FINAL DRAINAGE AND EROSION CONTROL REPORT

FOR

FIRST REPLAT OF PROSPECT RIVERSIDE SUBDIVISION
(RIVERSIDE STORAGE)

FINAL DRAINAGE AND EROSION CONTROL REPORT

FOR

FIRST REPLAT OF PROSPECT RIVERSIDE SUBDIVISION (RIVERSIDE STORAGE)

Prepared for:

Wickham Gustafson Architects
1449 Riverside Avenue
Fort Collins, CO 80524

Prepared by:

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(970) 686-6939

October 10, 2014

Job Number 264-02

North Star design

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October 10, 2014

Glen Schlueter
City of Fort Collins Stormwater
700 Wood Street
Fort Collins, CO 80522-0580

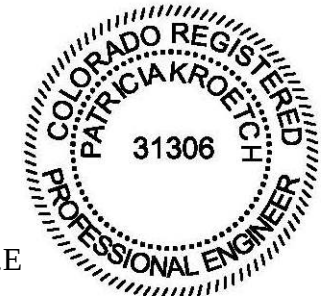
RE: Final Drainage and Erosion Control Report for First Replat of Prospect Riverside Subdivision (Riverside Storage)

Dear Glen,

I am pleased to submit for your review and approval, this Final Drainage and Erosion Control Report for First Replat of Prospect Riverside Subdivision. I certify that this report for the drainage design was prepared in accordance with the criteria in the City of Fort Collins Storm Drainage Manual.

I appreciate your time and consideration in reviewing this submittal. Please call if you have any questions.

Sincerely,



Patricia Kroetch, P.E

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1. GENERAL LOCATION AND DESCRIPTION

1.1 Location

This site is located on the east side of Riverside Drive north of East Prospect Road in the Southeast Quarter of Section 18, Township 7 North, Range 68 West of the Sixth Principal Meridian, in the City of Fort Collins, Larimer County, Colorado. See the Vicinity Map in Appendix A of this report.

This project is bounded on the north by existing storage units, on the east by existing Union Pacific Railroad tracks, on the west by Riverside Drive, and on the south by existing Rivendell School.

1.2 Description of Property

The entire project consists of approximately 2.2 acres. The site is currently developed, with areas of existing asphalt and gravel. Existing slope is to the northeast with slopes ranging from approximately 1.5% to 3%. The site currently drains into an existing swale located at the northeast corner of the site.

Proposed development on-site will include one office building, five self-storage buildings, and associated drives, parking, and walks. Existing drainage patterns will not be significantly altered with this development.

2. DRAINAGE BASINS AND SUB-BASINS

2.1 Major Basin Description

The proposed development lies within the Spring Creek Drainage Basin. Both stormwater detention and extended water quality detention are required in this basin. The City requirement for stormwater detention in the Spring Creek basin is a single-stage detention with a 100-year release rate equal to the existing 2-year runoff.

2.2 Sub-basin Description

Runoff from this site currently flows to an existing swale located in the northeast corner of the site. From there, the runoff is conveyed in a proposed pipe and the existing swale to the north along the rear of the adjacent properties to an existing pipe under the railroad

tracks. The existing swale across the adjacent properties was determined to be a historic conveyance for this site. With the proposed drainage concept for this site, the detained runoff will continue to be released into the existing swale via a short outfall pipe.

3. DRAINAGE DESIGN CRITERIA

3.1 Regulations

This report was prepared to meet or exceed the "City of Fort Collins Storm Drainage Design Criteria Manual" specifications except where variances are requested as noted in Section 4.2 of this report. Where applicable, the criteria established in the "Urban Storm Drainage Criteria Manual" (UDFCD), 2001, developed by the Denver Regional Council of Governments, has been used.

3.2 Development Criteria Reference and Constraints

The runoff from this site has been routed to conform to the requirements of the City of Fort Collins Stormwater Department. Both stormwater runoff detention and extended water quality detention are required for this site and are being provided by the proposed on-site detention pond. The release rate from the site will be equal to the existing 2-year runoff.

3.3 Hydrologic Criteria

Runoff computations were prepared for the 2-year minor and 100-year major storm frequencies utilizing the rational method. All hydrologic calculations associated with the basins are included in Appendix B of this report. Standard Form 8 (SF-8) provides time of concentration calculations for all sub-basins.

Detention volume was calculated using the runoff rate for the 2-year rainfall event with existing site conditions, which includes existing sections of asphalt paving and gravel. The FAA method for detention pond sizing was utilized to determine the required volume. Water quality volume was calculated using the method recommended in the "Urban Storm Drainage Criteria Manual". Refer to the detention calculations included in Appendix C of this report.

3.4 Hydraulic Criteria

Hydraulic elements have been designed per City of Fort Collins standards to adequately convey the 100-year storm runoff from this site to the proposed detention pond. An existing drainage swale will convey the detained runoff from the site to the downstream railroad crossing.

4. DRAINAGE FACILITY DESIGN

4.1 General Concept

The runoff from this site will flow into the parking lot and drive aisles which will be constructed using conventional materials (asphalt or concrete) and porous pavers. The runoff from the site will either flow on the surface or enter a perforated pipe via the porous pavers. In a situation where the porous pavements are clogged, the runoff will flow on the surface and enter the detention pond on the east side of the site. On-site runoff will also be conveyed to the detention pond via flows in LID swales along the north and south property boundaries. The detained runoff will discharge into the existing swale located at the northeast corner of the site. From there, runoff will be conveyed in the existing swale downstream to an existing railroad crossing. This existing swale may need to be cleaned out (with permission of the downstream property owner) to ensure adequate conveyance and removal of any obstructions.

4.2 Specific Flow Routing

With this design, the site is modeled as a single basin (Basin 1). This basin includes all of the proposed improvements on site including the office building, parking for the office building, the five storage buildings, the drives between the storage buildings, the sidewalks and all of the water quality enhancement features. The runoff from the site will follow the historic runoff path and will flow from the west (Riverside Avenue) to the east and into the detention area.

Drainage design for this site has been designed to convey on-site runoff to the proposed detention pond and incorporate the required water quality enhancement features. On-site runoff will be conveyed to the detention pond via surface flow in the drive aisles, in the LID swales and subsurface in the perforated pipes. The detention pond will release the detained runoff from the site at the existing (historic) 2-year runoff rate of 2 cfs. The

developed 2-year runoff rate for this Basin is 3.8 cfs and the developed 100-year runoff rate is 18.9 cfs.

One variance is requested for this project. A variance is being requested to reduce the minimum freeboard for the detention pond from 1.0' to 0.7'. This will not impact the structure on site or on the adjacent site.

4.3 Drainage Summary

This site has been designed to meet or exceed the "City of Fort Collins Storm Drainage Design Criteria Manual" specifications except where variances are requested as noted in Section 4.2 of this report. The proposed drainage design for this site has been designed to convey on-site runoff to the detention pond while minimizing future maintenance.

All drainage facilities proposed with this project, including the detention pond and outlet structure are private and will be owned and maintained by the property owner or Owner's Association.

5. STORMWATER MANAGEMENT CONTROLS

5.1 Written Analysis

The soils on this site are classified by the USGS Soil Survey as Kim Loam with a small area of Santana Loam and are classified in the hydrologic group B. The soils are described as having a slow runoff rate and the hazard of water erosion is slight and the hazard of wind erosion is moderate.

The site is surrounded by developed sites including streets and paved areas. The construction shall utilize silt fence around the perimeter to control sediment transport from rainfall and from wind. The silt fence that is located in the proposed pavement areas will be removed prior to placing new pavement. Rock socks will be utilized in the existing curb and the newly constructed swales to capture sediments that are not fully contained by the silt fence placement. The locations of the rock socks will be in the areas of concentrated flow such as in the existing curb, at the new swales and on the existing concrete sidewalks as needed.

The site will also utilize a vehicle tracking control pad to minimize sediment from being tracked onto adjacent pavements. Sediment that is tracked will be removed and placed within the site or permanently disposed of offsite. A concrete washout will be used on site during the concrete placement. All hardened concrete will be disposed of offsite. These BMP's have not been located on the site map due to the fact that the site is very small and these BMP's will need to be placed by the contractor in locations that are most beneficial and will minimize disruption of adjacent traffic.

Permanent erosion control consists of covering the soils with a building, concrete walks, concrete drives and sod. No soil will be left exposed to erosion after the construction is complete. Refer to the landscape plan for areas of and instructions for placement of sod and soil amendments required prior to placement of sod.

Refer to Appendix D for the timing of the construction phases and the sequential installation of all BMP phasing for this site.

Refer to the Appendix E for the Erosion Control Surety calculations.

5.2 SWMP contact information

Permit holder:

Name: _____

Address: _____

Phone Number: _____

Email Address: _____

Appointed agent:

Name: _____

Address: _____

Phone Number: _____

Email Address: _____

5.3 Identification and location of all potential pollution sources

Potential Pollutant Source Activity	Potential Pollutant Generated	Applicable to this project
Disturbed Areas	Sediment	X
Soil stockpiles	Sediment	X
Travel to adjacent public streets	Tracked sediment	X
Contaminated soils	Sediment, chemicals	
Loading and unloading chemicals	Chemicals	
Unloading of building materials	Trash, debris	X
Outdoor storage of chemicals	Chemicals	
On site equipment maintenance	Oil, grease	
On site equipment fueling	Diesel, gasoline	X
Dust generating activities	Particulates, sediment	X
Use of fertilizer, pesticides, herbicides	Fertilizer, pesticides	
Use of detergents, solvents, oils	Detergents, solvents, oil	X
Waste dumpsters, waste piles	Chemicals, trash, debris	X
Concrete washout	Concrete, sediment, wash water	X
On site equipment washing	Detergents, oil	
On site asphalt batch plant	Asphaltic cement, sediment	
On site concrete batch plant	Cement, sediment	
Portable toilets	Domestic sewage	X

5.4 Best Management Practices (BMP's) for Stormwater Pollution Prevention

Structural Practices for Erosion and Sediment Control

Structural practices for the site will consist mainly of silt fence and rock sock filters and are described in detail in the following paragraphs. These BMP's are expected to change as the construction progresses and it is the responsibility of the contractor to ensure appropriate BMP's are in place and/or removed at the appropriate time in the construction sequence. All temporary and permanent erosion and sediment control practices must be maintained and repaired as needed to assure continued performance of their intended function.

Silt fence and rock sock filters shall be in place prior to commencement of construction activities. During clearing and grubbing necessary for silt fence installation, all cleared material shall be placed on the uphill side so that if erosion occurs from the cleared material, the sediment will be trapped and not transported downstream. Rock socks shall be implemented in the existing curb line as shown on the Drainage & Erosion Control Plan.

All BMP's shall be installed per the details shown on the construction plan set.

Temporary & Permanent Structural BMP's:

Structural BMP	Approximate location on site	Applicable to this Project
Silt Fence	Site perimeter, refer to site map	X
Straw bale dams		
Rock Socks	At existing sidewalk culverts, in existing gutters, refer to site map	X
Earthen diversion dams		
Vegetated swales		
Sediment trap/pond	East boundary of site, in proposed det pond	X
Pipe slope drains		
Geogrid		
Inlet/outlet protection	In the detention Pond	X
Culverts		
Riprap		
Erosion control mats		
Inlet protection		
Vehicle Tracking Control Pad	At site entrance, refer to site map	X
Concrete Washout	To be located by Contractor, near site entry	X

Non-Structural Practices for Erosion and Sediment Control:

Soils exposed during the earthwork phase and landscape prep phase shall be kept in a roughened condition by ripping or disking along land contours until mulch, vegetation, or other permanent erosion control is installed. No large amount of soils (in excess of 15 yards) will be allowed to be stock piled on site. Overburden from the utility pipe trenching will be piled adjacent to trenches upstream of sediment controls and will be replaced in the trenches within 72 hours.

Excess excavated materials from the demolition and grading phases of the project that cannot be reused on site will be exported as it is excavated. This includes any asphalt pavement from the existing site that is to be removed.

A vehicle tracking pad will be installed at a location most beneficial to the site construction as determined by the contractor. Vehicles will not be permitted in the excavated area if soil is muddy. Gravel sub base will be placed and compacted in the areas indicated for pavement following excavation. In the current pre construction state the site enables tracking of silt onto the adjacent streets during wet conditions. During construction activities the street will be monitored for foreign debris tracked out of the site and mechanical sweeping and clean up will be performed as needed.

No area shall remain exposed by land disturbing activity for more than thirty (30) days before required temporary or permanent erosion control (e.g. seed/mulch, landscaping, etc.) is installed.

Temporary & Permanent non-structural BMP's:

Non-Structural BMP	Approximate location on site	Applicable to this Project
Surface roughening	Entire site	X
Soil stockpile height limit (less than 10')		
Perimeter vegetative buffer	West and north boundaries of site	X
Minimization of site disturbance		
Mulch		
Seed & mulch stockpiles after 30 days		
Stockpile toe protection (silt fence, wattles or ditch)		
Preservation & protection of existing vegetation & trees	West and north boundaries of site	X
Good site housekeeping (routine cleanup of trash & constr debris)	Entire Site	X
Sweeping & scraping of hardscape areas	On and off site pavements	X
Heavy equip staged on site, properly maintained & inspected daily (no onsite maintenance)	Staging area	X

5.5 BMP Implementation

1) Phased BMP Implementation

   BMP's are expected to change as the construction progresses and it is the responsibility of the contractor to ensure appropriate BMP's are in place and/or removed at the appropriate time in the construction sequence. A construction sequence schedule has been included on the Drainage & Erosion Control Plan and included in the construction plans for this site.

   All BMP's shall be inspected and repaired or replaced as required to satisfy the conditions of the Stormwater Discharge Permit. All BMP's must be maintained and repaired as needed to assure continued performance of their intended function. Refer to Appendix D for the BMP schedule and estimated costs.

2) Materials Handling and Spill Prevention:

Materials Handling & Spill Prevention BMP	Approximate location on site	Applicable to this Project
Portable toilets, anchored & located away from drainages	Contractor to determine	X
Fuel storage located in bulk tanks with secondary containment & spill kit		
Mobile fueling performed at least 200 feet away from drainages & fully attended	Contractor to determine	X
Fertilizers, form oil, solvents, cleaners, detergent stored in 55 gal or smaller containers, kept in storage units	Contractor to determine	X
Dumpsters containing used chemicals containers & liquid wastes kept covered	Contractor to determine	X
Equipment cleaning (on site) uses no detergents & flows to onsite retention basin		
In case of a release of fuel or other chemicals, absorbent booms or earthen berms will be immediately constructed to contain the spill & prevent runoff to adjacent surface waters	Location of spill	X
MSDS sheets for onsite chemicals will be kept at the construction trailer to facilitate spill response & cleanup	Contractor to determine	X

3) Dedicated Asphalt or Concrete Batch Plant:

   Not proposed with this development

4) Vehicle Tracking Pad:

   Vehicle tracking control pad shall be installed wherever construction vehicle access routes intersect paved public roads. Vehicle tracking control pads shall be installed to minimize the transport of sediment (mud) by runoff or vehicles tracking onto the paved surface. Any mud tracked to public roads shall be removed on a daily basis and after any significant storm that causes sediment to be transported. It is unlawful to track sediment/mud onto public streets and may be enforced by the City of Fort Collins, by the State of Colorado or by the EPA.

5) Waste Management and Disposal:

Portable toilets will be anchored & periodically maintained by waste management company. Dumpsters on site will be covered & periodically emptied by waste management company. Concrete waste will be allowed to harden and then will be removed from site.

No washing activities will occur on site.

Location of the concrete washout is shown on the site map. The washout will be sufficiently deep to accommodate all anticipated concrete truck wash water. Waste concrete will be allowed to harden and be removed from site periodically as the washout reaches 50% of its capacity. Truck wash water will not be allowed to reach the curb & gutter or any other water course.

6) Groundwater and Stormwater Dewatering:

No groundwater was encountered during soils exploration therefore ground water is not anticipated to be an issue. If groundwater is encountered a groundwater discharge permit shall be obtained and a detailed report shall be completed describing the location and the route of where pumped groundwater will be conveyed and the measures taken to prevent the transport of any pollutants to downstream waters.

7) Inspection & Maintenance:

It is required that routine site inspections are performed to effectively address maintenance and repair of Best Management Practices (BMP's). The site inspections are to performed by the contractor or an inspector designated by the administrator at a minimum of once every fourteen (14) calendar days on active construction sites and after any significant storm event (an event causing runoff). As part of the site inspections the inspector is required to keep documentation of
all inspections and BMP maintenance, including an updated Site Map indicating new BMP's or the removal of BMP's since the previous inspection.

Any maintenance, repair, or necessary installation of BMP's that are noted during the inspection must be completed within seven (7) calendar days from the date of the inspection

6. CONCLUSIONS

6.1 Compliance with Standards

All computations that have been completed within this report are in compliance with the "City of Fort Collins Erosion Control Reference Manual for Construction Sites", the "City of Fort Collins Storm Drainage Design Criteria Manual", and the "Urban Storm Drainage Criteria Manual" except where variances are requested as noted in Section 4.2 of this report.

6.2 Drainage Concept

The proposed drainage concepts presented in this report and on the construction plans adequately provide for the collection and conveyance of on-site runoff to the detention area. Conveyance elements exist to adequately convey detained runoff downstream.

If, at the time of construction, groundwater is encountered, a Colorado Department of Health Construction Dewatering Permit would be required.

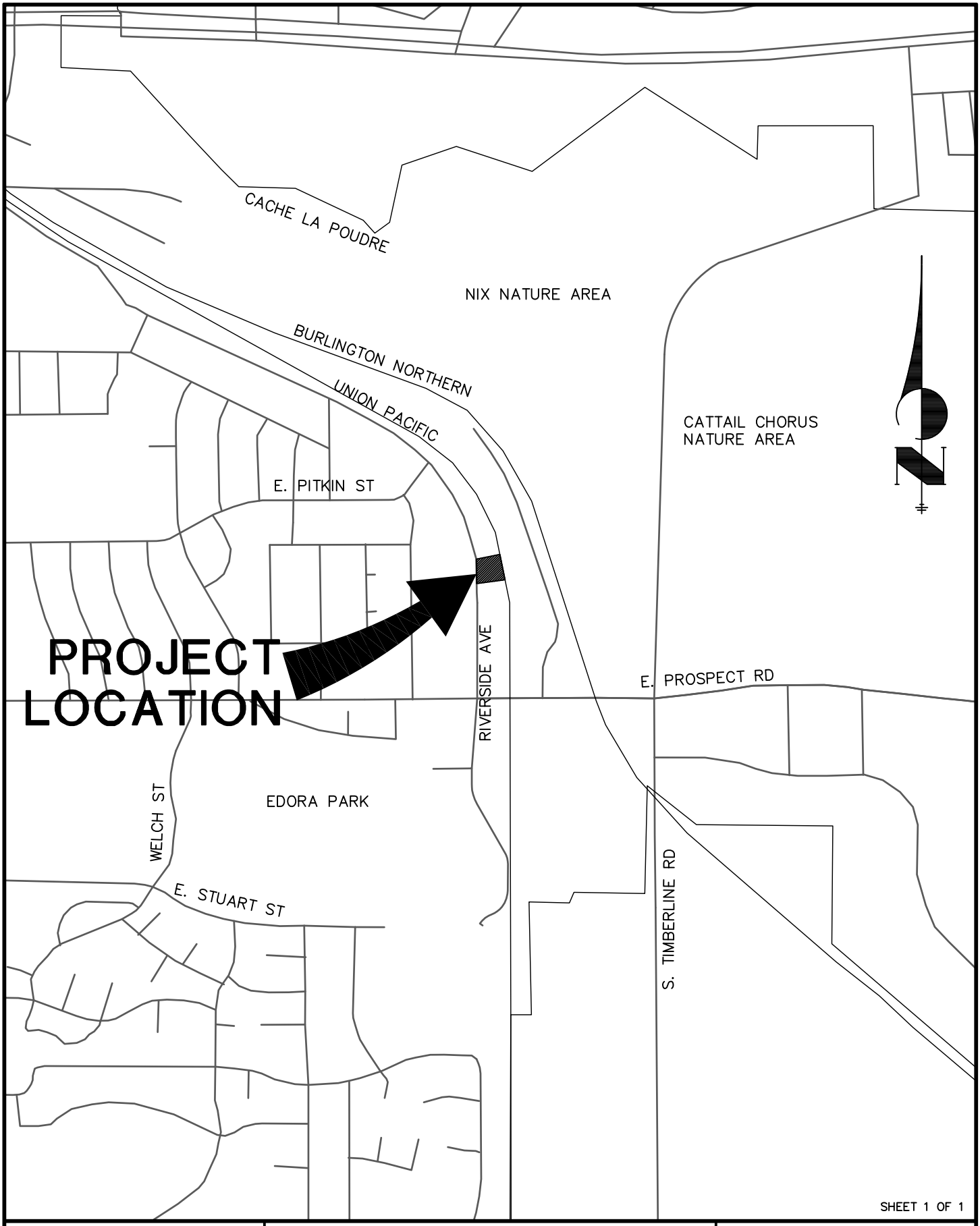
7. REFERENCES

1. City of Fort Collins, “Storm Drainage Criteria Manual”, (SDCM), dated March, 1986.

2. Urban Drainage and Flood Control District, “Urban Storm Drainage Criteria Manual”, Volumes 1 and 2, dated March, 1969, and Volume 3 dated September, 1992.

APPENDIX A

VICINITY MAP



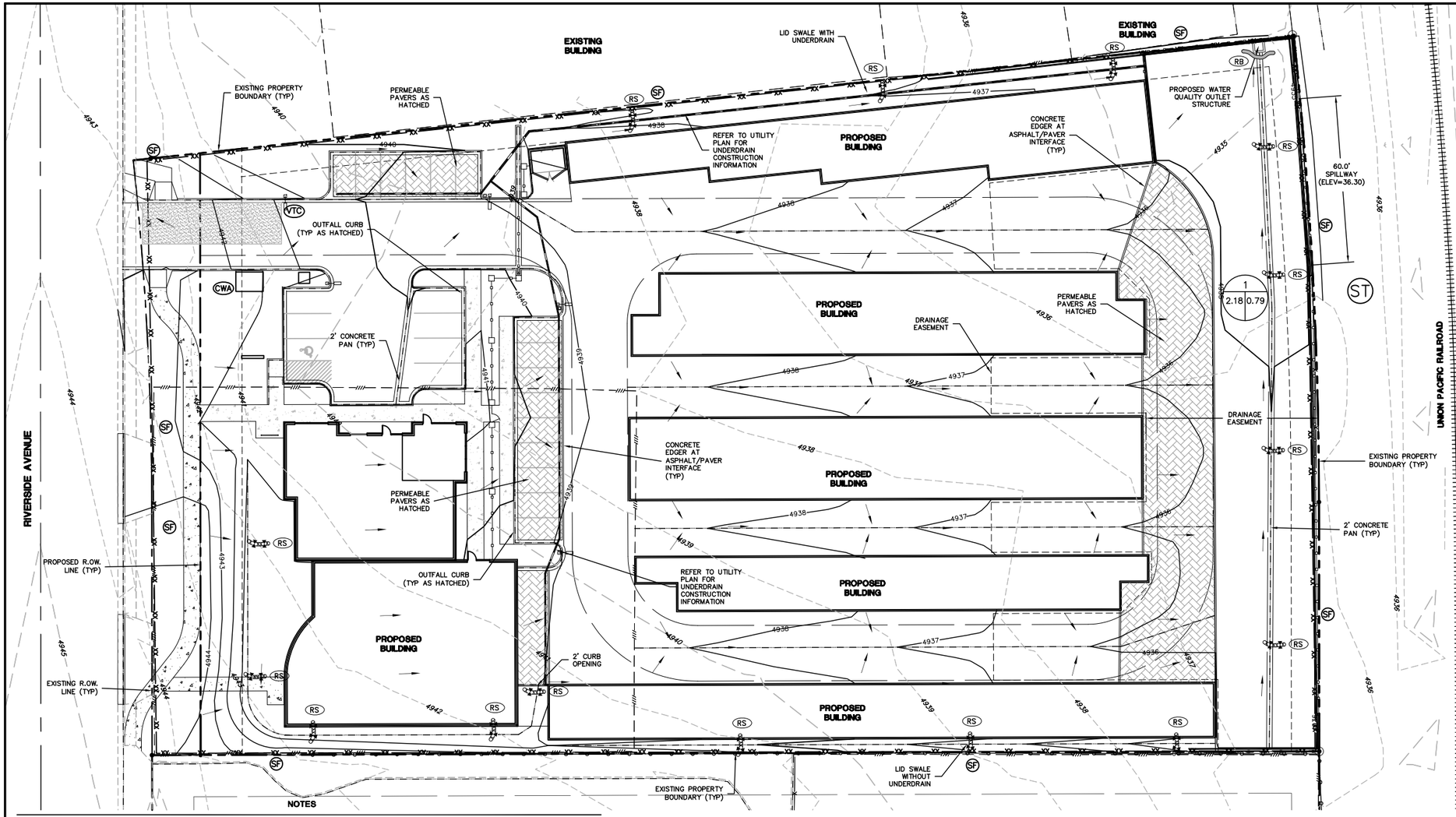
SHEET 1 OF 1

DATE:	10/10/14
SCALE:	1"=1000'
DESIGNED BY:	PPK
JOB NO.:	264-03

1640 RIVERSIDE DRIVE (RIVERSIDE STORAGE)

VICINITY MAP

North Star design, inc.
700 Automation Drive, Unit I
Windsor, Colorado 80550
Phone: 970-686-6939
Fax: 970-686-1188



20 10 0 20 40

SCALE: 1" = 20'

EROSION CONTROL NOTES:

1) The City Stormwater Department erosion control inspector must be notified at least 24 hours prior to any construction on this site.

2) All required BMPs shall be installed prior to any land disturbing activity (stockpiling, stripping, grading, etc). All of required erosion control measures must be installed at the appropriate time in the construction sequence as indicated in the approved project Xchedule, construction plans, and erosion control report.

3) Pre-disturbance vegetation shall be protected and retained wherever possible. Removal or disturbance of existing vegetation shall be limited to the area required for immediate construction operations, and for the shortest practical period of time.

4) All soils exposed during land disturbing activity (stripping, grading, utility installations, stockpiling, filling, etc.) shall be kept in a roughened condition by ripping or disking along land contours until mulch, vegetation, or other permanent erosion control is installed. No soils in areas outside project street rights of way shall remain exposed by land disturbing activity for more than thirty (30) days before required temporary or permanent erosion control (e.g. seed/mulch, landscaping, etc.) is installed, unless otherwise approved by
the Stormwater Department.

5) The property must be watered and maintained at all times during construction activities so as to prevent wind-caused erosion. All land disturbing activities shall be immediately discontinued when fugitive dust impacts adjacent properties, as determined by the City Engineering Department.

6) All temporary (structural) erosion control measures must be inspected and repaired or reconstructed as necessary after each runoff event and every 14 days in order to assure continued performance of their intended function. All retained sediments, particularly those on paved roadway surfaces, shall be removed and disposed of in a manner and location so as not to cause their release into any drainageway.

7) No soil stockpile shall exceed ten (10) feet in height. All soil stockpiles shall be protected from sediment transport by surface roughening, watering, and perimeter silt fencing. Any soil stockpile remaining after 30 days shall be seeded and mulched.

8) City Ordinance prohibits the tracking, dropping, or depositing of soils or any other material onto city streets by or from any vehicle. Any inadvertent deposited material shall be cleaned immediately by the contractor.

DETENTION POND SUMMARY	
WQ VOLUME REQUIRED	0.063 AC. FT.
100-YR DETENTION REQUIRED	0.336 AC. FT.
TOTAL 100-YEAR VOLUME PROVIDED	0.399 AC.FT.
100-YR WATER SURFACE ELEVATION	4936.31
100-YR MAXIMUM RELEASE RATE	2.0 CFS

NOTES

1. INSTALLATION OF ALL SURFACE AND UNDERGROUND WATER QUALITY AND WATER QUANTITY DETENTION SYSTEMS SHALL BE OBSERVED DURING THE TIME OF CONSTRUCTION BY THE DESIGN ENGINEER. THE DESIGN ENGINEER SHALL ENSURE THAT THE CONTRACTOR COMPLIES WITH ALL THE CONSTRUCTION NOTES SPECIFIED FOR THE DEVELOPMENT AS NOTED ON THE CONSTRUCTION DOCUMENTS AND SPECIFICALLY ADDRESSING CONSTRUCTION PRACTICES RELATED TO ALL STORMWATER APPURTENANCES AND INFRASTRUCTURE ASSOCIATED WITH THIS DEVELOPMENT.

2. CONTRACTOR SHALL NOTIFY THE DESIGN ENGINEER AND THE CITY OF FORT COLLINS STORM WATER UTILITY A MINIMUM OF ONE WEEK IN ADVANCE SO AS TO ALLOW FOR FIELD OBSERVATION AND DOCUMENTATION OF THE FOLLOWING DETENTION SYSTEM ITEMS IN THE PERMEABLE PAVER PARKING LOT:
- COMPACTION OF SUBGRADE
- INSTALLATION OF GEOTEXTILE FABRIC
- INSTALLATION OF UNDER DRAIN
- PLACEMENT AND COMPACTION OF SUB-BASE MATERIAL
- INSTALLATION OF EDGE RESTRAINT(S)
- PLACEMENT AND COMPACTION OF BASE MATERIAL
- PLACEMENT OF SETTING BED
- PLACEMENT OF UNIT PAVERS
- PLACEMENT AND SWEEPING OF JOINT FILLER

3. DETENTION STORAGE SUBGRADE AREAS ARE TO BE FIELD SURVEYED BY A LICENSED PROFESSIONAL. THE DESIGN ENGINEER MUST CONFIRM THE SUBGRADE ELEVATIONS AND DIMENSIONS, AND THE GEOTECHNICAL ENGINEER MUST CONFIRM COMPACTION, PRIOR TO PLACEMENT OF GEOTEXTILE FABRIC, SUB-BASE, OR ANY OTHER MATERIAL.

4. EDGE RESTRAINTS AND CURBS SHALL BE PROVIDED BY THE GENERAL CONTRACTOR OR THE EARTHWORK CONTRACTOR PRIOR TO PLACEMENT OF GEOTEXTILE FABRIC AND SUB-BASE.

5. INSTALLATION OF PERMEABLE INTERLOCKING CONCRETE PAVEMENT (PICP) SYSTEM SHALL FOLLOW THE GUIDELINES OF ICPI TECH SPEC NO. 1 BAND FULL ICPI SPECIFICATIONS. WORK SHALL BE PERFORMED BY A QUALIFIED CONTRACTOR. QUALIFIED CONTRACTOR SHALL MEAN AN ICPI "CERTIFIED PAVER INSTALLER" HOLDING A CURRENT PICP SPECIALIST DESIGNATION.

6. GENERAL CONTRACTOR SHALL CONVENE A PRE -CONSTRUCTION MEETING TO ENSURE THAT ALL SUBCONTRACTORS HAVE AN UNDERSTANDING OF HOW THE PICP SYSTEM IS INTENDED TO FUNCTION. CONTRACTOR SHOULD DISCUSS THE PROPOSED SEQUENCE OF CONSTRUCTION AND IDENTIFY ACTIVITIES THAT MAY REQUIRE PROTECTION OF THE PERMEABLE PAVEMENT
SYSTEM.

7. EXCAVATION OF SUBGRADE SHALL NOT COMMENCE UNTIL AFTER THE PRE -CONSTRUCTION MEETING. PRIOR TO PLACING THE SUB-BASE AGGREGATE, THE UPPER 12 INCHES OF THE SUBGRADE MATERIALS AT THE BASE OF THE SUB-EXCAVATION SHOULD BE SCARIFIED, MOISTURE CONDITIONED, AND RECOMPACTED TO AT LEAST 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY AT MOISTURE CONTENTS WITHIN 0 TO 3 PERCENTAGE POINTS ABOVE OPTIMUM. THE GEOTECHNICAL ENGINEER SHALL OBSERVE SUBGRADE PREPARATION AND PROVIDE APPLICABLE TESTING AND REPORTING.

8. THE CONTRACTOR SHOULD PROVIDE SLACK IN GEDTEXTILE FABRIC TO ENSURE PROPER INSTALLATION AND AGGREGATE PLACEMENT WITHOUT DAMAGE. PROVIDE SUFFICIENT SLACK SO THE FABRIC IS NOT TORN WHEN ROCK IS PLACED. IF TEARS ARE SEEN OR DISCOVERED, REPAIR THEM AS RECOMMENDED BY MANUFACTURER WITH NO LESS THAN 18 INCHES OF OVERLAP ON ALL SIDES OF THE TEAR.

9. THE CONTRACTOR SHALL, AT ALL TIMES DURING AND AFTER SYSTEM INSTALLATION, PREVENT SEDIMENT, DEBRIS, AND DIRT FROM ANY SOURCE FROM ENTERING THE PERMEABLE PAVEMENT SYSTEM. LOOSE MATERIALS SHALL NOT BE STORED ON THE PERMEABLE PAVEMENT AREA. MUD AND SEDIMENT-LADEN RUNOFF SHOULD BE KEPT AWAY FROM THE PAVEMENT AREA. TEMPORARILY DIVERT RUNOFF OR INSTALL SEDIMENT CONTROL MEASURES AS NECESSARY TO REDUCE THE AMOUNT OF SEDIMENT RUN-ON TO THE PAVEMENT. SURFACE PROTECTION COULD INCLUDE COVERING AREAS OF THE PAVEMENT, PROVIDING ALTERNATIVE CONSTRUCTION VEHICLE ACCESS, AND PROVIDING EDUCATION TO ALL PARTIES WORKING ONSITE.

10. THE CONTRACTOR SHOULD CONSIDER PLACING THE WEARING COURSE AFTER FINE GRADING AND LANDSCAPING IN ADJACENT AREAS IS COMPLETE. IF THE WEARING COURSE BECOMES CLOGGED DUE TO CONSTRUCTION ACTIVITIES, CLEAN THE SURFACE WITH A VACUUM MACHINE TO RESTORE
THE INFILTRA TION RATE AFTER CONSTRUCTION IS COMPLETE.

11. CONFIRM PAVER TYPE, COLOR, AND PATTERN WITH OWNER AND LANDSCAPE ARCHITECT PRIOR TO PURCHASING.

12. CONTRACTOR SHALL PROVIDE A 2% TO 3% OVERSTOCK OF UNCUT PAVERS TO THE OWNER FOR USE IN FUTURE REPAIRS AND REPLACEMENT.

13. ALL CUT PAVERS USED MUST BE AT LEAST 40% OF THEIR FULL, UNCUT SIZE.

14. LANDSCAPE ISLAND SHALL BE EXCAVATED DOWN TO SAME SUBGRADE ELEVATIONS AS ADJACENT PAVER SECTIONS. PROVIDE SUB-BASE, GEOTEXTILE FABRIC, PEA GRAVEL, AND TOPSOIL PER SECTION B DETAIL ON THIS SHEET.

NOTES:

1. THE PROPOSED DETENTION POND SHALL BE OVEREXCAVATED AND USED AS A SEDIMENT TRAP DURING CONSTRUCTION. THE POND SHALL BE CLEANED OF SEDIMENT AND BROUGHT TO FINISHED GRADE PRIOR TO SITE CERTIFICATION.

2. THE FINISHED FLOOR ELEVATIONS SHOWN ON THE GRADING PLAN ARE THE MINIMUM ELEVATIONS REQUIRED FOR PROTECTION FROM THE 100-YEAR STORM.

3. REFER TO SHEET 2 FOR STANDARD EROSION AND SEDIMENT CONTROL CONSTRUCTION PLAN NOTES.

DRAINAGE SUMMARY TABLE							
BASIN ID	AREA (ACRES)	C2	C100	Tc (2) (MIN)	Tc (100) (MIN)	Q (2) (CFS)	Q (100) (CFS)
EXISTING	2.18	0.46	0.58	12.5	12.5	2.0	8.9
PROPOSED	2.18	0.77	0.97	9.2	6.4	3.8	18.9

LEGEND

DESIGN POINT
BASIN ID
2-YR RUNOFF COEFFICIENT
AREA IN ACRES
FLOW DIRECTION
SILT FENCE
VEHICLE TRACKING CONTROL PAD
CONCRETE WASHOUT AREA
ROCK SOCK
INLET PROTECTION
ROCK BERM
PROPERTY BOUNDARY
RIGHT-OF-WAY
ADJACENT PROPERTY LINE
EASEMENT LINE
EXISTING 1' CONTOURS
EXISTING 5' CONTOURS
PROPOSED 1' CONTOURS
PROPOSED 5' CONTOURS
PROPOSED 2' CONCRETE PAN
PROPOSED DRAINAGE PIPE
EXISTING DRAINAGE PIPE
PROPOSED BASIN BOUNDARY
RIPRAP

CONSTRUCTION SEQUENCE

PROJECT: RIVERSIDE STORAGE DATE: 6/20/14

CONSTRUCTION PHASE (MONTH)	1	2	3	4	5	6	7	8	9	10	11	12
GRADING (INCLUDES OVERLOT)												
OVERLOT												
DETENTION / WQ PONDS												
SWALES, DRAINAGEWAYS, STREAMS												
PIPELINE INSTALLATION (INCLUDES OFFSITE)												
WATER												
SAINITARY SEWER												
STORM SEWER												
CONCRETE INSTALLATION (INCLUDES OFFSITE)												
AREA INLETS												
CURB INLETS												
POND OUTLET STRUCTURES												
CURB AND GUTTER												
PAVEMENT INSTALLTATION												
FINE GRADING / BASE COURSE INSTALL												
PAVEMENT												
BEST MANAGEMENT PRACTICES												
STRUCTURAL												
SILT FENCE BARRIERS												
CONTOUR FURROWS (RIPPING/DISKING)												
SEDIMENT TRAP / FILTER												
VEHICLE TRACKING PADS												
FLOW BARRIERS (WATTLES, ETC)												
CONCRETE WASHOUT												
ROCK SOCKS												
BARE SOIL PREPARATION												
TERRACING												
RIPRAP												
VEGETATIVE												
TEMPORARY SEED PLANTING												
MULCHING / SEALANT												
PERMANENT SEED PLANTING												
SOD INSTALLATION												
NETTING/BLANKETS/MATS												

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

City of Fort Collins, Colorado
UTILITY PLAN APPROVAL

APPROVED: _____ City Engineer _____ Date
CHECKED BY: _____ Water & Wastewater Utility _____ Date
CHECKED BY: _____ Stormwater Utility _____ Date
CHECKED BY: _____ Parks & Recreation _____ Date
CHECKED BY: _____ Traffic Engineer _____ Date
CHECKED BY: _____ Date

North Star design, inc.
700 Automation Drive, Unit I
Windsor, Colorado 80550
Phone: 970-686-6939
Fax: 970-686-1188

No.	REVISION	BY	DATE

Date: 9/30/14
Scale: 1"=20'
Designed by: PPK
Drawn by: PPK

COLORADO REGISTERED PATRICIA K. PROBERT 37966 PRELIMINARY NOT TO BE USED FOR CONSTRUCTION, BIDDING OR PERMIT PURPOSES. THIS PLAN WAS PREPARED UNDER THE PERSONAL SUPERVISION AND CERTIFIED TO BY A DULY REGISTERED PROFESSIONAL ENGINEER

FIRST REPLAT OF PROSPECT RIVERSIDE SUBDIVISON (RIVERSIDE STORAGE)
DRAINAGE & EROSION CONTROL PLAN

SHEET 5
5 OF 8

Job No. 264-03

APPENDIX B

HYDROLOGIC COMPUTATIONS

North Star Design, Inc.
700 Automation Drive, Unit I
Windsor, CO 80550

RUNOFF COEFFICIENTS & % IMPERVIOUS

LOCATION: First Replat of Prospect Riverside Subdivision
PROJECT NO: 264-03
COMPUTATIONS BY: ppk
DATE: 10/16/2014

Recommended Runoff Coefficients from Table 3-3 of City of Fort Collins Design Criteria
Recommended % Impervious from Urban Storm Drainage Criteria Manual

	% Impervious	Runoff coefficient C
Streets, parking lots (asphalt):	100%	0.95
Sidewalks:	96%	0.95
Gravel:	40%	0.50
Roofs:	90%	0.95
Lawns (flat <2%, heavy soil):	0%	0.20

SUBBASIN DESIGNATION	TOTAL AREA (ac.)	TOTAL AREA (sq.ft)	ROOF AREA (sq.ft)	PAVED AREA (sq.ft)	SIDEWALK AREA (sq.ft)	GRAVEL AREA (sq.ft)	LANDSCAPE AREA (sq.ft)	% Impervious	RUNOFF COEFF. (C)
Existing	2.18	95,094	0	17,700	0	19,530	57,864	30%	0.46
Proposed	2.18	95,094	31,743	38,365	1,763	0	23,223	72%	0.77

Equations

- Calculated C coefficients & % Impervious are area weighted

$C = \Sigma (Ci\ Ai) / At$

Ci = runoff coefficient for specific area, Ai
Ai = areas of surface with runoff coefficient of Ci
n = number of different surfaces to consider
At = total area over which C is applicable; the sum of all Ai's

North Star Design, Inc.
700 Automation Drive, Unit I
Windsor, CO 80550

STANDARD FORM SF-2

TIME OF CONCENTRATION - 2 YEAR

LOCATION: First Replat of Prospect Riverside Subdivision
PROJECT NO: 264-03
COMPUTATIONS BY: ppk
DATE: 10/16/2014

2-yr storm *Cf = 1.00*

SUB-BASIN DATA			INITIAL /OVERLAND TIME (ti)				TRAVEL TIME / GUTTER OR CHANNEL FLOW (tt)						tc CHECK (URBANIZED BASIN)		FINAL tc	REMARKS
DESIGN POINT	SUBBASIN(s) (1)	Area (ac) (2)	C (3)	Length (ft) (4)	Slope (%) (5)	ti (min) (6)	Length (ft) (7)	Slope (%) (8)	n Manning rough.	Vel. (ft/s) (9)	tt (min) (10)	tc = ti + tt (11)	Total L (ft) (12)	tc=(l/180)+10 (min) (13)	(min) (14)	
1	Existing	2.18	0.46	225	2.8	12.2	225	1.6	0.030	1.4	2.77	15.0	450	12.5	12.5	
1	Proposed	2.18	0.77	66	1.0	4.9	406	0.6	0.016	1.6	4.35	9.2	472	12.6	9.2	

EQUATIONS:

$tc = ti + tt$

$ti = [1.87 (1.1 - CC_f) L^{0.5}] / S^{1/3}$

tt = L/Vel. Velocity from Manning's Equation with R=0.1 (corresponds to Figure 3-3 of City of Fort Collins Design Manual)

final tc = minimum of ti + tt and urbanized basin check
min. tc = 5 minutes

North Star Design, Inc.
700 Automation Drive, Unit I
Windsor, CO 80550

STANDARD FORM SF-2

TIME OF CONCENTRATION - 100 YR

LOCATION: First Replat of Prospect Riverside Subdivision
PROJECT NO: 264-03
COMPUTATIONS BY: ppk
DATE: 10/16/2014

100-yr storm *Cf = 1.25*

SUB-BASIN DATA			INITIAL /OVERLAND TIME (ti)					TRAVEL TIME / GUTTER OR CHANNEL FLOW (tt)						tc CHECK (URBANIZED BASIN)		FINAL tc	REMARKS
DESIGN POINT	SUBBASIN(s) (1)	Area (ac) (2)	C (3)	C*Cf	Length (ft) (4)	Slope (%) (5)	ti (min) (6)	Length (ft) (7)	Slope (%) (8)	n Manning rough.	Vel. (ft/s) (9)	tt (min) (10)	tc = ti + tt (11)	Total L (ft) (12)	tc=(l/180)+10 (min) (13)	(min) (14)	
1	Existing	2.18	0.46	0.58	225	2.8	10.0	225	1.6	0.030	1.4	2.77	12.8	450	12.5	12.5	
1	Proposed	2.18	0.77	0.96	66	1.0	2.1	406	0.6	0.016	1.6	4.35	6.4	472	12.6	6.4	

EQUATIONS:

$tc = ti + tt$

$ti = [1.87 (1.1 - CC_f) L^{0.5}] / S^{1/3}$

tt = L/Vel. Velocity from Manning's Equation with R=0.1 (corresponds to Figure 3-3 of City of Fort Collins Design Manual)

final tc = minimum of ti + tt and urbanized basin check
min. tc = 5 minutes

North Star Design, Inc.
700 Automation Drive, Unit I
Windsor, CO 80550

RATIONAL METHOD PEAK RUNOFF
(2-YEAR)

LOCATION: First Replat of Prospect Riverside Subdivision
PROJECT NO: 264-03
COMPUTATIONS BY: ppk
DATE: ########

2-yr storm, Cf = 1.00

	DIRECT RUNOFF						CARRY OVER		TOTAL	REMARKS
Design Point	Tributary Sub-basin	A (ac)	C*Cf	tc (min)	i (new) (in/hr)	Q (2) (cfs)	from Design Point	Q (2) (cfs)	Q(2)tot (cfs)	
1	Existing	2.18	0.46	12.5	2.02	2.0			2.0	Allowable pond release
1	Proposed	2.18	0.77	9.2	2.28	3.8			3.8	

$Q = C_f C iA$

Q = peak discharge (cfs)
C = runoff coefficient
C_f = frequency adjustment factor
i = rainfall intensity (in/hr) from IDF curve
A = drainage area (acres)

North Star Design, Inc.
700 Automation Drive, Unit I
Windsor, CO 80550

RATIONAL METHOD PEAK RUNOFF
(100-YEAR)

LOCATION: First Replat of Prospect Riverside Subdivision
PROJECT NO: 264-03
COMPUTATIONS BY: ppk
DATE: ########

100-yr storm, Cf = 1.25

	DIRECT RUNOFF						CARRY OVER		TOTAL	REMARKS
Des. Point	Area Design.	A (ac)	C*Cf	tc (min)	i (new) (in/hr)	Q (100) (cfs)	from Design Point	Q (100) (cfs)	Q(100)tot (cfs)	
1	Existing	2.18	0.58	12.5	7.03	8.9			8.9	
1	Proposed	2.18	0.96	6.4	9.04	18.9			18.9	

Q = C iA

Q = peak discharge (cfs)
C = runoff coefficient
I = rainfall intensity (in/hr) from IDF curve
A = drainage area (acres)

APPENDIX C

DETENTION POND SIZING CALCULATIONS

Detention Pond Outlet Sizing

(100 yr event)

LOCATION: First Replat of Prospect Riverside Subdivision
PROJECT NO: 264-02
COMPUTATIONS BY: PPK
SUBMITTED BY: North Star Design, Inc.
DATE: ########

Submerged Orifice Outlet:
release rate is described by the orifice equation,

$$Q_o = C_o A_o \text{ sqrt}(2g(h-E_o))$$

where
Q_o = orifice outflow (cfs)
C_o = orifice discharge coefficient
g = gravitational acceleration = 32.2 ft/s
A_o = effective area of the orifice (ft^2)
E_o = greater of geometric center elevation of the orifice or d/s HGL (ft)
h = water surface elevation (ft)

Q_o =	2.0	cfs
outlet pipe dia = D =	12.0	in
Invert elev. =	4934.30	ft
E_o =	4934.63	ft
h =	4936.10	ft - 100 yr WSEL
C_o =	0.62	

solve for effective area of orifice using the orifice equation

A_o =	0.331	ft^2
=	47.7	in^2
orifice dia. = d =	7.79	in

Check orifice discharge coefficient using Figure 5-21 (*Hydraulic Engineering*)

d / D =	0.65	
kinematic viscosity, u =	1.22E-05	ft^2/s
Reynolds no. = Re_d = 4Q/(pdu) =	3.21E+05	
C_o = (K in figure) =	0.62	check

Use d =	***7.80***	***in***		
A_o =	*0.332*	*ft^2 =*	*47.78*	*in^2*
Q_{max} =	*2.0*	*cfs*		

DETENTION VOLUME BY THE MODIFIED FAA METHOD

Project: Riverside storage

Basin ID: 1

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)
(NOTE: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

Determination of MINOR Detention Volume Using Modified FAA Method

Design Information (Input):

Catchment Drainage Imperviousness	I_a =	72.00	percent
Catchment Drainage Area	A =	2.180	acres
Predevelopment NRCS Soil Group	Type =	C	A, B, C, or D
Return Period for Detention Control	T =	10	years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	Tc =	9	minutes
Allowable Unit Release Rate	q =	0.92	cfs/acre
One-hour Precipitation	P_1 =	1.61	inches
Design Rainfall IDF Formula $i = C_1 * P_1/(C_2+T_c)^{C_3}$			
Coefficient One	C_1 =	28.50	
Coefficient Two	C_2 =	10	
Coefficient Three	C_3 =	0.789	

Determination of Average Outflow from the Basin (Calculated):

Runoff Coefficient	C =	0.59	
Inflow Peak Runoff	Qp-in =	5.73	cfs
Allowable Peak Outflow Rate	Qp-out =	**2.01**	cfs
Mod. FAA Minor Storage Volume =		3,507	**cubic feet**
Mod. FAA Minor Storage Volume =		**0.081**	**acre-ft**

5 <- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)

Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume acre-feet (output)	Adjustment Factor "m" (output)	Average Outflow cfs (output)	Outflow Volume acre-feet (output)	Storage Volume acre-feet (output)
5	5.42	0.048	1.00	2.01	0.014	0.034
10	4.32	0.076	0.96	1.93	0.027	0.050
15	3.62	0.096	0.81	1.62	0.033	0.063
20	3.13	0.111	0.73	1.46	0.040	0.071
25	2.78	0.123	0.68	1.37	0.047	0.076
30	2.50	0.133	0.65	1.31	0.054	0.079
35	2.28	0.141	0.63	1.27	0.061	0.080
40	2.09	0.148	0.62	1.23	0.068	0.081
45	1.94	0.155	0.60	1.21	0.075	0.080
50	1.81	0.161	0.59	1.19	0.082	0.079
55	1.70	0.166	0.58	1.17	0.089	0.077
60	1.61	0.171	0.58	1.16	0.096	0.075
65	1.52	0.175	0.57	1.14	0.102	0.073
70	1.45	0.179	0.57	1.13	0.109	0.070
75	1.38	0.183	0.56	1.13	0.116	0.067
80	1.32	0.187	0.56	1.12	0.123	0.064
85	1.26	0.190	0.55	1.11	0.130	0.060
90	1.21	0.193	0.55	1.11	0.137	0.056
95	1.17	0.196	0.55	1.10	0.144	0.052
100	1.12	0.199	0.55	1.10	0.151	0.048
105	1.09	0.202	0.54	1.09	0.158	0.044
110	1.05	0.205	0.54	1.09	0.165	0.040
115	1.02	0.207	0.54	1.08	0.172	0.036
120	0.99	0.210	0.54	1.08	0.178	0.031
125	0.96	0.212	0.54	1.08	0.185	0.027
130	0.93	0.214	0.54	1.07	0.192	0.022
135	0.90	0.216	0.53	1.07	0.199	0.017
140	0.88	0.218	0.53	1.07	0.206	0.012
145	0.86	0.220	0.53	1.07	0.213	0.007
150	0.84	0.222	0.53	1.06	0.220	0.002
155	0.82	0.224	0.53	1.06	0.227	-0.003
160	0.80	0.226	0.53	1.06	0.234	-0.008
165	0.78	0.228	0.53	1.06	0.241	-0.013
170	0.76	0.230	0.53	1.06	0.248	-0.018
175	0.75	0.231	0.53	1.06	0.254	-0.023
180	0.73	0.233	0.53	1.05	0.261	-0.028
185	0.72	0.235	0.52	1.05	0.268	-0.034
190	0.70	0.236	0.52	1.05	0.275	-0.039
195	0.69	0.238	0.52	1.05	0.282	-0.044
200	0.68	0.239	0.52	1.05	0.289	-0.050
205	0.66	0.241	0.52	1.05	0.296	-0.055
210	0.65	0.242	0.52	1.05	0.303	-0.061
215	0.64	0.244	0.52	1.05	0.310	-0.066
220	0.63	0.245	0.52	1.04	0.317	-0.072
225	0.62	0.246	0.52	1.04	0.323	-0.077
230	0.61	0.248	0.52	1.04	0.330	-0.083
235	0.60	0.249	0.52	1.04	0.337	-0.088
240	0.59	0.250	0.52	1.04	0.344	-0.094
245	0.58	0.251	0.52	1.04	0.351	-0.100
250	0.57	0.253	0.52	1.04	0.358	-0.105
255	0.56	0.254	0.52	1.04	0.365	-0.111
260	0.55	0.255	0.52	1.04	0.372	-0.117
265	0.55	0.256	0.52	1.04	0.379	-0.122
270	0.54	0.257	0.52	1.04	0.386	-0.128
275	0.53	0.259	0.52	1.04	0.393	-0.134
280	0.52	0.260	0.52	1.04	0.399	-0.140
285	0.52	0.261	0.52	1.04	0.406	-0.146
290	0.51	0.262	0.52	1.03	0.413	-0.151
295	0.50	0.263	0.52	1.03	0.420	-0.157
300	0.50	0.264	0.52	1.03	0.427	-0.163
305	0.49	0.265	0.52	1.03	0.434	-0.169

Mod. FAA Minor Storage Volume (cubic ft.) = 3,507
Mod. FAA Minor Storage Volume (acre-ft.) = 0.0805

Determination of MAJOR Detention Volume Using Modified FAA Method

Design Information (Input):

Catchment Drainage Imperviousness	I_a =	72.00	percent
Catchment Drainage Area	A =	2.180	acres
Predevelopment NRCS Soil Group	Type =	C	A, B, C, or D
Return Period for Detention Control	T =	100	years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	Tc =	9	minutes
Allowable Unit Release Rate	q =	0.92	cfs/acre
One-hour Precipitation	P_1 =	2.61	inches
Design Rainfall IDF Formula $i = C_1 * P_1/(C_2+T_c)^{C_3}$			
Coefficient One	C_1 =	28.50	
Coefficient Two	C_2 =	10	
Coefficient Three	C_3 =	0.789	

Determination of Average Outflow from the Basin (Calculated):

Runoff Coefficient	C =	0.69	
Inflow Peak Runoff	Qp-in =	10.87	cfs
Allowable Peak Outflow Rate	Qp-out =	**2.01**	cfs
Mod. FAA Major Storage Volume =		10,059	**cubic feet**
Mod. FAA Major Storage Volume =		**0.231**	**acre-ft**

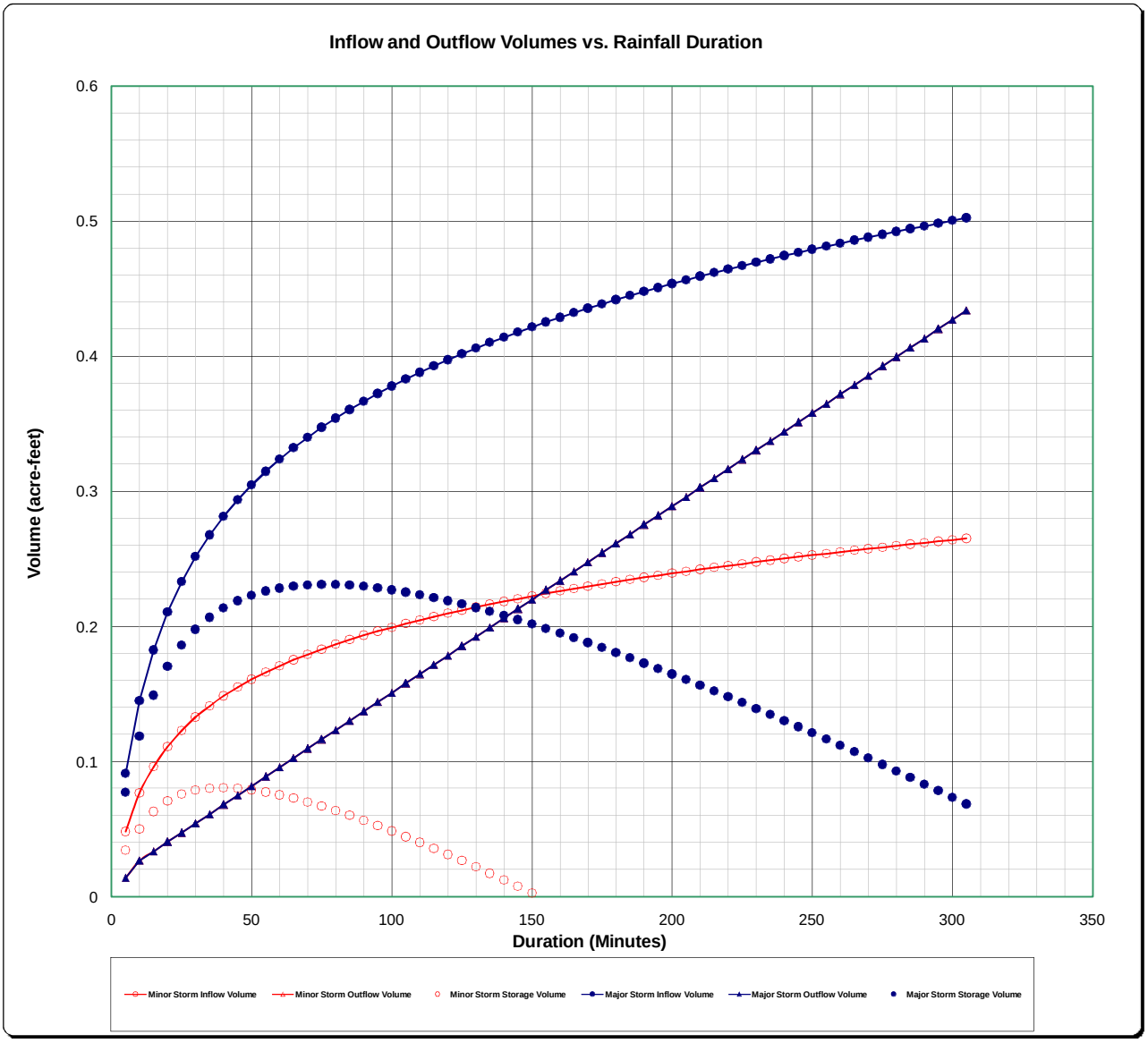
Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume acre-feet (output)	Adjustment Factor "m" (output)	Average Outflow cfs (output)	Outflow Volume acre-feet (output)	Storage Volume acre-feet (output)
5	8.78	0.091	1.00	2.01	0.014	0.077
10	7.00	0.145	0.96	1.93	0.027	0.118
15	5.87	0.182	0.81	1.62	0.033	0.149
20	5.08	0.211	0.73	1.46	0.040	0.170
25	4.50	0.233	0.68	1.37	0.047	0.186
30	4.05	0.252	0.65	1.31	0.054	0.198
35	3.69	0.268	0.63	1.27	0.061	0.207
40	3.40	0.281	0.62	1.23	0.068	0.214
45	3.15	0.294	0.60	1.21	0.075	0.219
50	2.94	0.305	0.59	1.19	0.082	0.223
55	2.76	0.315	0.58	1.17	0.089	0.226
60	2.60	0.324	0.58	1.16	0.096	0.228
65	2.47	0.332	0.57	1.14	0.102	0.230
70	2.34	0.340	0.57	1.13	0.109	0.231
75	2.23	0.347	0.56	1.13	0.116	0.231
80	2.14	0.354	0.56	1.12	0.123	0.231
85	2.05	0.360	0.55	1.11	0.130	0.230
90	1.97	0.367	0.55	1.11	0.137	0.229
95	1.89	0.372	0.55	1.10	0.144	0.228
100	1.82	0.378	0.55	1.10	0.151	0.227
105	1.76	0.383	0.54	1.09	0.158	0.225
110	1.70	0.388	0.54	1.09	0.165	0.223
115	1.65	0.393	0.54	1.08	0.172	0.221
120	1.60	0.397	0.54	1.08	0.178	0.219
125	1.55	0.402	0.54	1.08	0.185	0.216
130	1.51	0.406	0.54	1.07	0.192	0.214
135	1.47	0.410	0.53	1.07	0.199	0.211
140	1.43	0.414	0.53	1.07	0.206	0.208
145	1.39	0.418	0.53	1.07	0.213	0.205
150	1.36	0.422	0.53	1.06	0.220	0.202
155	1.32	0.425	0.53	1.06	0.227	0.198
160	1.29	0.429	0.53	1.06	0.234	0.195
165	1.26	0.432	0.53	1.06	0.241	0.191
170	1.24	0.435	0.53	1.06	0.248	0.188
175	1.21	0.439	0.53	1.06	0.254	0.184
180	1.18	0.442	0.53	1.05	0.261	0.180
185	1.16	0.445	0.52	1.05	0.268	0.177
190	1.14	0.448	0.52	1.05	0.275	0.173
195	1.12	0.451	0.52	1.05	0.282	0.169
200	1.09	0.454	0.52	1.05	0.289	0.165
205	1.07	0.456	0.52	1.05	0.296	0.160
210	1.06	0.459	0.52	1.05	0.303	0.156
215	1.04	0.462	0.52	1.05	0.310	0.152
220	1.02	0.464	0.52	1.04	0.317	0.148
225	1.00	0.467	0.52	1.04	0.323	0.143
230	0.99	0.469	0.52	1.04	0.330	0.139
235	0.97	0.472	0.52	1.04	0.337	0.135
240	0.95	0.474	0.52	1.04	0.344	0.130
245	0.94	0.477	0.52	1.04	0.351	0.126
250	0.92	0.479	0.52	1.04	0.358	0.121
255	0.91	0.481	0.52	1.04	0.365	0.116
260	0.90	0.484	0.52	1.04	0.372	0.112
265	0.88	0.486	0.52	1.04	0.379	0.107
270	0.87	0.488	0.52	1.04	0.386	0.102
275	0.86	0.490	0.52	1.04	0.393	0.098
280	0.85	0.492	0.52	1.04	0.399	0.093
285	0.84	0.494	0.52	1.04	0.406	0.088
290	0.83	0.496	0.52	1.03	0.413	0.083
295	0.82	0.498	0.52	1.03	0.420	0.078
300	0.81	0.500	0.52	1.03	0.427	0.073
305	0.79	0.502	0.52	1.03	0.434	0.068

Mod. FAA Major Storage Volume (cubic ft.) = 10,059
Mod. FAA Major Storage Volume (acre-ft.) = 0.2309

DETENTION VOLUME BY THE MODIFIED FAA METHOD

Project: Riverside storage

Basin ID: 1



STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project: Riverside Storage

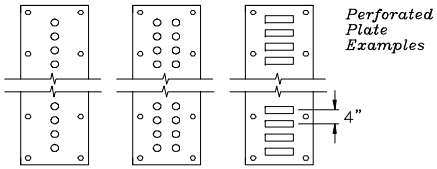
Basin ID: 1

WQCV Design Volume (Input):

Catchment Imperviousness, I_a =	72.0	percent			
Catchment Area, A =	2.18	acres	Diameter of holes, D =	0.562	inches
Depth at WQCV outlet above lowest perforation, H =	1	feet	Number of holes per row, N =	1	
Vertical distance between rows, h =	4.00	inches		**OR**	
Number of rows, NL =	3.00				
Orifice discharge coefficient, C_o =	0.62		Height of slot, H =		inches
Slope of Basin Trickle Channel, S =	0.005	ft / ft	Width of slot, W =		inches
Time to Drain the Pond =	40	hours			

Watershed Design Information (Input):

Percent Soil Type A =		%
Percent Soil Type B =	0	%
Percent Soil Type C/D =	100	%



Outlet Design Information (Output):

Water Quality Capture Volume, WQCV =	0.346	watershed inches
Water Quality Capture Volume (WQCV) =	0.063	acre-feet
Design Volume (WQCV / 12 * Area * 1.2) Vol =	**0.075**	**acre-feet**
Outlet area per row, Ao =	0.25	square inches
Total opening area at each row based on user-input above, Ao =	0.25	square inches
Total opening area at each row based on user-input above, Ao =	0.002	square feet

3

	Central Elevations of Rows of Holes in feet																							Σ Flow
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20	Row 21	Row 22	Row 23	
	34.04	34.37	34.71																					
	Collection Capacity for Each Row of Holes in cfs																							
34.05	0.0009	0.0000	0.0000																					**0.00**
34.15	0.0028	0.0000	0.0000																					**0.00**
34.25	0.0039	0.0000	0.0000																					**0.00**
34.35	0.0048	0.0000	0.0000																					**0.00**
34.45	0.0055	0.0024	0.0000																					**0.01**
34.55	0.0061	0.0036	0.0000																					**0.01**
34.65	0.0067	0.0045	0.0000																					**0.01**
34.75	0.0072	0.0053	0.0017																					**0.01**
34.85	0.0077	0.0059	0.0032																					**0.02**
34.95	0.0082	0.0065	0.0042																					**0.02**
35.05	0.0086	0.0071	0.0050																					**0.02**
35.15	0.0090	0.0076	0.0057																					**0.02**
35.25	0.0094	0.0080	0.0063																					**0.02**
35.35	0.0098	0.0085	0.0069																					**0.03**
35.45	0.0102	0.0089	0.0074																					**0.03**
35.55	0.0105	0.0093	0.0079																					**0.03**
35.65	0.0109	0.0097	0.0083																					**0.03**
35.75	0.0112	0.0101	0.0088																					**0.03**
35.85	0.0115	0.0104	0.0092																					**0.03**
35.95	0.0119	0.0108	0.0096																					**0.03**
	#N/A	#N/A	#N/A																					**#N/A**
	#N/A	#N/A	#N/A																					**#N/A**
	#N/A	#N/A	#N/A																					**#N/A**
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	#N/A	#N/A	#N/A																					**#N/A**
	#N/A	#N/A	#N/A																					**#N/A**
	#N/A	#N/A	#N/A																					**#N/A**
	#N/A	#N/A	#N/A																					**#N/A**
	Override Area Row 1	Override Area Row 2	Override Area Row 3	Override Area Row 4	Override Area Row 5	Override Area Row 6	Override Area Row 7	Override Area Row 8	Override Area Row 9	Override Area Row 10	Override Area Row 11	Override Area Row 12	Override Area Row 13	Override Area Row 14	Override Area Row 15	Override Area Row 16	Override Area Row 17	Override Area Row 18	Override Area Row 19	Override Area Row 20	Override Area Row 21	Override Area Row 22	Override Area Row 23	Override Area Row 24	

STAGE - STORAGE TABLE
(100-YEAR)

LOCATION: First Replat of Prospect Riverside Subdivision
PROJECT NO: 264-02
COMPUTATIONS BY: PPK
SUBMITTED BY: North Star Design, Inc.
DATE: 8/1/2008

100 yr Detention Volume Required = 0.231
Water Quality Volume Required = 0.075
Total Volume Required= 0.306

	Stage (ft)	Surface Area (ft^2)	Incremental Storage (ac-ft)	Total Storage (ac-ft)
	4934.30	0		
	4935.0	7,850	0.042	0.04
WQCV	**4935.17**	**8,801**	**0.032**	**0.075**
	4936.0	13,442	0.242	0.284
100 WSEL	**4936.10**	**15,105**	**0.033**	**0.316**
	4937.0	30,070	0.487	0.770

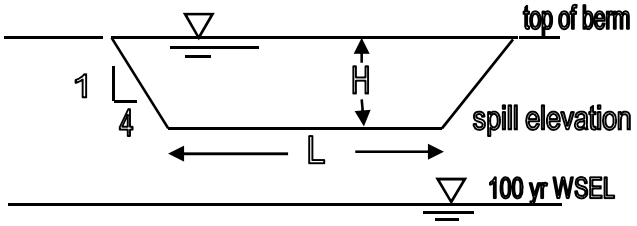
Emergency Overflow Spillway Sizing

LOCATION: First Replat of Prospect Riverside Subdivision
PROJECT NO: 264-02
COMPUTATIONS BY: PPK
SUBMITTED BY: North Star Design, Inc.
DATE: 5/24/2005

Equation for flow over a broad crested weir

$Q = CLH^{3/2}$

where C = weir coefficient = 2.8
H = overflow height
L = length of the weir



The pond has a spill elevation 0 ft above the maximum water surface elevation in the pond
Spillways will be designed with 0.25 ft flow depth, thus H = 0.25 ft
Size the spillway assuming that the pond outlet is completely clogged.

Q (100) =	18.9	cfs			
Spill elev =	4936.35	ft	100 yr WSEL =	4936.10	ft
Top of berm elev.=	4937.00				

Weir length required:

L =	54	ft
Use L =	***55***	***ft***

v = 1.20 ft/s

APPENDIX D

BMP SCHEDULE & COST ESTIMATE

CONSTRUCTION SEQUENCE

PROJECT: RIVERSIDE STORAGE DATE: 10/10/14

CONSTRUCTION PHASE (MONTH)	1	2	3	4	5	6	7	8	9	10	11	12
GRADING (INCLUDES OVERLOT)												
OVERLOT	■	■										
DETENTION / WQ PONDS	■	■										
SWALES, DRAINAGEWAYS, STREAMS												
PIPELINE INSTALLATION (INCLUDES OFFSITE)												
WATER		■										
SAINITARY SEWER		■										
STORM SEWER		■	■									
CONCRETE INSTALLATION (INCLUDES OFFSITE)												
AREA INLETS												
CURB INLETS												
POND OUTLET STRUCTURES			■									
CURB AND GUTTER				■	■	■						
PAVEMENT INSTALLTATION												
FINE GRADING / BASE COURSE INSTALL					■	■						
PAVEMENT							■					
BEST MANAGEMENT PRACTICES												
STRUCTURAL												
SILT FENCE BARRIERS	■	■	■	■	■	■	■	■				
CONTOUR FURROWS (RIPPING/DISKING)												
SEDIMENT TRAP / FILTER	■	■	■	■	■	■	■	■				
VEHICLE TRACKING PADS	■	■	■	■	■	■	■					
FLOW BARRIERS (WATTLES, ETC)												
CONCRETE WASHOUT			■	■	■	■						
ROCK SOCKS	■	■	■	■	■	■	■	■	■			
BARE SOIL PREPARATION												
TERRACING												
RIPRAP				■	■							
VEGETATIVE												
TEMPORARY SEED PLANTING			■	■	■	■						
MULCHING / SEALANT			■	■	■	■						
PERMANENT SEED PLANTING							■	■				
SOD INSTALLATION							■	■				
NETTING/BLANKETS/MATS												

Example Erosion and Sediment Control Escrow/Security Calculation for The City of Fort Collins

Project: Riverside Storage **Disturbed Acres:** 2.18

BMP Amount

EROSION CONTROL BMPs	Units	Estimated Quantity	Unit Price	Total Price
Silt Fence	L.F.	1300	$3.00	$3,900.00
Rock Sock	each	15	$85.00	$1,275.00
Vehicle Tracking Control Pad	each	1	$1,500.00	$1,500.00
Concrete Washout	each	1	$1,200.00	$1,200.00
Rock Berm	each	1	$65.00	$65.00

(add all other BMPs for the site in this list)

Sub-Total:	$7,940.00
1.5 x Sub-Total:	$11,910.00
Amount of security:	***$11,910.00***

Reseeding Amount

	Total Acres x Price/acre:	$2,616.00
Unit Price of Seeding per acre: $1,200.00	Sub-Total:	$2,616.00
	1.5 x Sub-Total:	$3,924.00
	Amount to Re-seed:	***$3,924.00***

Miniumum Escrow Amount

Minimum escrow amount:	***$3,000.00***

Final Escrow Amount

Erosion Control Escrow:	***$11,910.00***

"The amount of the security must be based on one and one-half times the estimate of the cost to install the approved measures, or one and one-half times the cost to re-vegetate the disturbed land to dry land grasses based upon unit cost determined by the City's Annual Revegetation and Stabilization Bid, whichever is greater. In no instance, will the amount of security be less than one thousand five hundred dollars ($1,500) for residential development or three thousand dollars ($3,000) for commercial development"