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December 8, 2010

400168.01.02

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City of Boulder Planning and Development Services
Building Services Center
P.O. Box 791
Boulder, Colorado 80306-0791

Subject: Hogan-Pancost Development/ Annexation Review

-Revised Report Review

Introduction

This letter contains CH2M HILL's review of several reports updated in November 2010 in response to comments received from CH2M HILL (CH2M HILL, 2010) and during an October 7, 2010 conference with Boulder Creek Commons, LLC (BCC - the prospective developer), the developer's consulting engineers and resource consultants, the City of Boulder, and CH2M HILL. These reports are related to the proposed development of the Hogan Pancost property, a 22-acre parcel south of the East Boulder Community Park and Recreation Center. The parcel is broken into 2 pieces with 55th street running generally from south to north through the east third of the parcel. The main parcel west of 55th street (West Parcel) is surrounded on three sides by irrigation ditches with 55th street forming the eastern boundary. The Dry Creek Ditch No. 2 forms the western boundary for the west parcel, The Bodum Lateral forms the Southern Boundary to the west parcel and the Howard - Superphostical ditch forms the northern boundary of the west parcel. The parcel east of 55th Street is bordered on the North and west by 55th Street and bounded by South Boulder Creek to the east.

The land has be zoned in the *Boulder Valley Comprehensive Plan (BVCP)* as a class IIA area which is an area appropriate for low density residential development of 2-6 units per an acre for the parcel west of 55th Street (West Parcel) and for the parcel East of 55th street (East Parcel) appropriate for environmental preservation.

The following reports (listed below) were provided to the City of Boulder (and passed along to CH2M HILL) by the prospective developer, Boulder Creek Commons, LLC in November 2010.

Environmental and Engineering Assessment and Feasibility Study, Executive Summary, Book 1 of 4. Boulder Creek Commons, LLC. June 2010, Revised November 2010.

Environmental and Engineering Assessment and Feasibility Study, Conceptual Storm Water Management and Floodplain Mitigation Report, Book 2 of 4. Drexel, Barrell & Co. June 2010, Revised November 2010.

Groundwater Hydrology Monitoring and Wetland Delineation Report. Western Ecological Resources, Inc. May 2010, Revised November 2010.

Groundwater Evaluation. Telesto Solutions, Incorporated. June 2010, Revised November 2010.

Preliminary Subsurface Investigation. Western Soils, Inc. April 2010, Revised November 2010.

Vegetation and Wildlife Habitat Existing Conditions. Western Ecological Resource, Inc. May 2010, Revised November 2010.

Wetland Mitigation/Enhancement and Prairie and Riparian Habitat Creations. Western Ecological Resource, Inc. May 2010, Revised November 2010.

The City of Boulder requested that CH2M HILL review the resubmitted reports to verify that comments had been addressed and that the reports submitted meet the City of Boulder Regulations regarding development. These regulations are described in the *City of Boulder Design and Construction Standards, November 16, 2000* and in *The City of Boulder Revised Code (BRC) Title 9, Land Use Regulations, 1981*. These regulations spell out the requirements and design constraints that must be met to complete development within the Cities limits and include transportation design, streetscape design, tree protection, general utilities design, water design, wastewater design, stormwater design, and erosion and sediment control.

CH2M HILL was asked to provide an impartial third party review of three specific areas related to the Hogan-Pancost Development Proposal submitted by BBC, Inc. These three areas are:

1. stormwater design;
2. floodplain mitigation and design;
3. and groundwater issues.

The neighborhood surrounding the proposed property have voiced concern that development of the property could adversely affect hydrology in the area and cause increased groundwater and surface water drainage that would impact existing basements and residences. The City of Boulder also shares these concerns and has asked CH2M HILL to review the groundwater analysis completed by the developer to address these concerns.

The City of Boulder has specific regulations regarding the stormwater design and floodplain mitigation and design as laid out in the BRC and Design and Construction standards. However, there are currently no specific regulations regarding changes in groundwater as affected by construction and development. To complete the analysis of existing and proposed improvements and modeling relating to groundwater, CH2M HILL used currently acceptable engineering standards of practice to review the groundwater analysis found in the development submittal. In addition, based on concerns from surrounding

neighborhoods and at request of the City of Boulder, CH2M HILL reviewed the development submittal for the following issues :

1. negative impacts to the surrounding neighborhood;
2. wetland considerations;
3. drainage systems;
4. construction issues;
5. and the feasibility of basements.

These specific issues outlined above were reviewed in the development re-submittal to evaluate how comments were addresses regarding issues identified and evaluated in the original submittal.

Other aspects of the development plan including transportation design, streetscape design, tree protection, general utilities design, water design, wastewater design, wetlands identification and mitigation and erosion control are not included in this report. The City of Boulder has completed internal review or procured the services of additional engineering firms to complete the review for items not defined in this memorandum. Wetlands issues, impacts and mitigation were reviewed by an outside consultant. Impacts to wetlands outlined in this memorandum are specific to issues related to the potential impacts of fluctuating and changing groundwater conditions based on the proposed development.

This letter summarizes and comments on on-site issues related to wetlands, stormwater design and drainage, floodplain mitigation and soils; followed by a discussion of off-site groundwater hydrology issues that could affect the surrounding community.

Development Review Results

A comprehensive review of all submitted documents was completed between August 6, 2010 and August 20, 2010 by CH2M HILL staff. The results of that review are documented below. In response to comments received from CH2M HILL (CH2M HILL, 2010) and during an October 7, 2010 conference with Boulder Creek Commons, LLC (BCC - the prospective developer), the developer's consulting engineers and resource consultants, the City of Boulder, and CH2M HILL, the developer has resubmitted the reports with the comments addresses. Below is the review of the resubmitted reports and the verification of comment incorporation.

Storm Water Design

The following discussion presents the results of reviewing the *Hogan-Pancost Environmental and Engineering Assessment and Feasibility Study Conceptual Storm Water Management and Floodplain Mitigation Report*, May 2010 and Revised November 2010, herein referred to simply as *Report*¹.

The Report provides a conceptual overview of the proposed storm water management and mitigation impacts for a proposed development on the Hogan-Pancost Property. CH2M

¹ Unless otherwise specified, the Report is binder 2 of 4 of the submittal.

HILL reviewed the Report for concurrence with the City of Boulder Design and Construction Standards and Title 9 of the BRC.

Chapter 7 of the *City and Boulder Design and Construction Standards* (Standards) provides guidance for storm water design and design criteria for development within the City of Boulder. Below is a discussion of sections that are considered important to mention or may not have been fully covered within the Report.

Section 7.01 H specifically details the standards for developing near irrigation ditches and laterals. The proposed site is bordered on three sides by irrigation ditches. The western edge of the property is defined by the Dry Creek Ditch No. 2, the southern edge of the property is bordered by the Bodum Lateral and the north edge of the property is bordered by the Howard-Superphostical Ditch.

As noted in the initial review by CH2M HILL of the initial development reports, several issues were noted regarding Section 7.01H of the standards. These included:

- Designated rights-of-way and easements were not specifically included in the report dated June 2010,
- and written agreements from the Ditch Companies acknowledging and accepting modifications to their conveyance facilities were not included in the report dated June 2010.

The property owners have met with the Ditch Companies Board of Directors, which have reviewed the construction documents and hydraulic calculations regarding improvements to the specific ditches. During these discussions, verbal agreements have been made with the ditch companies to complete the improvements. Easements for Dry Creek Ditch No. 2 will be 30' wide and be dedicated to the Ditch Company and the City of Boulder. Easements for the Bodum lateral have yet to be determined. The geometry of each easement dedication will be shown during subsequent City Land Use Reviews and the actual dedications will be provided as part of the City's Technical Document Review application. As discussed at the October 7, 2010 meeting with the City, at this time the City has indicated that the above information satisfies the requirements of Section 7.01-H.

Section 7.02 of the standards contains a requirement that the topography datum needs to be identified. After reviewing the report from June 2010, the following comment was noted. It is not clear what the topography presented in the Report is based on. To meet the requirements of the Standards the topography needs to be in the National Geodetic Vertical Datum (NGVD 29) and clearly documented in the text.

The datum of the topography has been identified and updated in the revised report and is defined as follows:

- For NGVD 1929 Datum, add 0.4 ft to the elevations presented within the report.
- For NGVD 1988 Datum, add 3.43 ft to the elevations presented within the report.

It should be noted that the report references the NGVD 1988 Datum for the new South Boulder Creek Flood Study. It is assumed that this was meant to be the North American

Vertical Datum of 1988 (NAVD 1988 Datum). This typo, NGVD 1988 Datum, should be fixed to reference NAVD 1988 Datum in the report so that the datum is clear.

In Section 7.05-B of the Standards indicates that a 2-year storm is required to be analyzed for the hydrologic analysis and hydraulic design stormwater improvements in Single Family Residential development. Within the original report from June 2010 both the 10-and 100-year storms are used for detention sizing and sizing of the stormwater facilities. Although this is a conservative approach to stormwater sizing, an analysis of the 2-year storm needs to be included to comply with the literal recommendations of Section 7.05-B of the Standards. A waiver could be obtained to indicate acceptance by the City of the 10-year design storm.

As discussed at the October 7, 2010 meeting with the City, at this time the City has indicated that the above information satisfies the requirements of Section 7.05-B and that the minor 2-year storm will be addressed during the City's Land Use Review and Site Review Application.

During the initial review of the hydraulic calculations made for open channels, in the initial report dated June, 2010, it was noted that the hydraulic calculations for Bioswale 1 (Section 1) as found in Appendix D does not include any relevant computations for the 10-year flowrate since the flow rate is set to 0.00 cfs. The adequacy of this channel cannot be ascertained until the required calculations are completed as outlined in Section 7.07.

Upon review of the resubmitted report on November 2010, it was clarified that the bioswale will not convey flow during the 10-year storm and that the reports in Appendix D are correct.

Section 7.07-D-2-g has requirements for the horizontal curvature of all open channels and indicates that the horizontal curvature be a minimum of 50 feet or twice the top width of the proposed channel. It is difficult to determine if the channel radiuses presented on Figure 3d of the Report fall within a minimum of 50 feet or two times the channel top width. The adequacy of the channel cannot be ascertained until the required radiuses are detailed as required in section 7.07-D-2.g of the Standards.

As discussed at the October 7, 2010 meeting with the City, at this time the City has indicated that the reduced radii in the storm water channels is acceptable and the channel satisfies the requirements of Section 7.07-D-2. The radius of the channels will be addressed during the City's Land Use Review and Site Review Application and a variance will be applied for if necessary.

Floodplain Mitigation

Recently a Flood Hazard Area Delineation was completed on South Boulder Creek. The revised regulatory floodplain for this area does affect the Hogan Pancost Property so to develop the property; Title 9 of the BRC will need to be adhered to as well as FEMA regulatory standards including no-adverse impact to surrounding properties.

Sections 9-3-2 and 9-3-3 and 9-3-6 of Title 9 within the Land Use Code govern floodplains and floodplain regulations for the City of Boulder. At the conceptual stage, many of the floodplain rules and regulations do not apply for this submittal. However, the discussion

presented in the Report addresses the flooding and proposed mitigations. After review, it appears the Report complies with the requirements of the City for a Conceptual Storm Water Plan. However, Section 9-3-6.b(3) of Title 9 states:

(3) A floodplain analysis by a Colorado registered professional engineer of the flood profile, elevation, and velocity, using methodology acceptable to FEMA, including existing and anticipated uses and making a determination that the proposed construction or development will not cause a rise in the elevation of the water surface of a one hundred-year flood;

The Report proposes flood channels and detention within the property to mitigate the flooding and the effects of flooding on the property. However, an analysis of the 100-year flood was not completed to determine if the proposed improvements on the Hogan-Pancost property would cause an adverse impact on surrounding properties upstream or downstream of the property. Previous studies of the South Boulder Creek Floodplain have indicated a complicated interaction between the removal of floodplain storage and impacts to the surrounding floodplain. An understanding of the flood impacts to surrounding properties would be required to make this analysis compliant with Title 9 of the BRC.

As discussed at the October 7, 2010 meeting with the City, at this time the City has indicated that a floodplain analysis using the Regulatory MIKE FLOOD model will not be required. A conservative analysis of the flows, including flow volume, has been included in the report that conceptually addresses the storm drainage and floodplain concerns across the site. The City has indicated, in the October 7, 2010 meeting that floodplain analysis using MIKE FLOOD may be required in future submittals including the Land Use Review and Site Review applications.

On-site natural resources, drainage, groundwater and soil issues

As discussed in CH2M HILL's August 2010 review, the groundwater evaluation report was prepared to address concerns of neighbors that the proposed housing development could elevate the groundwater table and increase their use of basement sump pumps. Although the City of Boulder has stormwater and floodplain development rules, there are no explicit rules related to perturbing groundwater hydrology during development. As such, CH2M HILL evaluated the groundwater evaluation report against currently acceptable engineering standards of practice.

One of the principal conclusions from CH2M HILL's review of the June 2010 groundwater evaluation report was that authors relied heavily on professional judgment to assign flux rates for recharge, runoff, evapotranspiration, and other hydrologic processes when estimating water balances in the study area and assigning parameters to their numeric model. Telesto responded to these comments by adding a separate section to the revised report – Attachment 1: Calculations and Supporting Documentation for Parameters Used in the Analysis. This attachment provides rationale for each of the assigned flux rates used in the ground water evaluation:

- The groundwater withdrawal rate (40 gallons per minute) of resident sump pumps adjacent to the proposed development.
- Baseline pre-development recharge rates in the study area,

- Irrigation rates used to account for summer flood irrigation that was conducted on the property before 2008,
- Groundwater recharge rates from flood irrigation,
- Bioswale evapotranspiration and recharge,
- Landscape irrigation rates and recharge from landscape irrigation

The original report was also modified to include references to the new attachment at each point in the text where these rates were first discussed.

Telesto also issued a separate response –to-comment letter dated November 8, 2010 (Telesto, 2010b) that reproduced Attachment 1 but also addressed three additional CH2M HILL comments. Both Attachment 1 and the response-comment letter were further clarified in a November 30, 2010 follow-up email.

By providing additional rationale on assigned flux rates, Attachment 1 and Telesto’s response-to-comment letter generally resolve CH2M HILL’s comments on the groundwater evaluation report. Specific issues and exceptions are detailed below.

Sump Pump Withdrawals

Basement sump pumping rates were estimated based on anecdotal reports and notes provided by neighboring landowners. In the attachment, Telesto provides further support for assigning a combined pumping rate of 40 gallons per minute from resident sump pumps by providing raw questionnaire response data from the only two respondents that provided any sort of quantitative information on flow rates from their sump pumps and by describing how Telesto’s assigned rate was derived from the raw data. Note that Telesto identified a minor error in their write-up (see the November 30, 2010 email): the second quote from the questionnaires should be attributed to the resident at 250 Cimarron Way. Re-issuing a corrected Attachment 1 will resolve CH2M HILL’s comments on Sump Pump Withdrawal rates.

Baseline Pre-development Recharge Rates

This section of Attachment 1 presents support for Telesto’s assumptions that 10 percent of annual rainfall percolates to the underlying shallow groundwater aquifer in the study area. This allocation was based on simplifying assumptions that recharge only takes place during October, November, and March. No recharge is assumed for the other months because potential evapotranspiration exceeds precipitation during the summer and the ground is frozen during December, January, and February. These simplifications evoke the maxim “All models are wrong. Some models are useful.” Recharge to the groundwater table from precipitation almost certainly takes place outside the October, November, and March window, but growing season ET and winter frost depth in the study area are significant constraints on recharge. Telesto’s allocations to balance annual precipitation in the study area are not unreasonable and result in a recharge rate that is estimated at 3.3 percent of annual precipitation. This budget reveals conservatism in their 90/10 split between recharge and other pathways used in their groundwater model. Note that Telesto provided additional clarification in their November 30th email (Attached to letter) that was needed to reproduce their calculations. Re-issuing a clarified Attachment 1 that explicitly states the amount of mean precipitation that takes place between December and February will resolve CH2M HILL’s comments on recharge rates from precipitation. There is currently some

discrepancy in this value – the text (page 5) and Table 1 of the report cite 7.4 inches of precipitation during the winter, but calculations in Section 1.2 of Attachment 1 use 7.7 inches. The report needs to use a consistent value throughout.

Flood Irrigation Rates

No comments.

Recharge Rates for Flood Irrigation

No comments.

Bioswale ET and Recharge Rate

Recharge to groundwater from bioswales in the proposed development was estimated by performing a winter- and summer-season water balance on water entering these features. Telesto's accounting is reasonable, but the table in Attachment 1 could be clearer by including intermediate calculations used to derive the total amount of recharge that takes place during a season. Telesto should additionally present these fluxes in units of gallons per minute, the unit that was adopted throughout the text and in tables 2 and 3 of the report and feet per day as was used throughout Appendix A. The winter and summer bioswale recharge rates derived in Attachment 1 should match with values used in Table 3 of the report.

In their supporting documentation, Telesto indicates that the MODFLOW model was modified to represent the locations of bioswales on the proposed development and that additional model runs predict a 2.0 gallon per minute drop in sump pump rates between pre-development and post-development scenarios. This difference is less than the 4.3 gallon per minute noted in the conclusion of Appendix A (page A-9).

Landscape Irrigation Rates

No comments.

Response to CH2M HILL specific comment #1

See discussion of Telesto's Bioswale ET and Recharge Rate analysis.

Response to CH2M HILL specific comment #2

Flood irrigation represents a reasonable baseline scenario provided the landowner still has their water right.

Response to CH2M HILL specific comment #3

No comments.

Summary and Conclusions

In general, Boulder Creek Commons, LLC. has completed the conceptual design and reported the impacts of the development and has created mitigation plans to mitigate the impacts of the Hogan-Pancost Development in accordance with the City of Boulder Development Standards. In addition, the resubmittal of the site development reports has addressed the majority of comments raised during the initial review of the Reports by CH2M HILL in August 2010

For the Stormwater and Floodplain mitigation review of the resubmitted reports, one notable discrepancy required by the *City of Boulder Design and Construction Standards, November 16, 2000* or *The City of Boulder Revised Code (BRC) Title 9, Land Use Regulations* is noted below:

Storm Water Design

- **7.02-C-2:** It appears that a typo has occurred in the report. In the revised Report the NGVD 1988 Datum is referenced. This should be corrected to reference the North American Vertical Datum of 1988 (NAVD 1988 Datum)

Floodplain Mitigation

- **Section 9-3-6.b(3) of Title 9:** The Report proposes flood channels and detention within the property to mitigate the flooding and the effects of flooding on the property. However, an analysis of the 100-year flood was not completed to determine if the proposed improvements on the Hogan-Pancost property would cause an adverse impact on surrounding properties upstream or downstream of the property

As discussed at the October 7, 2010 meeting with the City, at this time the City has indicated that a floodplain analysis using the Regulatory MIKE FLOOD model will not be required. A conservative analysis of the flows, including flow volume, has been included in the report that conceptually addresses the storm drainage and floodplain concerns across the site. The City has indicated, in the October 7, 2010 meeting that floodplain analysis using MIKE FLOOD may be required in future submittals including the Land Use Review and Site Review applications

On-site natural resources, drainage, groundwater and soil issues

- **Sump Pump Withdrawals:** Telesto identified a minor error in their write-up. The second quote from the questionnaires should be attributed to the resident at 250 Cimarron Way. Re-issuing a corrected Attachment 1 will resolve CH2M HILL's comments on Sump Pump Withdrawal rates.
- **Baseline Pre-development Recharge Rates:** Telesto provided additional clarification in their November 30th email (Attached to this letter) to CH2M HILL that was needed to reproduce their calculations regarding recharge rates. Re-issuing a clarified Attachment 1 that explicitly states the amount of mean precipitation that takes place between December and February will resolve CH2M HILL's comments on recharge rates from precipitation. There is currently some discrepancy in this

value – the text (page 5) and Table 1 of the report cite 7.4 inches of precipitation during the winter, but calculations in Section 1.2 of Attachment 1 use 7.7 inches. The report needs to use a consistent value throughout.

- **Bioswale ET and Recharge Rate:** T table in Attachment 1 could be made clearer by including intermediate calculations used to derive the total amount of recharge that takes place during a season. In addition, the units used for fluxes in the report should be made consistent by reporting in units of gallons per minute, adopted throughout the text and in tables 2 and 3 of the report and feet per day as was used throughout Appendix A. The winter and summer bioswale recharge rates derived in Attachment 1 should match with values used in Table 3 of the report.

In their supporting documentation, Telesto indicates that the MODFLOW model was modified to represent the locations of bioswales on the proposed development and that additional model runs predict a 2.0 gallon per minute drop in sump pump rates between pre-development and post-development scenarios. This difference is less than the 4.3 gallon per minute noted in the conclusion of Appendix A (page A-9).

In general, the reports reviewed in relation to the Boulder Creek Commons, LLC proposed development of the Hogan/Pancost Property meets the requirements outlined in the *City of Boulder Design and Construction Standards, November 16, 2000* and in *The City of Boulder Revised Code (BRC) Title 9, Land Use Regulations, 198*. In addition, a review of On-site natural resources, drainage, groundwater and soil issues against currently acceptable engineering standards of practice was completed and found that the modeling and procedures used to evaluate the On-site natural resources, drainage, groundwater and soil issues does meet current and acceptable engineering standards of practice and no additional information is requested at this time.

It is noted that the few discrepancies, and typos noted in the summary and conclusions of this letter should be fixed before submitting the final report.

We hope that this review of the Hogan-Pancost reports assists the City of Boulder in evaluating the issues related to the proposed development. Please call or email Alan Turner, if you have any questions or comments about this information.

Sincerely,

CH2M HILL



Alan Turner, P.E., CFM
Project Manager
Water Resources Engineer

Matt Findley, CPSS
Environmental Scientist

Rob Healy, RG
Geologist

Email from Telesto November 30, 2010

Turner, Alan/DEN

From: Account Expired per GGAA (amerrit1) Findley, Matthew/DEN
Sent: Thursday, December 09, 2010 7:09 AM
To: Turner, Alan/DEN
Subject: FW: Boulder Creek Commons: Ground Water Evaluation Response to Comments
Attachments: image001.jpg; Table_1_BioswaleRechargeEstimate.xls

Here ya go.

From: Terry Fairbanks [<mailto:tfairbanks@telesto-inc.com>]
Sent: Tuesday, November 30, 2010 1:39 PM
To: Findley, Matthew/DEN
Cc: 'Walter Niccoli'; 'Leslie Ewy'
Subject: Boulder Creek Commons: Ground Water Evaluation Response to Comments

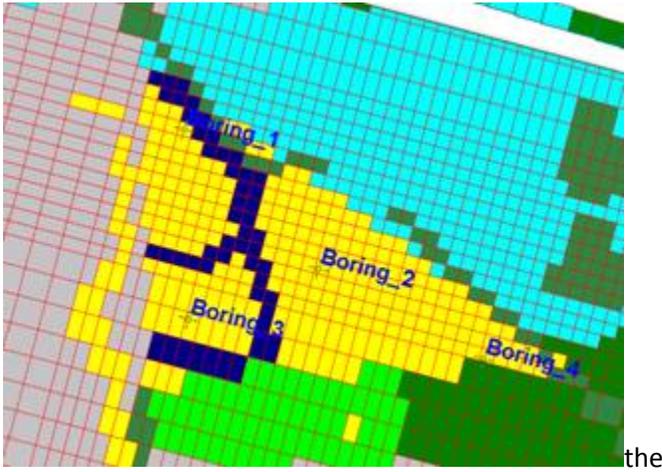
Resending to full e-mail address.

Hi Matt,

Here's the info:

1. Table 1 Bioswale Recharge Estimate. See attached Table_1_BioswaleRechargeEstimate.xls – The original file contains daily Penman Monteith calculations and is 28MB so I have only included the portion that includes the information in the summary table.
2. "Assuming native ground is populated with pasture grasses, the potential evapotranspiration is 24.3 in/yr." The 24.3 in/yr is the Penman Monteith ET rate. Looking through my notes I see that this should be 23.5 in/yr.
3. I do not have information regarding the water right for the property.
4. The anecdotal information on the 15,000 gpd is for the resident at 250 Cimmaron Way.
5. Frost depth: The Colorado State University Colorado Climate Center reported the following for their research site:

"In most years, the max frost penetration on level, non-shaded ground is only 10-14" (much more in shaded). The greatest penetration in the past 20 years has been 18" at our site. We have had many mild winters recently, and we've had some with only a few inches (3-8") penetration. The ground is most likely frozen from just after Thanksgiving until sometime in early March at our station. This year, the ground remained unfrozen all January except in the top 2 inches at night and in the morning. This was very unusual."
<http://climate.colostate.edu/questions.php>
6. Regarding the local effect of the bioswale, the model was run with an explicit representation of the bioswale included at the calculated recharge rate (dark blue area in image below).



7. On Page 2, Paragraph 4, the winter precipitation of 7.7 inches should be mentioned to make the calculation clearer. The following table will help:

Winter Precipitation =	7.7	in
Frost Period Runoff =	-2.6	in
Soil Storage =	-4.4	in
Net Infiltration =	0.7	in
Annual Precipitation =	20.8	in/yr
Net Infiltration / Annual Precipitation =	3.3%	

Let me know if you have any other questions.

Terry

Terry Fairbanks
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 Telesto Solutions, Inc.
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 Fort Collins, CO 80528
 970.484.7704 (ph)
 970.484.7789 (fax)

DEVELOPED CONDITION (Bioswale*)								
			Area					
			(acre)			Acre-ft	%	
Precipitation								
Annual	20.8	in	0					
Summer	13.1	in	2.52			2.7		
Winter	7.7	in	2.52			1.6		
Irrigation								
Summer (Cattails, Bulrushes, killing frost)	0.0	in	0.00			0.0		
Summer (KY Bluegrass)	16.9	in	1.83			2.6		
Winter	0.0	in	0			0.0		
Runoff (CN=98)								
Summer	7.89	in	9.6			6.3		
Winter	4.19	in	9.6			3.4		
Winter Frost Period								
Runoff (CN=69)								
Summer	0.30	in	9.6			0.2		
Winter	0.03	in	9.6			0.0		
Winter Frost Period	2.59	in	9.6			2.1		
Evaptranspiration								
Summer (Cattails, Bulrushes, killing frost)	24.3	in	0.69			1.4	36%	Summer
Summer (KY Bluegrass)	19.3	in	1.83			2.9		
Winter	0	in				0.0		
Bioswale Recharge								
Summer	36.0	in	2.52			7.5	64%	Winter
Winter	33.7	in	2.52			7.1	100%	

0.0 <= Summer Check
0.0 <= Winter Check

* Cover the channel bottom with loamy soils upon which cattails, sedges, and reeds should be established. Side slopes should be planted with native or irrigated turf grasses.