

Pond 10P: DMH-6 Peak ElevT21.®4F Nn$of T0.I ®cSs 0.0®® aS
12.0> x ound Culvert nT0.01' wT=8.0F ©T0.00®0 FF Out$of T0.I ®cSs 0.0®® aS

Pond 11P: WQ-2 Peak ElevT21.14F Nn$of T1.' 8 cSs 0.1=0 aS
12.0> x ound Culvert nT0.01' wT=1.=F ©T0.0101 FF Out$of T1.' 8 cSs 0.1=0 aS

Link 4L: Southwesterly Flow Nn$of T8.4= cSs 1.4I = aS
PrimaryT8.4= cSs 1.4I = aS

Link 5L: Southeasterly Flow Nn$of T0.8= cSs 0.088 aS
PrimaryT0.8= cSs 0.088 aS

Link 6L: Post Total Nn$of T7.27 cSs 1.=® aS
PrimaryT7.27 cSs 1.=® aS

Total Runoff Area = 3.614 ac Runoff Volume = 1.570 af Average Runoff Depth = 5.21"
46.22% Pervious = 1.671 ac 53.78% Impervious = 1.944 ac

Summary for Pond 2P: DBL-CB-2

wn©oS 3rea L 0.I I 1 ac, =9.=I 7 wnpervious, wn©oS Depth % A.08> ©or 2"-yr event
wn©oS L 1.4A c©s @ 12.09 hrs, VolumeL 0.1A8 a©
Out©oS L 1.4A c©s @ 12.09 hrs, VolumeL 0.1A8 a©, 3ttenL 07 , f agL 0.0 min
Primary L 1.4A c©s @ 12.09 hrs, VolumeL 0.1A8 a©

Routing by Dyn-6tor-wnd method, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs / 2
Peak ElevL 22.81' @ 12.09 hrs

Device	Routing	wnvert	Outlet Devices
#1	Primary	22.0"'	**12.0" Round Culvert** f L A4."' CPP, projecting, no headSall, KeL 0.=00 wnlet / Outlet wnvertL 22.0"' / 21.40' 6L 0.0101 '/' CcL 0.=00 nL 0.01I Corrugated PE, smooth interior, FloS 3reaL 0.9= s©

Primary OutFlow MaxL1.40 c©s @ 12.09 hrs HWL22.9=' TWL22.2I' (Dynamic TailSater)
1=Culvert (Outlet Controls 1.40 c©s @ I .11 ©ps)

Summary for Pond 3P: DBL-CB-1

wn©oS 3rea L 0.I "= ac, =0.I I 7 wnpervious, wn©oS Depth % ".8"> ©or 2"-yr event
wn©oS L 1.9" c©s @ 12.04 hrs, VolumeL 0.19" a©
Out©oS L 1.9" c©s @ 12.04 hrs, VolumeL 0.19" a©, 3ttenL 07 , f agL 0.0 min
Primary L 1.9" c©s @ 12.04 hrs, VolumeL 0.19" a©

Routing by Dyn-6tor-wnd method, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs / 2
Peak ElevL 22."8' @ 12.0" hrs

Device	Routing	wnvert	Outlet Devices
#1	Primary	21.A2'	**12.0" Round Culvert** f L 21."' CPP, projecting, no headSall, KeL 0.=00 wnlet / Outlet wnvertL 21.A2' / 21.40' 6L 0.0102 '/' CcL 0.=00 nL 0.01I Corrugated PE, smooth interior, FloS 3reaL 0.9= s©

Primary OutFlow MaxL1.A2 c©s @ 12.04 hrs HWL22."" ' TWL22.24' (Dynamic TailSater)
1=Culvert (wnlet Controls 1.A2 c©s @ 2.12 ©ps)

Summary for Pond 4P: CB-1

wn©oS 3rea L 0.22" ac, 99.127 wnpervious, wn©oS Depth % ".A1> ©or 2"-yr event
wn©oS L 0.84 c©s @ 12.12 hrs, VolumeL 0.10" a©
Out©oS L 0.84 c©s @ 12.12 hrs, VolumeL 0.10" a©, 3ttenL 07 , f agL 0.0 min
Primary L 0.84 c©s @ 12.12 hrs, VolumeL 0.10" a©

Routing by Dyn-6tor-wnd method, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs / 2
Peak ElevL 21.9A' @ 12.09 hrs

Device	Routing	wnvert	Outlet Devices
#1	Primary	20.88'	**12.0" Round Culvert**

f L " .0'   CPP, projecting, no headSall, KeL 0.=00
wnlet / Outlet wnvertL 20.88' / 20.8" '   6L 0.00A0 '/'   CcL 0.=00
nL 0.01I   Corrugated PE, smooth interior, FloS 3reaL 0.9= s©

Primary OutFlow MaxL0.2A c©s @ 12.12 hrs HWL21.A8' TWL21.A9'   (Dynamic TailSater)
└─**1=Culvert** (wnlet Controls 0.2A c©s @ 0.I = ©ps)

Summary for Pond 5P: CB-3

wn©oS 3rea L 0.1I 1 ac,100.007 wnpervious, wn©oS Depth % A.0=>   ©or 2" -yr event
wn©oS L 0.9A c©s @ 11.=8 hrs, VolumeL 0.0AA a©
Out©oS L 0.9A c©s @ 11.=8 hrs, VolumeL 0.0AA a©, 3ttenL 07 , f agL 0.0 min
Primary L 0.9A c©s @ 11.=8 hrs, VolumeL 0.0AA a©

Routing by Dyn-6tor-wnd method, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs / 2
Peak ElevL 21.9=' @ 11.=8 hrs

Device	Routing	wnvert	Outlet Devices
#1	Primary	21.1A'	**12.0" Round Culvert** f L A" ' CPP, projecting, no headSall, KeL 0.=00 wnlet / Outlet wnvertL 21.1A' / 21.12' 6L 0.00A2 '/' CcL 0.=00 nL 0.01I Corrugated PE, smooth interior, FloS 3reaL 0.9= s©

Primary OutFlow MaxL0.92 c©s @ 11.=8 hrs HWL21.9A' TWL21.A2'   (Dynamic TailSater)
└─**1=Culvert** (wnlet Controls 0.92 c©s @ 1.4" ©ps)

Summary for Pond 6P: CB-2

wn©oS 3rea L 0.192 ac, =0.027 wnpervious, wn©oS Depth % " .8" >   ©or 2" -yr event
wn©oS L 0.80 c©s @ 12.0" hrs, VolumeL 0.084 a©
Out©oS L 0.80 c©s @ 12.0" hrs, VolumeL 0.084 a©, 3ttenL 07 , f agL 0.0 min
Primary L 0.80 c©s @ 12.0" hrs, VolumeL 0.084 a©

Routing by Dyn-6tor-wnd method, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs / 2
Peak ElevL 21.41' @ 12.0" hrs

Device	Routing	wnvert	Outlet Devices
#1	Primary	20.8" '	**12.0" Round Culvert** f L 8.0' CPP, projecting, no headSall, KeL 0.=00 wnlet / Outlet wnvertL 20.8" ' / 20.99' 6L 0.0100 '/' CcL 0.=00 nL 0.01I Corrugated PE, smooth interior, FloS 3reaL 0.9= s©

Primary OutFlow MaxL0.9= c©s @ 12.0" hrs HWL21.41' TWL21.08'   (Dynamic TailSater)
└─**1=Culvert** (Barrel Controls 0.9= c©s @ 2." 4 ©ps)

Summary for Pond 7P: DMH-5

```
wn©oS 3rea L        0.A=0 ac,  =I .=97  wnpervious,  wn©oS Depth %  " .=A>   ©or  2" -yr event
wn©oS       L       I .1A c©s @  12.0"  hrs,  VolumeL          0.I 4I  a©
Out©oS      L       I .1A c©s @  12.0"  hrs,  VolumeL          0.I 4I  a©, 3ttenL 07 ,  f agL 0.0 min
Primary     L       I .1A c©s @  12.0"  hrs,  VolumeL          0.I 4I  a©
```

Routing by Dyn-6tor-wnd method, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs / 2
Peak ElevL 22.28' @ 12.0A hrs

Device	Routing	wnvert	Outlet Devices
#1	Primary	21.1" '	**15.0" Round Culvert** f L " " .0' CPP, projecting, no headSall, KeL 0.=00 wnlet / Outlet wnvertL 21.1" ' / 20.A0' 6L 0.0100 '/' CcL 0.=00 nL 0.01I Corrugated PE, smooth interior, FloS 3reaL 1.2I s©

Primary OutFlow MaxLI .08 c©s @ 12.0" hrs HWL22.29' TWL21.90' (Dynamic TailSater)
↑**1=Culvert** (Outlet Controls I .08 c©s @ I ." 2 ©ps)

Summary for Pond 8P: WQ-1

```
wn©oS 3rea L        0.=1"  ac,  8=.8I 7  wnpervious,  wn©oS Depth %  " .89>   ©or  2" -yr event
wn©oS       L       I .8"  c©s @  12.0A hrs,  VolumeL          0.448 a©
Out©oS      L       I .8"  c©s @  12.0A hrs,  VolumeL          0.448 a©, 3ttenL 07 ,  f agL 0.0 min
Primary     L       I .8"  c©s @  12.0A hrs,  VolumeL          0.448 a©
```

Routing by Dyn-6tor-wnd method, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs / 2
Peak ElevL 21.92' @ 12.08 hrs

Device	Routing	wnvert	Outlet Devices
#1	Primary	20.I I '	**15.0" Round Culvert** f L 4.0' CPP, projecting, no headSall, KeL 0.=00 wnlet / Outlet wnvertL 20.I I ' / 20.28' 6L 0.012" '/' CcL 0.=00 nL 0.01I Corrugated PE, smooth interior, FloS 3reaL 1.2I s©

Primary OutFlow MaxLI .9A c©s @ 12.0A hrs HWL21.90' TWL21.0" ' (Dynamic TailSater)
↑**1=Culvert** (wnlet Controls I .9A c©s @ I .09 ©ps)

Summary for Pond 9P: Storage Area

```
wn©oS 3rea L        0.=1"  ac,  8=.8I 7  wnpervious,  wn©oS Depth %  " .89>   ©or  2" -yr event
wn©oS       L       I .8"  c©s @  12.0A hrs,  VolumeL          0.448 a©
Out©oS      L       1.91 c©s @   12.28 hrs,  VolumeL          0.441 a©, 3ttenL " A7 ,  f agL 1I .2 min
Primary     L       1.91 c©s @   12.28 hrs,  VolumeL          0.441 a©
```

Routing by Dyn-6tor-wnd method, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs / 2
Peak ElevL 21.I 1' @ 12.28 hrs 6ur©3reaL 9,9I 9 s© 6torageL 4,014 c©

Plug-FloS detention timeL " I .I min calculated ©or 0.440 a© (=87 o© in©oS)
Center-o©Mass det. timeL 4I .I min (80I .0 - 9" =.9)

Volume	wnvert	3vail.6torage	6torage Description
#13	1=."0'	0 c©	**53.27'W x 145.00'L x 2.75'H Field A** 21,24" c©Overall - ",841 c©Embedded L 1",404 c© x 0.07 Voids
#23	20.00'	4,922 c©	**ADS N-12 18** x 12A wnside #1 wnsideL 18.2>W x 18.2>H L%1.80 s©x 20.00'f L I A.0 c© OutsideL 21.0>W x 21.0>H L%2.2I s©x 20.00'f L 44." c© 18 RoSs o©9 Chambers " 1.99' Header x 1.80 s© x 2 L 18A.4 c©wnside
#I	1=.=='	4A c©	**4.00'D x 3.65'H Vertical Cone/Cylinder**
#4	2I .90'	2,I =9 c©	**Lower Parking Lot (Prismatic)** f isted beloS (Recalc)
		9,1A" c©	Total 3vailable 6torage

6torage Group 3 created Sith Chamber Wizard

Elevation (©eet)	6ur©3rea (sq-©t)	wnc.6tore (cubic-©eet)	Cum.6tore (cubic-©eet)
2I .90	2	0	0
24.00	1,9A4	2A"	2A"
2".00	2,"00	2,1I 2	2,I =9

Device	Routing	wnvert	Outlet Devices
#1	Primary	1=.=0'	**15.0" Round Culvert** f L 94.0' CPP, projecting, no headSall, KeL 0.=00 wnlet / Outlet wnvertL 1=.=0' / 1=.4"' 6L 0.00A1 '/' CcL 0.=00 nL 0.01I Corrugated PE, smooth interior, FloS 3reaL 1.2I s©
#2	Device 1	20.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (©eet) 0.00 0."0 0."0 I .00 I .00 I ."0 Width (©eet) 0.20 0.20 0."0 0."0 4.00 4.00

Primary OutFlow MaxL1.90 c©s @ 12.28 hrs HWL21.I 1' TWL1=.22' (Dynamic TailSater)
└─**1=Culvert** (Passes 1.90 c©s o©4.14 c©s potential ©loS)
  └─**2=Custom Weir/Orifice** (Weir Controls 1.90 c©s @ I .I 9 ©ps)

Summary for Pond 10P: DMH-6

wn©loS 3rea L 0.1I 1 ac,100.007 wnpervious, wn©loS Depth % A.0=> ©or 2"-yr event
wn©loS L 0.9A c©s @ 11.=8 hrs, VolumeL 0.0AA a©
Out©loS L 0.9A c©s @ 11.=8 hrs, VolumeL 0.0AA a©, 3ttenL 07 , f agL 0.0 min
Primary L 0.9A c©s @ 11.=8 hrs, VolumeL 0.0AA a©

Routing by Dyn-6tor-wnd method, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs / 2
Peak ElevL 21.A4' @ 11.=8 hrs

Device	Routing	wnvert	Outlet Devices
#1	Primary	21.12'	**12.0" Round Culvert** f L "8.0' CPP, projecting, no headSall, KeL 0.=00 wnlet / Outlet wnvertL 21.12' / 20.99' 6L 0.00A0 '/' CcL 0.=00 nL 0.01I Corrugated PE, smooth interior, FloS 3reaL 0.9= s©

Primary OutFlow MaxL0.92 c@s @ 11.=8 hrs HWL21.A2' TWL21.10' (Dynamic TailSater)
↑—**1=Culvert** (Barrel Controls 0.92 c@s @ 2.A9 @ps)

Summary for Pond 11P: WQ-2

wn@oS 3rea L 0.I 0I ac, =4.I I 7 wnpervious, wn@oS Depth % " .=" > @or 2" -yr event
wn@oS L 1.I 8 c@s @ 12.01 hrs, VolumeL 0.1" 0 a@
Out@oS L 1.I 8 c@s @ 12.01 hrs, VolumeL 0.1" 0 a@, 3ttenL 07 , f agL 0.0 min
Primary L 1.I 8 c@s @ 12.01 hrs, VolumeL 0.1" 0 a@

Routing by Dyn-6tor-wnd method, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs / 2
Peak ElevL 21.14' @ 12.01 hrs

Device	Routing	wnvert	Outlet Devices
#1	Primary	20.42'	**12.0" Round Culvert** f L " 1." ' CPP, projecting, no headSall, KeL 0.=00 wnlet / Outlet wnvertL 20.42' / 1=.=0' 6L 0.0101 '/' CcL 0.=00 nL 0.01I Corrugated PE, smooth interior, FloS 3reaL 0.9= s@

Primary OutFlow MaxL1.I 4 c@s @ 12.01 hrs HWL21.1I ' TWL0.00' (Dynamic TailSater)
↑—**1=Culvert** (wnlet Controls 1.I 4 c@s @ 2.2A @ps)

Summary for Link 4L: Southwesterly Flow

wn@oS 3rea L I .I 8" ac, " " .=A7 wnpervious, wn@oS Depth % " .2I > @or 2" -yr event
wn@oS L 8.4" c@s @ 12.0= hrs, VolumeL 1.49" a@
Primary L 8.4" c@s @ 12.0= hrs, VolumeL 1.49" a@, 3ttenL 07 , f agL 0.0 min

Primary out@oS L wn@oS, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs

Summary for Link 5L: Southeasterly Flow

wn@oS 3rea L 0.22= ac, 21." " 7 wnpervious, wn@oS Depth % 4.A0> @or 2" -yr event
wn@oS L 0.8" c@s @ 12.09 hrs, VolumeL 0.088 a@
Primary L 0.8" c@s @ 12.09 hrs, VolumeL 0.088 a@, 3ttenL 07 , f agL 0.0 min

Primary out@oS L wn@oS, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs

Summary for Link 6L: Post Total

wn@oS 3rea L I .A14 ac, " I .987 wnpervious, wn@oS Depth % " .1=> @or 2" -yr event
wn@oS L =.2= c@s @ 12.08 hrs, VolumeL 1." AI a@
Primary L =.2= c@s @ 12.08 hrs, VolumeL 1." AI a@, 3ttenL 07 , f agL 0.0 min

Primary out@oS L wn@oS, Time 6panL 0.00-24.00 hrs, dtL 0.0" hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1-1: Exist Parking Entrance Runoff Area=3,476 sf 70.029 Impervious Runoff Depth%8.67>
" low Length=218F Slope=0.0125 FF Tc=3.' min CN=76 Runoff=1.08 cfs 0.125 af

Subcatchment P1-2: Exist Parking Runoff Area=5,685 sf 100.009 Impervious Runoff Depth%8.75>
" low Length=215F Slope=0.0125 FF Tc=2.1 min CN=78 Runoff=1.01 cfs 0.073 af

Subcatchment P2-1: Prop Park Upper Runoff Area=14,416 sf 73.7' 9 Impervious Runoff Depth%8.7' >
" low Length=142F Tc=8.8 min CN=78 Runoff=1.76 cfs 0.246 af

Subcatchment P2-2: Prop Park Middle Runoff Area=15,655 sf 70.' ' 9 Impervious Runoff Depth%8.30>
" low Length=1' 2F Tc=6.1 min CN=76 Runoff=2.' 5 cfs 0.260 af

Subcatchment P2-3: Prop Park Lower Runoff Area=7,376 sf 33.129 Impervious Runoff Depth%8.44>
" low Length=160F Tc=12.3 min CN=74 Runoff=1.15 cfs 0.158 af

Subcatchment P3: Prop. Access & Wetland Runoff Area=40,635 sf 5.679 Impervious Runoff Depth%3.03>
" low Length=328F Tc=22.5 min CN=8' Runoff=' .41 cfs 0.550 af

Subcatchment P4: Exist Parking Entrance Runoff Area=7,774 sf 21.559 Impervious Runoff Depth%3.' 5>
" low Length=2' 0F Tc=7.0 min CN=85 Runoff=1.2' cfs 0.141 af

Subcatchment P5: Exist Parking Runoff Area=26,482 sf 37.539 Impervious Runoff Depth%8.45>
" low Length=262F Tc=10.2 min CN=74 Runoff=' .' 6 cfs 0.428 af

Subcatchment P6: Exist Parking Building Runoff Area=13,458 sf 62.279 Impervious Runoff Depth%8.07>
" low Length=5' 5F Tc=3.0 min CN=71 Runoff=2.48 cfs 0.230 af

Subcatchment P7: Remain-grass-swale Runoff Area=7,334 sf 0.009 Impervious Runoff Depth%3.2' >
" low Length=' 64F Tc=3.5 min CN=84 Runoff=1.23 cfs 0.1' 5 af

Reach 1R: Channel Avg. " low Depth=0.48F Max Vel=1.28 fps Inflow=4.46 cfs 0.65' af
n=0.040 L=122.0F S=0.0040 FF Capacity=28.32 cfs Outflow=' .30 cfs 0.652 af

Pond 2P: DBL-CB-2 Peak Elev=2' .54F Inflow=1.76 cfs 0.246 af
12.0> Round Culvert n=0.01' L=64.5F S=0.0101 FF Outflow=1.76 cfs 0.246 af

Pond 3P: DBL-CB-1 Peak Elev=2' .51F Inflow=2.' 5 cfs 0.260 af
12.0> Round Culvert n=0.01' L=21.5F S=0.0102 FF Outflow=2.' 5 cfs 0.260 af

Pond 4P: CB-1 Peak Elev=22.82F Inflow=1.15 cfs 0.158 af
12.0> Round Culvert n=0.01' L=5.0F S=0.0060 FF Outflow=1.15 cfs 0.158 af

Pond 5P: CB-3 Peak Elev=21.70F Inflow=1.01 cfs 0.073 af
12.0> Round Culvert n=0.01' L=6.5F S=0.0062 FF Outflow=1.01 cfs 0.073 af

Pond 6P: CB-2 Peak Elev=21.52F Inflow=1.08 cfs 0.125 af
12.0> Round Culvert n=0.01' L=8.0F S=0.0100 FF Outflow=1.08 cfs 0.125 af

Pond 7P: DMH-5 Peak Elev=2' .25F Inflow=4.24 cfs 0.503 af
15.0> Round Culvert n=0.01' L=55.0F S=0.0100 F/F Outflow=4.24 cfs 0.503 af

Pond 8P: WQ-1 Peak Elev=22.73F Inflow=5.20 cfs 0.665 af
15.0> Round Culvert n=0.01' L=4.0F S=0.0125 F/F Outflow=5.20 cfs 0.665 af

Pond 9P: Storage Area Peak Elev=22.24F Storage=4,351 cf Inflow=5.20 cfs 0.665 af
Outflow=4.46 cfs 0.65' af

Pond 10P: DMH-6 Peak Elev=21.35F Inflow=1.01 cfs 0.073 af
12.0> Round Culvert n=0.01' L=58.0F S=0.0060 F/F Outflow=1.01 cfs 0.073 af

Pond 11P: WQ-2 Peak Elev=21.' 0F Inflow=1.85 cfs 0.222 af
12.0> Round Culvert n=0.01' L=51.5F S=0.0101 F/F Outflow=1.85 cfs 0.222 af

Link 4L: Southwesterly Flow Inflow=12.38 cfs 2.253 af
Primary=12.38 cfs 2.253 af

Link 5L: Southeasterly Flow Inflow=1.2' cfs 0.141 af
Primary=1.2' cfs 0.141 af

Link 6L: Post Total Inflow=1' .37 cfs 2.' 78 af
Primary=1' .37 cfs 2.' 78 af

Total Runoff Area = 3.614 ac Runoff Volume = 2.411 af Average Runoff Depth = 8.01"
46.22% Pervious = 1.671 ac 53.78% Impervious = 1.944 ac

Summary for Pond 2P: DBL-CB-2

Ln$of 5rea l 0.==1 ac, 39.3=7 Lmpervious, Ln$of Depth % 8.3=> $or 100-yr event
Ln$of l 1.3®c$s " 12.09 hrs, @olumel 0.24®a$
Vut$of l 1.3®c$s " 12.09 hrs, @olumel 0.24®a$, 5ttenl 07 , wagl 0.0 min
Primary l 1.3®c$s " 12.09 hrs, @olumel 0.24®a$

Oouting by Dyn-©tor-Lnd method, Rime ©panl 0.00-24.00 hrs, dtl 0.0T hrs / 2
Peak Elevl 2=.T4' " 12.10 hrs

Device	Oouting	Lnvert	Vutlet Devices
#1	Primary	22.0T'	**12.0" Round Culvert** wl ®4.T' CPP, projecting, no headf all, Kel 0.300 Lnlet / Vutlet Lnvertl 22.0T' / 21.40' ©l 0.0101 '/' Ccl 0.300 nl 0.01= Corrugated PE, smooth interior, Flof 5real 0.93 s$

Primary OutFlow Maxl 1.41 c$s " 12.09 hrs HWl 2=.==' RWl 2=.11' (Dynamic Railf ater)
↑—**1=Culvert** (Lnlet Controls 1.41 c$s " 1.93 $ps)

Summary for Pond 3P: DBL-CB-1

Ln$of 5rea l 0.=T3 ac, 30.==7 Lmpervious, Ln$of Depth % 8.90> $or 100-yr event
Ln$of l 2.=T c$s " 12.04 hrs, @olumel 0.2®0 a$
Vut$of l 2.=T c$s " 12.04 hrs, @olumel 0.2®0 a$, 5ttenl 07 , wagl 0.0 min
Primary l 2.=T c$s " 12.04 hrs, @olumel 0.2®0 a$

Oouting by Dyn-©tor-Lnd method, Rime ©panl 0.00-24.00 hrs, dtl 0.0T hrs / 2
Peak Elevl 2=.T1' " 12.03 hrs

Device	Oouting	Lnvert	Vutlet Devices
#1	Primary	21.®2'	**12.0" Round Culvert** wl 21.T' CPP, projecting, no headf all, Kel 0.300 Lnlet / Vutlet Lnvertl 21.®2' / 21.40' ©l 0.0102 '/' Ccl 0.300 nl 0.01= Corrugated PE, smooth interior, Flof 5real 0.93 s$

Primary OutFlow Maxl 1.=9 c$s " 12.04 hrs HWl 2=.29' RWl 2=.0®' (Dynamic Railf ater)
↑—**1=Culvert** (Lnlet Controls 1.=9 c$s " 1.9T $ps)

Summary for Pond 4P: CB-1

Ln$of 5rea l 0.22T ac, 99.127 Lmpervious, Ln$of Depth % 8.44> $or 100-yr event
Ln$of l 1.1T c$s " 12.12 hrs, @olumel 0.1T8 a$
Vut$of l 1.1T c$s " 12.12 hrs, @olumel 0.1T8 a$, 5ttenl 07 , wagl 0.0 min
Primary l 1.1T c$s " 12.12 hrs, @olumel 0.1T8 a$

Oouting by Dyn-©tor-Lnd method, Rime ©panl 0.00-24.00 hrs, dtl 0.0T hrs / 2
Peak Elevl 22.82' " 12.13 hrs

Device	Oouting	Lnvert	Vutlet Devices
#1	Primary	20.88'	**12.0" Round Culvert**

wI T.0' CPP, projecting, no headf all, KeI 0.300
Lnlet / Vutlet LnvertI 20.88' / 20.8T' ©I 0.00®0 '/' CcI 0.300
nI 0.01= Corrugated PE, smooth interior, Flof 5realI 0.93 sS

Primary OutFlow MaxI 0.00 c$s " 12.12 hrs HWI 22.44' RWI 22.94' (Dynamic Railf ater)
1=Culvert (Controls 0.00 c$s)

Summary for Pond 5P: CB-3

Ln$of 5rea I 0.1=1 ac,100.007 Lmpervious, Ln$of Depth % 8.3T> $or 100-yr event
Ln$of I 1.01 c$s " 11.38 hrs, @olumeI 0.039 aS
Vut$of I 1.01 c$s " 11.38 hrs, @olumeI 0.039 aS, 5ttenI 07 , wagI 0.0 min
Primary I 1.01 c$s " 11.38 hrs, @olumeI 0.039 aS

Oouting by Dyn-©tor-Lnd method, Rime ©panI 0.00-24.00 hrs, dtI 0.0T hrs / 2
Peak ElevI 21.30' " 11.33 hrs

Device	Oouting	Lnvert	Vutlet Devices
#1	Primary	21.1®'	**12.0" Round Culvert** wI ®.T' CPP, projecting, no headf all, KeI 0.300 Lnlet / Vutlet LnvertI 21.1®' / 21.12' ©I 0.00®2 '/' CcI 0.300 nI 0.01= Corrugated PE, smooth interior, Flof 5realI 0.93 sS

Primary OutFlow MaxI 0.31 c$s " 11.38 hrs HWI 21.88' RWI 21.92' (Dynamic Railf ater)
1=Culvert (Lnlet Controls 0.31 c$s " 1.T0 $ps)

Summary for Pond 6P: CB-2

Ln$of 5rea I 0.192 ac, 30.027 Lmpervious, Ln$of Depth % 8.®3> $or 100-yr event
Ln$of I 1.08 c$s " 12.0T hrs, @olumeI 0.12T aS
Vut$of I 1.08 c$s " 12.0T hrs, @olumeI 0.12T aS, 5ttenI 07 , wagI 0.0 min
Primary I 1.08 c$s " 12.0T hrs, @olumeI 0.12T aS

Oouting by Dyn-©tor-Lnd method, Rime ©panI 0.00-24.00 hrs, dtI 0.0T hrs / 2
Peak ElevI 21.T2' " 12.04 hrs

Device	Oouting	Lnvert	Vutlet Devices
#1	Primary	20.8T'	**12.0" Round Culvert** wI 8.0' CPP, projecting, no headf all, KeI 0.300 Lnlet / Vutlet LnvertI 20.8T' / 20.99' ©I 0.0100 '/' CcI 0.300 nI 0.01= Corrugated PE, smooth interior, Flof 5realI 0.93 sS

Primary OutFlow MaxI 1.09 c$s " 12.0T hrs HWI 21.T2' RWI 21.22' (Dynamic Railf ater)
1=Culvert (Barrel Controls 1.09 c$s " 2.92 $ps)

Summary for Pond 7P: DMH-5

Ln$of 5rea I 0.®30 ac, 3=.397 Lmpervious, Ln$of Depth % 8.81> $or 100-yr event
Ln$of I 4.24 c$s " 12.0T hrs, @olumeI 0.T09 aS
Vut$of I 4.24 c$s " 12.0T hrs, @olumeI 0.T09 aS, 5ttenI 07 , wagI 0.0 min
Primary I 4.24 c$s " 12.0T hrs, @olumeI 0.T09 aS

Oouting by Dyn-©tor-Lnd method, Rime ©panI 0.00-24.00 hrs, dtI 0.0T hrs / 2
Peak ElevI 2=.2T' " 12.0® hrs

Device	Oouting	Lnvert	Vutlet Devices
#1	Primary	21.1T'	**15.0" Round Culvert** wI TT.0' CPP, projecting, no headf all, KeI 0.300 Lnlet / Vutlet LnvertI 21.1T' / 20.®0' ©I 0.0100 '/' CcI 0.300 nI 0.01= Corrugated PE, smooth interior, FIof 5reaI 1.2= sS

Primary OutFlow MaxI =.9® c$s " 12.0T hrs HWI 2=.20' RWI 22.TT' (Dynamic Railf ater)
↑—**1=Culvert** (Lnlet Controls =.9® c$s " =.0® $ps)

Summary for Pond 8P: WQ-1

Ln$of 5rea I 0.31T ac, 83.8=7 Lmpervious, Ln$of Depth % 8.92> $or 100-yr event
Ln$of I T.20 c$s " 12.0® hrs, @olumeI 0.®®T aS
Vut$of I T.20 c$s " 12.0® hrs, @olumeI 0.®®T aS, 5ttenI 07 , wagI 0.0 min
Primary I T.20 c$s " 12.0® hrs, @olumeI 0.®®T aS

Oouting by Dyn-©tor-Lnd method, Rime ©panI 0.00-24.00 hrs, dtI 0.0T hrs / 2
Peak ElevI 22.39' " 12.14 hrs

Device	Oouting	Lnvert	Vutlet Devices
#1	Primary	20.=='	**15.0" Round Culvert** wI 4.0' CPP, projecting, no headf all, KeI 0.300 Lnlet / Vutlet LnvertI 20.==' / 20.28' ©I 0.012T '/' CcI 0.300 nI 0.01= Corrugated PE, smooth interior, FIof 5reaI 1.2= sS

Primary OutFlow MaxI T.03 c$s " 12.0® hrs HWI 22.TT' RWI 21.=®' (Dynamic Railf ater)
↑—**1=Culvert** (Lnlet Controls T.03 c$s " 4.14 $ps)

Summary for Pond 9P: Storage Area

Ln$of 5rea I 0.31T ac, 83.8=7 Lmpervious, Ln$of Depth % 8.92> $or 100-yr event
Ln$of I T.20 c$s " 12.0® hrs, @olumeI 0.®®T aS
Vut$of I 4.4® c$s " 12.1T hrs, @olumeI 0.®T= aS, 5ttenI 147 , wagI T.® min
Primary I 4.4® c$s " 12.1T hrs, @olumeI 0.®T= aS

Oouting by Dyn-©tor-Lnd method, Rime ©panI 0.00-24.00 hrs, dtI 0.0T hrs / 2
Peak ElevI 22.24' " 12.1T hrs ©urS5reaI 9,9=9 sS ©torageI 4,9T1 cS

Plug-FIof detention timeI T2.2 min calculated $or 0.®T= aS(387 oSin$of)
Center-oSMass det. timeI =3.® min (931.2 - 9T1.®)

@olume	Lnvert	5vail.©torage	©torage Description
#15	13.T0'	0 cS	**53.27'W x 145.00'L x 2.75'H Field A** 21,24T cSVverall - T,841 cSEmbedded I 1T,404 cS x 0.07 @oids
#25	20.00'	4,922 cS	**ADS N-12 18 x 12® Lnside #1** LnsideI 18.2>W x 18.2>H I %1.80 sSx 20.00'wI =®.0 cS VutsideI 21.0>W x 21.0>H I %2.2= sSx 20.00'wI 44.T cS 18 Oof s oS9 Chambers T1.99' Header x 1.80 sS x 2 I 18®.4 cSLnside
#=	13.33'	4®cS	**4.00'D x 3.65'H Vertical Cone/Cylinder**
#4	2=.90'	2,=39 cS	**Lower Parking Lot (Prismatic)** wisted belof (Oecalc)
		9,1®T cS	Rotal 5vailable ©torage

©torage Group 5 created f ith Chamber Wizard

Elevation (Seet)	©urS5rea (sq-S)	Lnc.©tore (cubic-Seet)	Cum.©tore (cubic-Seet)
2=.90	2	0	0
24.00	1,9®4	2®T	2®T
2T.00	2,T00	2,1=2	2,=39

Device	Oouting	Lnvert	Vutlet Devices
#1	Primary	13.30'	**15.0" Round Culvert** wI 94.0' CPP, projecting, no headf all, KeI 0.300 Lnlet / Vutlet LnvertI 13.30' / 13.4T' ©I 0.00®1 '/' CcI 0.300 nI 0.01= Corrugated PE, smooth interior, Flof 5real 1.2= sS
#2	Device 1	20.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (Seet) 0.00 0.T0 0.T0 =.00 =.00 =.T0 Width (Seet) 0.20 0.20 0.T0 0.T0 4.00 4.00

Primary OutFlow MaxI 4.=2 cS " 12.1T hrs HWI 22.20' RWI 13.=8' (Dynamic Railf ater)
└─**1=Culvert** (Passes 4.=2 cS oS®.04 cS potential Sof)
  └─**2=Custom Weir/Orifice** (Weir Controls 4.=2 cS " 4.T4 Sps)

Summary for Pond 10P: DMH-6

LnSof 5rea I 0.1=1 ac,100.007 Lmpervious, LnSof Depth % 8.3T> Sor 100-yr event
LnSof I 1.01 cS " 11.38 hrs, @olumeI 0.039 aS
VutSof I 1.01 cS " 11.38 hrs, @olumeI 0.039 aS, 5ttenI 07 , wagI 0.0 min
Primary I 1.01 cS " 11.38 hrs, @olumeI 0.039 aS

Oouting by Dyn-©tor-Lnd method, Rime ©panI 0.00-24.00 hrs, dtI 0.0T hrs / 2
Peak ElevI 21.9T' " 11.33 hrs

Device	Oouting	Lnvert	Vutlet Devices
#1	Primary	21.12'	**12.0" Round Culvert** wI T8.0' CPP, projecting, no headf all, KeI 0.300 Lnlet / Vutlet LnvertI 21.12' / 20.99' ©I 0.00®0 '/' CcI 0.300 nI 0.01= Corrugated PE, smooth interior, Flof 5real 0.93 sS

Primary OutFlow MaxI 0.39 c$s " 11.38 hrs HWI 21.92' RWI 21.2T' (Dynamic Railf ater)
↑—**1=Culvert** (Vutlet Controls 0.39 c$s " 2.80 $ps)

Summary for Pond 11P: WQ-2

Ln$of 5rea I 0.=0= ac, 34.==7 Lmpervious, Ln$of Depth % 8.80> $or 100-yr event
Ln$of I 1.8T c$s " 12.01 hrs, @olumeI 0.222 aS
Vut$of I 1.8T c$s " 12.01 hrs, @olumeI 0.222 aS, 5ttenI 07 , wagI 0.0 min
Primary I 1.8T c$s " 12.01 hrs, @olumeI 0.222 aS

Oouting by Dyn-©tor-Lnd method, Rime ©panI 0.00-24.00 hrs, dtI 0.0T hrs / 2
Peak ElevI 21.=0' " 12.01 hrs

Device	Oouting	Lnvert	Vutlet Devices
#1	Primary	20.42'	**12.0" Round Culvert** wI T1.T' CPP, projecting, no headf all, KeI 0.300 Lnlet / Vutlet LnvertI 20.42' / 13.30' ©I 0.0101 '/' CcI 0.300 nI 0.01= Corrugated PE, smooth interior, Flof 5reaI 0.93 sS

Primary OutFlow MaxI 1.80 c$s " 12.01 hrs HWI 21.28' RWI 0.00' (Dynamic Railf ater)
↑—**1=Culvert** (Lnlet Controls 1.80 c$s " 2.T0 $ps)

Summary for Link 4L: Southwesterly Flow

Ln$of 5rea I =.=8T ac, TT.3®7 Lmpervious, Ln$of Depth % 8.00> $or 100-yr event
Ln$of I 12.98 c$s " 12.1T hrs, @olumeI 2.2T9 aS
Primary I 12.98 c$s " 12.1T hrs, @olumeI 2.2T9 aS, 5ttenI 07 , wagI 0.0 min

Primary out$of I Ln$of , Rime ©panI 0.00-24.00 hrs, dtI 0.0T hrs

Summary for Link 5L: Southeasterly Flow

Ln$of 5rea I 0.223 ac, 21.TT7 Lmpervious, Ln$of Depth % 9.=T> $or 100-yr event
Ln$of I 1.2= c$s " 12.09 hrs, @olumeI 0.141 aS
Primary I 1.2= c$s " 12.09 hrs, @olumeI 0.141 aS, 5ttenI 07 , wagI 0.0 min

Primary out$of I Ln$of , Rime ©panI 0.00-24.00 hrs, dtI 0.0T hrs

Summary for Link 6L: Post Total

Ln$of 5rea I =.®14 ac, T=.987 Lmpervious, Ln$of Depth % 9.3®> $or 100-yr event
Ln$of I 1=.93 c$s " 12.14 hrs, @olumeI 2.=38 aS
Primary I 1=.93 c$s " 12.14 hrs, @olumeI 2.=38 aS, 5ttenI 07 , wagI 0.0 min

Primary out$of I Ln$of , Rime ©panI 0.00-24.00 hrs, dtI 0.0T hrs

APPENDIX C

DRAINAGE SYSTEM DESIGN CAPACITIES

HOPE CHURCH - 11 HALE STREET, NEWBURYPORT

DRAINAGE SYSTEM DESIGN FLOWS AND CAPACITIES

DEC. 14, 2017

Rev. FEB. 3, 2018

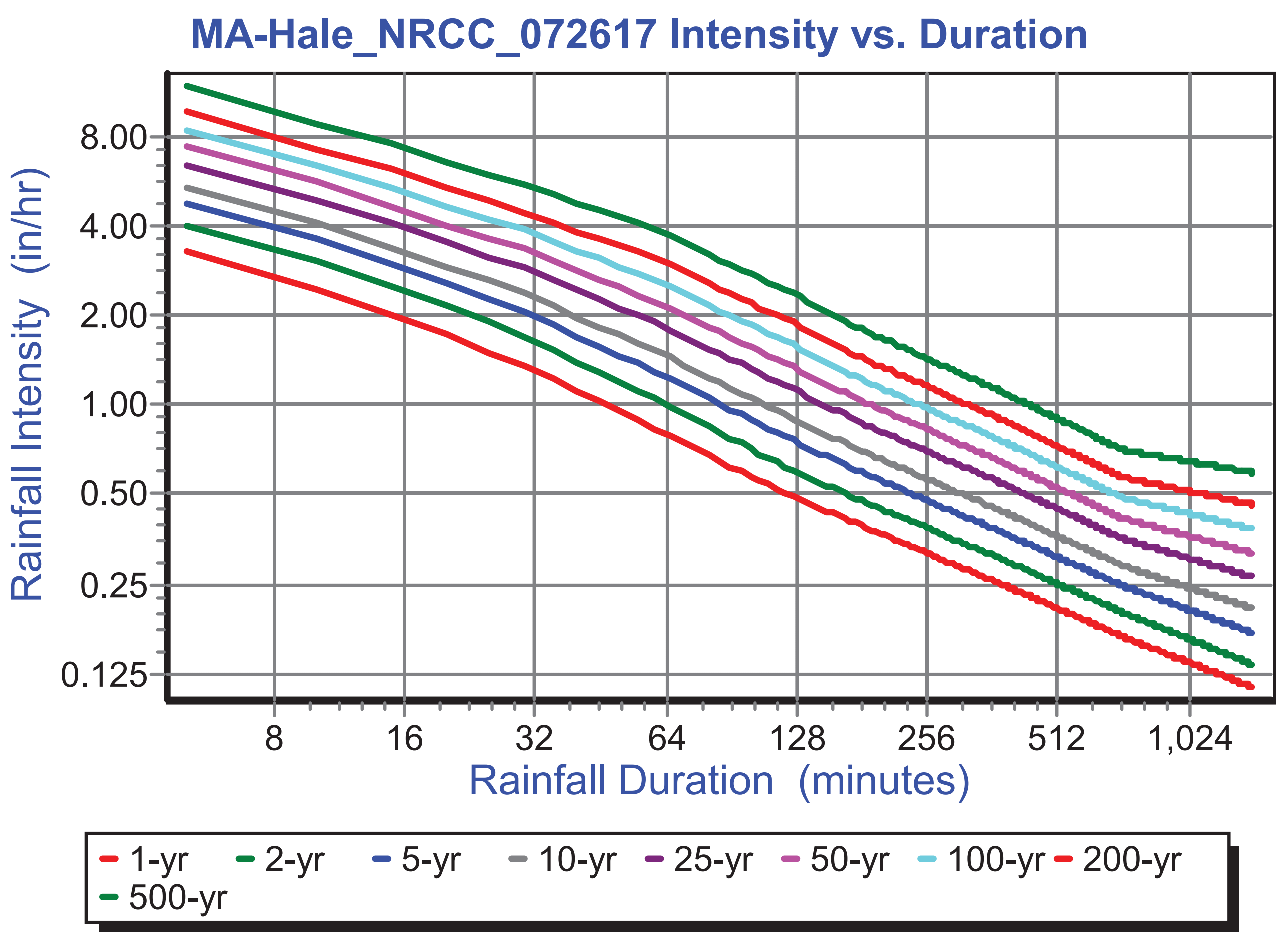
DESIGN STORM - 25 YEAR

STRUCTURE			STRUCTURE			PIPE					FLOWS AND CAPACITIES			
UPSTREAM	RIM	INV. OUT	DOWNSTREAM	RIM	INV. IN	DIA. (INCHES)	MATERIAL	LENGTH	SLOPE	MANNING - N	TOTAL FLOW	VELOCITY (FPS)	DEPTH FLOW	% FULL
DBL-CB-2	24.68	22.05	DMH-5	24.31	21.40	12	HDPE	64.5	0.010	0.012	1.46	4.57	5.12	42.7%
DBL-CB-1	24.04	21.62	DMH-5	24.31	21.40	12	HDPE	21.5	0.010	0.012	1.75	4.79	5.67	47.3%
DMH-5	24.31	21.15	WQ-1	23.79	20.60	15	HDPE	55	0.010	0.012	3.16	5.56	7.07	47.1%
CB-1	23.7	20.88	WQ-1	23.79	20.85	12	HDPE	5	0.006	0.012	0.84	3.27	4.35	36.3%
WQ-1	23.79	20.33	DMH-4 INLET	23.87	20.28	15	HDPE	4	0.0125	0.012	3.85	6.35	7.49	49.9%
DMH-4 INLET	23.87	20.00	DMH-3 OUTLET	24.45	20.00	18	HDPE	NA	0.000	0.012	SYSTEM STORAGE			
DMH-3 OUTLET	24.45	19.90	DMH-2	22.82	19.48	15	HDPE	69	0.006	0.012	1.71	3.91	5.79	38.6%
DMH-2	22.82	19.48	DMH-1	22.5	19.45	15	HDPE	5	0.006	0.012	1.71	3.91	5.79	38.6%
DMH-1	22.5	19.20	18" OUTFALL	NA	19.09	18	RCP	21	0.005	0.015	3.74	3.78	9.85	54.7%
18" INLET	NA	19.30	18" OUTFALL	NA	19.09	18	RCP	42	0.005	0.015	2.03	3.23	6.94	38.6%
CB-4	23.65	21.40	DMH-6	23.9	21.35	12	HDPE	6	0.008	0.012	0			
CB-3	23.6	21.16	DMH-6	23.9	21.12	12	HDPE	6.5	0.006	0.012	0.76	4.13	3.18	26.5%
DMH-6	23.9	21.12	WQ-2	24.9	20.77	12	HDPE	58	0.006	0.012	0.76	4.13	3.18	26.5%
CB-2	23.55	20.85	WQ-2	24.9	20.77	12	HDPE	8	0.010	0.012	0.8	3.88	3.7	30.8%
WQ-2	24.9	20.42	OUTFALL	NA	19.9	15	HDPE	52	0.010	0.012	1.38	4.43	4.52	30.1%

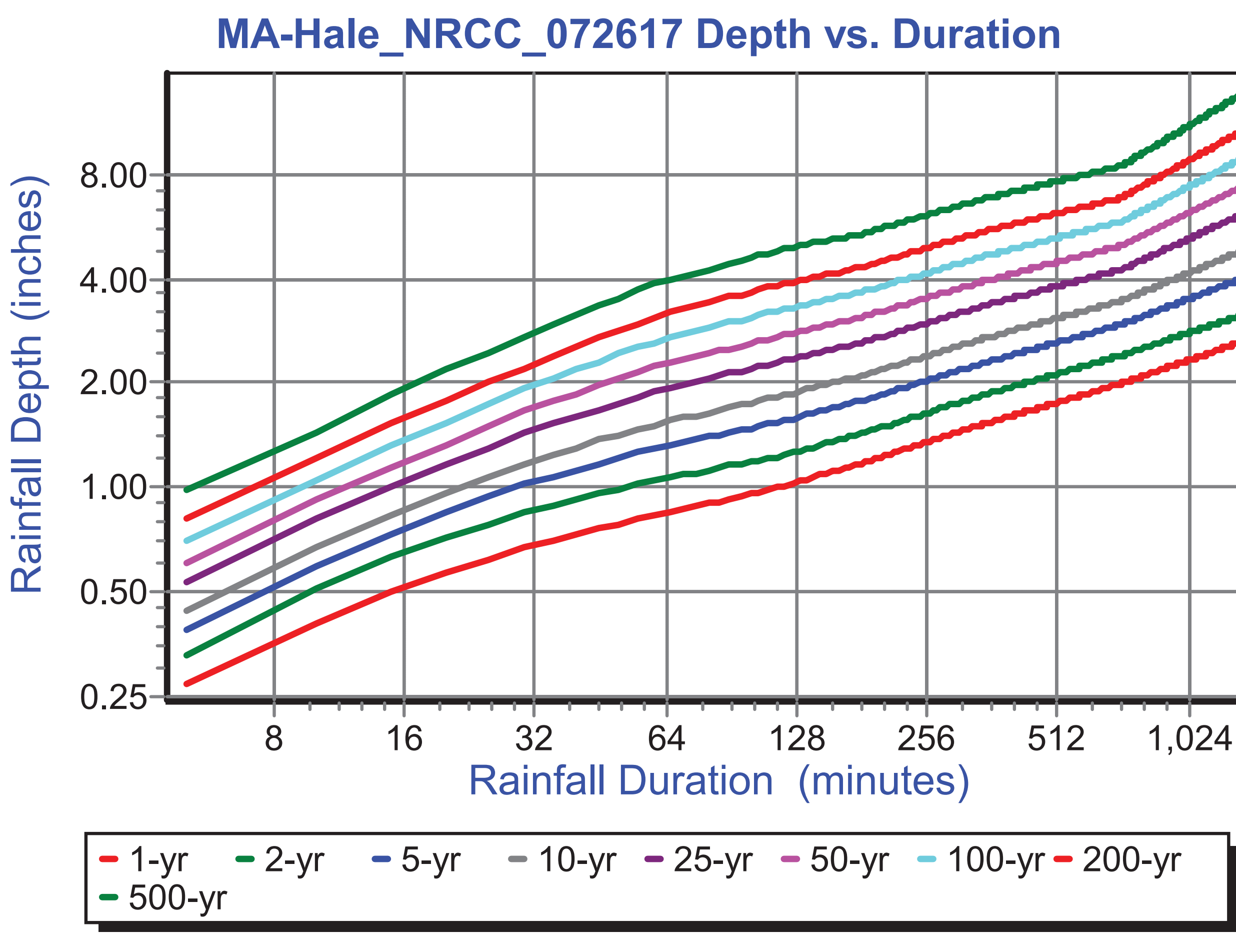
APPENDIX D

NRCC EXTREME PRECIPITATION RAINFALL DATA

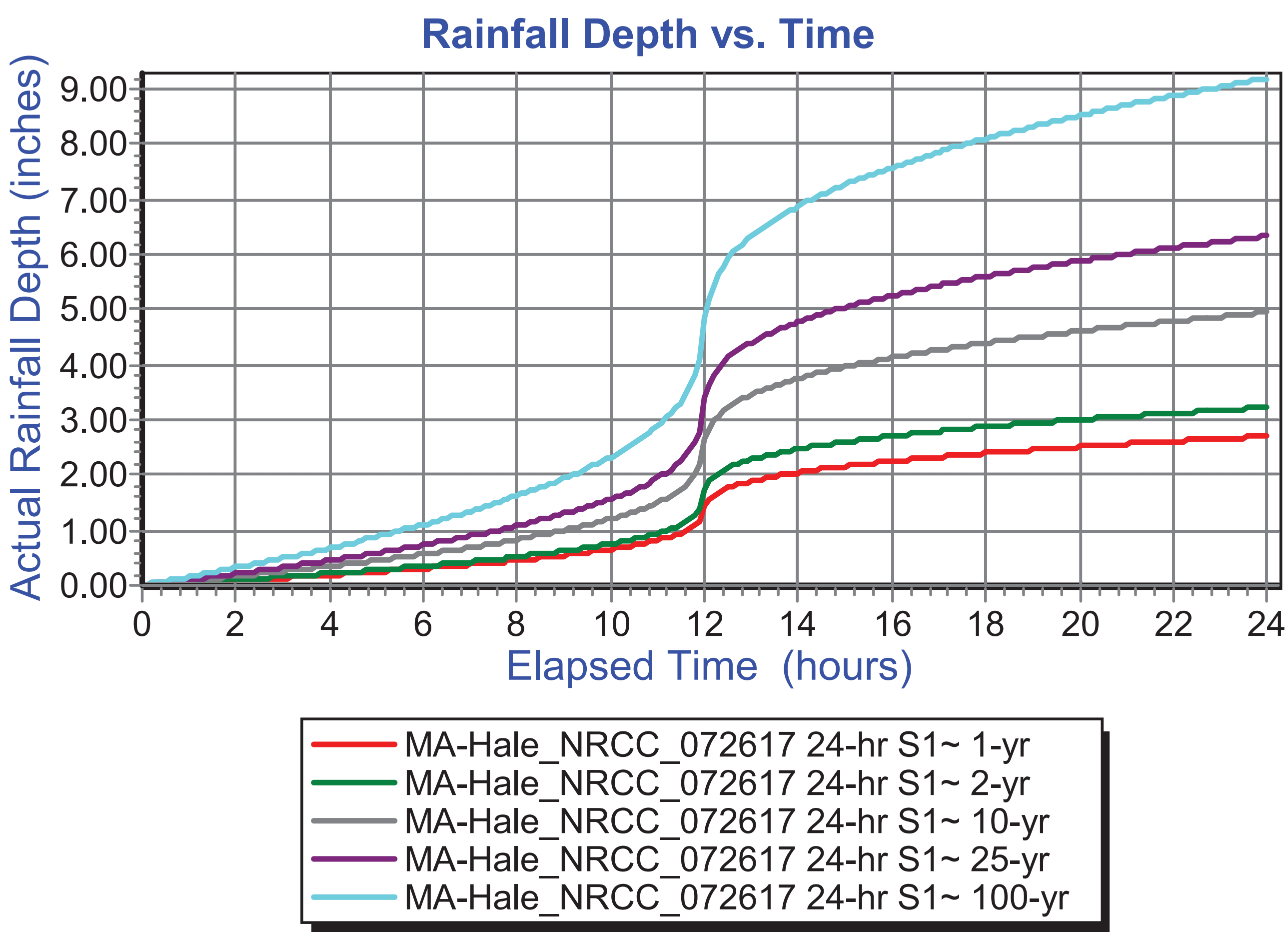
IDF Curve Report



IDF Curve Report



Storm Distribution Report



Northeast Regional Climate Center Extreme Precipitation estimates (inches)
Point Estimates, Unsmoothed
Data series, Partial duration series
State, Massachusetts
Location,
Lon (dd), -70.891
Lat (dd), 42.808
Elev (feet), 0
MEAN PRECIPITATION FREQUENCY ESTIMATES
Freq
(yr),5-min,10-min,15-min,30-min,60-min,120-min,3-hr,6-hr,12-hr,24-hr,2-day,4-day,7-day,10-day
1, 0.27, 0.41, 0.50, 0.68, 0.83, 1.01, 1.18, 1.55, 2.00, 2.70, 2.98, 3.30, 4.00, 4.68
2, 0.33, 0.51, 0.63, 0.85, 1.05, 1.24, 1.43, 1.88, 2.41, 3.22, 3.59, 3.97, 4.71, 5.38
5, 0.39, 0.60, 0.74, 1.02, 1.30, 1.56, 1.78, 2.32, 2.96, 4.12, 4.62, 5.11, 6.03, 6.78
10, 0.44, 0.68, 0.84, 1.18, 1.52, 1.85, 2.10, 2.73, 3.46, 4.95, 5.59, 6.18, 7.26, 8.09
25, 0.53, 0.81, 1.01, 1.44, 1.89, 2.32, 2.61, 3.39, 4.26, 6.33, 7.18, 7.96, 9.30,10.22
50, 0.61, 0.93, 1.15, 1.66, 2.23, 2.75, 3.09, 3.99, 4.99, 7.62, 8.69, 9.64,11.21,12.20
100, 0.70, 1.06, 1.33, 1.92, 2.63, 3.27, 3.65, 4.70, 5.85, 9.19,10.53,11.69,13.52,14.56
200, 0.81, 1.21, 1.54, 2.22, 3.10, 3.88, 4.31, 5.54, 6.85,11.08,12.75,14.16,16.32,17.40
500, 0.98, 1.45, 1.87, 2.72, 3.87, 4.88, 5.38, 6.88, 8.46,14.20,16.42,18.27,20.94,22.02

UPPER LIMIT PRECIPITATION FREQUENCY ESTIMATES
Freq
(yr),5-min,10-min,15-min,30-min,60-min,120-min,3-hr,6-hr,12-hr,24-hr,2-day,4-day,7-day,10-day
1, 0.29, 0.45, 0.55, 0.74, 0.91, 1.08, 1.31, 1.71, 2.17, 2.88, 3.18, 3.54, 4.34, 4.98
2, 0.34, 0.53, 0.65, 0.88, 1.08, 1.30, 1.51, 1.97, 2.52, 3.30, 3.69, 4.08, 4.90, 5.56
5, 0.42, 0.64, 0.80, 1.09, 1.39, 1.68, 1.93, 2.54, 3.24, 4.39, 4.93, 5.48, 6.45, 7.24
10, 0.50, 0.76, 0.95, 1.32, 1.71, 2.06, 2.35, 3.11, 3.93, 5.48, 6.17, 6.89, 8.05, 8.91
25, 0.63, 0.95, 1.18, 1.69, 2.22, 2.70, 3.06, 4.06, 5.08, 7.35, 8.31, 9.32,10.81,11.75
50, 0.74, 1.13, 1.40, 2.02, 2.71, 3.32, 3.74, 4.97, 6.21, 9.21,10.41,11.75,13.54,14.49
100, 0.88, 1.34, 1.67, 2.42, 3.32, 4.06, 4.57, 6.10,

7.58,11.56,13.06,14.80,17.02,17.88
200, 1.05, 1.58, 2.01, 2.90, 4.05, 4.99, 5.61, 7.49,
9.24,14.53,16.41,18.69,21.36,22.07
500, 1.33, 1.98, 2.55, 3.70, 5.26, 6.53, 7.33,
9.85,12.06,19.71,22.18,25.39,28.85,29.27

LOWER LIMIT PRECIPITATION FREQUENCY ESTIMATES
Freq
(yr),5-min,10-min,15-min,30-min,60-min,120-min,3-hr,6-hr,12-hr,24-hr,2-day,4-day,7-d
ay,10-day
1, 0.24, 0.37, 0.45, 0.60, 0.74, 0.87, 1.00, 1.31, 1.64, 2.49, 2.63, 2.97, 3.55,
4.23
2, 0.32, 0.49, 0.61, 0.82, 1.02, 1.22, 1.39, 1.83, 2.34, 3.17, 3.53, 3.88, 4.61,
5.29
5, 0.37, 0.56, 0.70, 0.96, 1.22, 1.45, 1.65, 2.13, 2.73, 3.85, 4.31, 4.77, 5.64,
6.37
10, 0.41, 0.63, 0.78, 1.08, 1.40, 1.67, 1.86, 2.40, 3.06, 4.47, 5.01, 5.56, 6.50,
7.29
25, 0.47, 0.72, 0.89, 1.27, 1.67, 2.00, 2.17, 2.77, 3.56, 5.41, 6.12, 6.78, 7.82,
8.69
50, 0.52, 0.80, 0.99, 1.42, 1.92, 2.30, 2.43, 3.09, 3.97, 6.25, 7.10, 7.88, 8.99,
9.92
100, 0.59, 0.89, 1.12, 1.61, 2.21, 2.65, 2.73, 3.45, 4.43, 7.21, 8.22,
9.15,10.30,11.26
200, 0.66, 0.99, 1.26, 1.82, 2.54, 3.04, 3.06, 3.84, 4.93, 8.30,
9.54,10.61,11.78,12.77
500, 0.78, 1.16, 1.49, 2.16, 3.07, 3.67, 3.57, 4.41, 5.70,
9.94,11.59,12.91,13.97,15.07

Date/time: Wed Jul 26 13:51:21 EDT 2017

APPENDIX E

PROPRIETARY TREATMENT UNITS -
WATER QUALITY TREATMENT VOLUME
CALCULATIONS

Project: Parking Improvement - Hope Church
Location: Newburyport, MA
Prepared For: Atlantic Engineering & Survey Consultants, Inc.

CONTECH ENGINEERED SOLUTIONS

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1/2" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Given:

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)
WQ-1	0.82	0.0012813	5.0	0.083	0.50
WQ-2	0.29	0.0004453	5.0	0.083	0.50

Procedure:

Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Structure Name	qu (csm/in.)
WQ-1	773.00
WQ-2	773.00

1. Compute Q Rate using the following equation:

$$Q_1 = (qu)\ (A)\ (WQV)$$

where:

Q1 = flow rate associated with first 1/2" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1/2" in this case)

Structure Name	Q (cfs)
WQ-1	0.50
WQ-2	0.17

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

PARKING IMPROVEMENT - HOPE CHURCH
NEWBURYPORT, MA

Area	0.82 ac	Unit Site Designation	WQ-1
Weighted C	0.9	Rainfall Station #	69
t_c	6 min		
CDS Model	2015-4	CDS Treatment Capacity	1.4 cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	96.5	9.8
0.04	9.6%	19.8%	0.03	0.03	95.8	9.2
0.06	9.4%	29.3%	0.04	0.04	95.1	9.0
0.08	7.7%	37.0%	0.06	0.06	94.3	7.3
0.10	8.6%	45.6%	0.07	0.07	93.6	8.0
0.12	6.3%	51.9%	0.09	0.09	92.9	5.9
0.14	4.7%	56.5%	0.10	0.10	92.2	4.3
0.16	4.6%	61.2%	0.12	0.12	91.5	4.2
0.18	3.5%	64.7%	0.13	0.13	90.8	3.2
0.20	4.3%	69.1%	0.15	0.15	90.0	3.9
0.25	8.0%	77.1%	0.18	0.18	88.2	7.1
0.30	5.6%	82.7%	0.22	0.22	86.4	4.8
0.35	4.4%	87.0%	0.26	0.26	84.6	3.7
0.40	2.5%	89.5%	0.30	0.30	82.9	2.1
0.45	2.5%	92.1%	0.33	0.33	81.1	2.0
0.50	1.4%	93.5%	0.37	0.37	79.3	1.1
0.75	5.0%	98.5%	0.55	0.55	70.3	3.5
1.00	1.0%	99.5%	0.74	0.74	61.3	0.6
1.50	0.0%	99.5%	1.11	1.11	43.4	0.0
2.00	0.0%	99.5%	1.48	1.40	29.1	0.0
3.00	0.5%	100.0%	2.21	1.40	29.1	0.1
						90.0

Removal Efficiency Adjustment[2] = 6.5%

Predicted % Annual Rainfall Treated = 93.4%

Predicted Net Annual Load Removal Efficiency = 83.5%

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

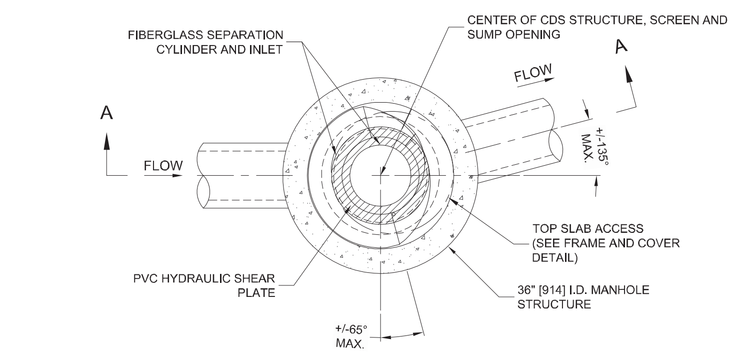
CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

PARKING IMPROVEMENT - HOPE CHURCH
NEWBURYPORT, MA

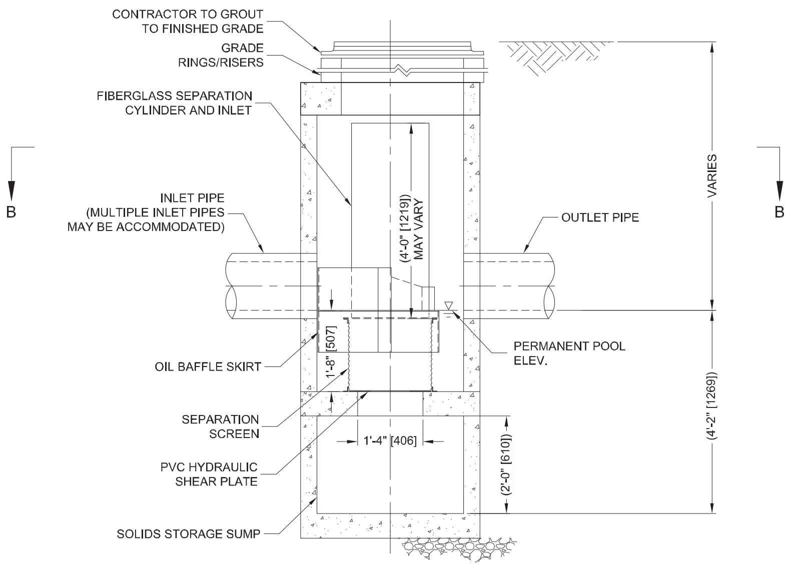
Area	**0.29 ac**	Unit Site Designation	**WQ-2**
Weighted C	**0.9**	Rainfall Station #	**69**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	96.9	9.9
0.04	9.6%	19.8%	0.01	0.01	96.5	9.3
0.06	9.4%	29.3%	0.02	0.02	96.2	9.1
0.08	7.7%	37.0%	0.02	0.02	95.8	7.4
0.10	8.6%	45.6%	0.03	0.03	95.4	8.2
0.12	6.3%	51.9%	0.03	0.03	95.1	6.0
0.14	4.7%	56.5%	0.04	0.04	94.7	4.4
0.16	4.6%	61.2%	0.04	0.04	94.4	4.4
0.18	3.5%	64.7%	0.05	0.05	94.0	3.3
0.20	4.3%	69.1%	0.05	0.05	93.7	4.1
0.25	8.0%	77.1%	0.07	0.07	92.8	7.4
0.30	5.6%	82.7%	0.08	0.08	91.9	5.1
0.35	4.4%	87.0%	0.09	0.09	91.0	4.0
0.40	2.5%	89.5%	0.10	0.10	90.1	2.3
0.45	2.5%	92.1%	0.12	0.12	89.2	2.3
0.50	1.4%	93.5%	0.13	0.13	88.3	1.2
0.75	5.0%	98.5%	0.20	0.20	83.9	4.2
1.00	1.0%	99.5%	0.26	0.26	79.4	0.8
1.50	0.0%	99.5%	0.39	0.39	70.5	0.0
2.00	0.0%	99.5%	0.52	0.52	61.7	0.0
3.00	0.5%	100.0%	0.78	0.78	43.9	0.2
						93.6
					Removal Efficiency Adjustment[2] =	6.5%
					Predicted % Annual Rainfall Treated =	93.5%
					Predicted Net Annual Load Removal Efficiency =	**87.1%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.



PLAN VIEW B-B
N.T.S.



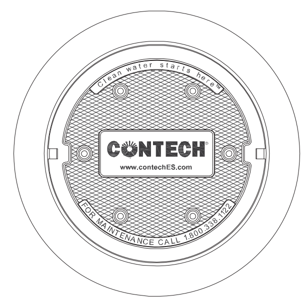
ELEVATION A-A
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,780,048; 5,667,200; 5,531,102; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CDS1515-3-C DESIGN NOTES

CDS1515-3-C RATED TREATMENT CAPACITY IS 1.0 CFS, OR PER LOCAL REGULATIONS.

THE STANDARD CDS1515-3-C CONFIGURATION IS SHOWN.



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			

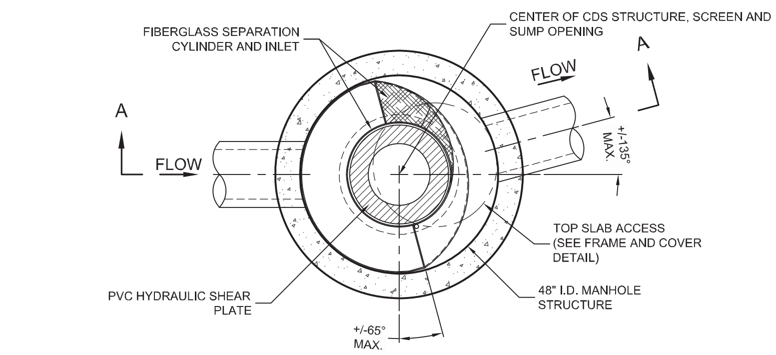
* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO..
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

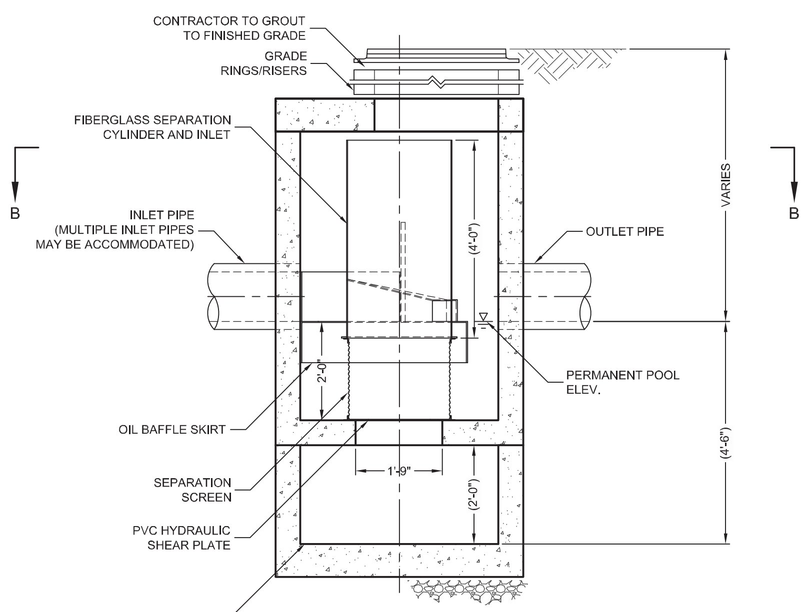
INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS1515-3-C
ONLINE CDS
STANDARD DETAIL



PLAN VIEW B-B
N.T.S.



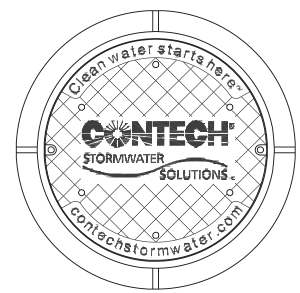
ELEVATION A-A
N.T.S.

CDS2015-4-C DESIGN NOTES

CDS2015-4-C RATED TREATMENT CAPACITY IS 1.4 CFS, OR PER LOCAL REGULATIONS.

THE STANDARD CDS2015-4-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS)			*
PEAK FLOW RATE (CFS)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH CONSTRUCTION PRODUCTS REPRESENTATIVE. www.contech-cpi.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET AASHTO M306 LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
1. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
2. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
3. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
4. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
5. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH®
CONSTRUCTION PRODUCTS INC.
www.contech-cpl.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS2015-4-C
CDS INLINE
STANDARD DETAIL

APPENDIX F

LONG TERM POLLUTION PREVENTION - STORMWATER OPERATION AND MAINTENANCE PLAN

Long Term Pollution Prevention

StormWater

Operation and Maintenance Plan

for

Parking Improvements

The Hope Community Church of Newburyport
located at

11 Hale Street

Newburyport, Massachusetts 01950

Prepared For

The Hope Community Church of Newburyport
11 Hale Street
Newburyport, MA 01950

Date: December 14, 2017

Atlantic Engineering & Survey Consultants Inc.
97 Tenney Street, Georgetown, Massachusetts 01833
(978) 352-7870

TABLE OF CONTENTS

Stormwater Pollution Prevention Plan

Site: 11 Hale Street
Newburyport, MA 01950

Owner: The Hope Community Church of Newburyport
11 Hale Street
Newburyport, MA 01950
Tel. No.
Email:

Operator - TBD
Name:
Tel. No.
Email:

Preparation Date:

December 14, 2017

Post Construction Operation and Maintenance Plan

POST CONSTRUCTION MAINTENANCE RESPONSIBILITIES

Long-term post construction operation, monitoring and maintenance of the drainage system BMP's will be the responsibility of The Hope Community Church of Newburyport. A copy of all maintenance inspections, cleanings and repairs should be maintained on site and made available to public officials upon request. The following is the recommended maintenance program for the installed devices.

GENERAL CONDITIONS

- A rain event shall be considered a major storm event when rainfall exceeds 2 inches in a 24 hour period.
- In the event the paved surfaces of site experiences a chemical release equal to or greater than five (5) gallons, the property owners shall immediately remediate the spill, and notify the Local Board of Health and Mass Department of Environmental Protection.

SITE AND DRAINAGE SYSTEM BMPs

SNOW MANAGEMENT

It is recommended winter snow operations are managed as follows:

- Snow storage shall be stored in areas and in a manor to prevent blockage of BMP's and to insure all snow run-off is directed to the stormwater management system's components.
- Snow storage shall be managed to prevent blockage of the stoned filter strips, drainage swales. Inlets and outfalls, catch basins, sedimentation and detention basins. Snow combined with sand and debris may block a storm drainage system, diminish the infiltration capacity of the system and causing localized flooding.
- Sand and debris deposited on the pavement parking areas shall be cleared from the site and properly disposed of at the end of the snow season, no later than May 15.

SITE SWEEPING

- All asphalt pavement areas shall be swept a minimum of two times per year to maintain design performance. All sweepings shall be removed and properly disposed.
- All paved areas shall be swept of winter sand as soon as possible in the spring and in early fall as needed.
- Recommended sweeping schedule:
  Apr/May
  Oct/Nov

DEEP SUMP CATCH BASIN

Inspections and Cleaning

- The catch basin grates should be inspected bi-annually and cleaned as necessary.

- The catch basin sump should be inspected early Spring and if there is less than two feet of clearance below the invert, the sump should be cleaned.
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

ROADWAY STONE FILTER STRIP

- The roadway stoned filter strip shall be inspected annually and after major storms for accumulation of debris and sediments.
- The top layer of stone shall be kept free of debris and yard waste; and removed as observed.
- Areas found to be clogged shall be removed and replaced to a depth necessary to assure proper functioning of the filter strip.

CULTEC CDS SEPARATOR

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants depends more heavily on site activities than the size of the unit. Unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspections

Pollutant transport and deposition may vary from year to year and regular inspections ensure that the system is cleaned at the appropriate time.

- At a minimum, inspections should be performed twice per year (e.g. spring and fall). More frequent inspections may be necessary when excessive winter sanding operations occur.
- The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen.
- The inspection should quantify the accumulation of hydrocarbons, trash, and sediment in the system.
- The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated.
- If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. When absorbent material is used, it should be replaced when significant discoloration has occurred.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system.

- The system should be completely drained down and the sump fully evacuated of sediment.
- The screen should be cleaned to ensure it is free of trash and debris.
- The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

- Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed with absorbent pads when an appreciable layer has been captured.
- In the event of a petroleum spills the system should be cleaned out immediately.
- Disposal of all material removed from the CDS system should be done in accordance with local regulations

SUB-SURFACE DETENTION UNITS

Subsurface detention basin is used to capture regulate storm water runoff. To maintain functionality, this system requires regular inspection and cleaning when necessary.

The systems entrance manhole and outlet control manhole should be inspected early Spring and cleaned of the accumulation of sediments or debris.

Inspections and Cleaning

- The subsurface infiltration systems will be inspected at least once each year, in the spring, by inspecting the access manhole or port during a rainstorm to determine if the systems operation is operating normally.
- If the system is not receiving runoff or does not drain after storms the system should be future evaluated and repaired or replaced as necessary.
- The control structure sump should be inspected early Spring and Fall and if there is less than two feet of clearance below the invert, the sump should be cleaned.
- Inspect and observe system following significant rainfalls to determine if it is operating properly.

RIP RAP DRAINAGE OUTFALLS, WEIRS AND CHECK DAMS

- Rip rap outfalls and check dams shall be inspected for stability and damage following major storm events. All damaged areas shall be repair as needed.

- The rip rap check dams and rip rap adjacent to and down-gradient of the outfall swale should be inspected annually. Disturbed rip rap should be restored to prevent erosion and insure stability of the channel and slopes.

DRAINAGE OUTFALL PIPE

- The rip rap adjacent to and down-gradient of the drainage systems outfall pipes should be inspected annually and after major storm events.
- Disturbed rip rap should be restored to prevent erosion and insure stability of the slope

DRAIANGE SWALE

- Drainage swales should be inspected on a semi-annual basis for soil stability, slope integrity, soil erosion, ponding and sedimentation. All damaged areas shall be repaired upon discovery.
- Sediments and debris shall be removed annually or more frequently if needed.

APPENDIX G

•

NRCS SOILS RESOURCE REPORT

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Essex County, Massachusetts, Northern Part

11 Hale Street - Newburyport, MA

August 1, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:2,200 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 30, 60, 120, 180

Feet: 0, 100, 200, 400, 600

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 12, Sep 14, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 30, 2011—Apr 8, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Essex County, Massachusetts, Northern Part (MA605)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
12A	Maybid silt loam, 0 to 3 percent slopes	4.7	45.6%
16A	Scantic silt loam, 0 to 3 percent slopes	5.4	52.0%
719B	Suffield silt loam, 3 to 8 percent slopes	0.2	2.4%
Totals for Area of Interest		**10.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Essex County, Massachusetts, Northern Part

12A—Maybid silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: vjhj
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Maybid and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Maybid

Setting

Landform: Depressions, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Soft silty and clayey glaciolacustrine deposits and/or firm silty marine deposits

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 19 inches: silty clay
H3 - 19 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Scantic

Percent of map unit: 12 percent
Landform: Depressions
Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Bogs
Hydric soil rating: Yes

16A—Scantic silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: vjrl
Elevation: 10 to 900 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Scantic and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scantic

Setting

Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Soft fine-silty glaciolacustrine deposits and/or soft fine-silty glaciomarine deposits over hard fine-silty glaciolacustrine deposits and/or hard fine-silty glaciomarine deposits

Typical profile

H1 - 0 to 11 inches: silt loam
H2 - 11 to 26 inches: silty clay loam
H3 - 26 to 60 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Maybid

Percent of map unit: 10 percent
Landform: Depressions
Hydric soil rating: Yes

Buxton

Percent of map unit: 5 percent
Hydric soil rating: No

719B—Suffield silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vjsr
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Suffield and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Suffield

Setting

Landform: Lakebeds (relict), lakebeds (relict)
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Soft coarse-silty glaciolacustrine deposits over hard clayey glaciolacustrine deposits

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 35 inches: silt loam
H3 - 35 to 60 inches: silty clay

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 40 inches to strongly contrasting textural stratification
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Buxton

Percent of map unit: 10 percent
Hydric soil rating: No

Scantic

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Atlantic Engineering & Survey Consultants, Inc.
faex ATTA)e, 8MA8eeee3 A7M-A871 Tgei c e@n JJ
fa. hJ BPha. a@eeeef a. hJ BPhf f u@esLt dZeeeet 8GT80b. uE - 2 t 0Gb72

97 Ten yeSt r G67TgeSywy, yeSMo01 AT8
3 A7M-A9ye5 t 2 47r MlogeSy(y

February 5, 2018

Newburyport Planning Board
Office of Planning & Development
Newburyport City Hall
60 Pleasant Street
Newburyport, MA 01950

Re: Site Plan Review
Hope Church – 11 Hale Street

Dear Planning Board Members,

Below please find responses to the site plan review checklist comments prepared by Christensen & Sergi, Inc. dated Jan. 25, 2018. The responses follow the same order as presented on the checklist. Were checklist items represent items referred to the stormwater report, responses to these items are located in the following section of this response letter.

XV-1 Materials for Review

- Plan scale is at a 20 scale. - A plan scale of 20 is larger, not smaller, than a 40 scale and allows the depiction of the sites proposed improvements in greater detail.

XV-E(a) Submission Requirements

- Is there a sewer connections easement for the adjacent property. – There is no record of the easement in the Registry.
- No gross floor area provided for the existing building. – No gross floor area of the building has been provided as the proposed work only result in alterations to the site and no changes are proposed to the existing building or its use.
- No sign information provided. – The sign details are being developed and will be furnished when completed.
- Traffic patterns – Addressed in stormwater section of this letter.
- Bike Racks. – No bike racks have been proposed as the site use is typically not accessed by individuals on bicycles. If this requirement is not waived by the planning Board a bike rack will be installed and “share the road signs” can be installed along one of the access drives.
- Site contours at 1 foot intervals. – The use of 1 foot contours provides greater detail of the site than the required 2 foot intervals.

XV-E (b) Narrative Submittals

- Surface and groundwater pollution. - Addressed in stormwater section of this letter.

XV-G(b) Traffic, parking and public access

- No bike racks – See response above

- No incentives for the use of alternatives provided. – The project is to increase onsite parking to alleviate congestion and safety concerns occurring within the site and on Hale Street. No additional alternatives exist.

XV-G(d) Public Services and Utilities

- Pollution potential of groundwater - Addressed in stormwater section of this letter.

XV-H Development and Performance Standards

- Two access drives proposed. – Based on the configuration of the site and extent of wetlands within the site, the only means to alleviate the congestion and improve safety occurring within the site and on Hale Street is to create separate entrance and access drives.
- Traffic Circulation – Duplication and is addressed in stormwater section of this letter.
- No Bike Racks - Duplication see response above.
- Parking located in front of building – Due to location of the onsite wetlands the creation of additional parking is only possible in front of the building.
- Parking located within front set back – This comment is incorrect the proposed parking is not located within the front setback.
- No bike lanes or rumble strips provided. - See response above.

Below please find responses to Christensen & Sergi, Inc. site plan review comments dated Jan. 25, 2018. The responses follow the same numeric order as Christensen & Sergi, Inc. comments.

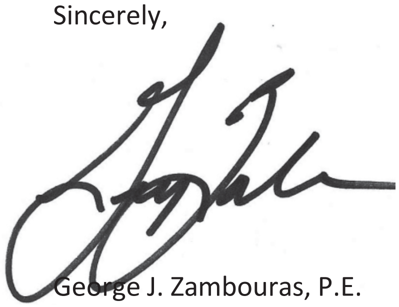
While I believe the hydraulic analysis originally presented produced a conservative analysis of the pre and post development stormwater flows and volumes for the site, the revised analysis has been recalculated per your comments as indicated below.

1. The actual time of concentration is used and the minimum Tc of 6 minutes was not utilized.
2. All catch basins and manholes were modeled as ponds.
3. The hydraulic model was calculated as a dynamic model.
4. The hydraulic model analysis was restructured to separate the pre and post development flows and volumes from the southeasterly and southwesterly watersheds. This was originally combined as all site discharges, regardless of path around the building, to the wetland located to the rear (south) of the building.
5. The poor and fair conditions indicated for the post development conditions were in error and have been corrected.
6. All rim to invert depths were reviewed for constructability. The review required an adjustment for CB-3 located within the existing parking area to be reconstructed. The adjustment was made by altering the grade of the drain line from WQ-2 structure to DMH-6 and CB-3. All other structures were found to be capable of being constructed.
7. The handicap ramps details have been revised to include additional information to ensure the ramps are constructed in accordance with ADA requirements.
8. The existing drive cross section correctly shows the drive as being crowned and does not require correction. The proposed new access drive is super-elevated from sta.0+90 to Sta. 2+80. Additional notations were provided on the plan and profile of the proposed access drive to further define the limits of the super-elevated roadways sections to avoid any confusion.
9. The filter strip is solely to capture the heavy solid suspended particles resulting from the roadway runoff that is within the crowned section of the roadway. The balance of treatment is to be provided by the existing constructed wetland detention basin and associated stomwater

components. Per your comments the depth of the filter strip was increased slightly to provide the capture of additional solids. As this section of the proposed improvements and associated wetlands filling will be further discussed at the Conservation hearing no additional revision is proposed at this time.

10. The most congested times for the site occur on Sunday, when the traffic volumes are at a minimum on High Street, and when the site is used for voting. The potential for re-circulation of vehicles back on to Hale Street only occurs when vehicles have accessed the upper parking area near Hale Street and spaces are not available. Vehicles that access the lower or middle parking area can re-enter the parking area via the middle or upper sections respectfully without utilizing Hale Street to gain access to parking. While this re-circulation could result in looping trips it primarily occurs on Sundays when Hale Street volumes are at a minimum. We believe that the potential for these minor looping trips is far outweighed by the reduction in congestion which presently exists on Hale Street and the significant increase of safety within the site as result of the proposed improvements.
11. Additional notations and elevations have been provided on the dentition basin detail as requested.

Sincerely,



George J. Zambouras, P.E.

Cc: Attorney Lisa Mead
Brad Gardner