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Memorandum

To: Russell Stewart, President BMOA

CC: Cheryl McKnight, BMOA

From: William P. Ruzzo, P.E.

Date: December 29, 2004

Re: Buell Mansion - Flood Analysis for Wetland Pond

BACKGROUND

In the process of performing drainage investigations for another client, I discovered that the offsite area tributary to the Buell Mansion wetlands pond was significantly larger than suggested by the drainage report for Buell Mansion[1]. The extent of the tributary area is shown on Figure 1, as well as the tributary area used for the original drainage analysis of Buell Mansion[2]. Analysis of storm runoff from the larger area determined that the wetlands pond is undersized for the tributary area, which can result in flooding of existing properties on Buell Mansion.

Because of the potential impacts of this finding, I further investigated drainage in the area in an attempt to verify the tributary area. I obtained a copy of the drainage master plan[3] for the City of Englewood, which confirmed the extent of offsite area tributary to the wetlands pond.

These findings were discussed with BMOA at our meeting of December 22, 2004, at which time I recommended additional analysis to determine the extent of flooding that could occur as the result of the larger tributary area to the wetlands pond. This recommendation was accepted and additional analysis was conducted.

SUMMARY OF FINDINGS

Presented in this memorandum are the results of an analysis which consisted of obtaining storm runoff hydrographs for the offsite area and performing storage

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[1] Turner Collie & Braden, August 24, 1997. *Final Storm Drainage Report for Buell Property*
[2] Ibid
[3] Turner Collie & Braden Inc. September 1999. *City of Englewood Outfall Systems Planning Preliminary Design Report.*

routing calculations to estimate different flood levels. The results are presented graphically on Figure 2 for two scenarios:

- The first scenario assumes that the Denver Highline Canal does not intercept storm runoff from the area east (uphill) of the canal. This assumption, which is the more conservative of the two, is in accordance with the drainage policy and criteria for the City of Cherry Hills Village[4], which references the Arapahoe County criteria[5]. This policy recognizes, among other facts, that irrigation facilities are not sized for urban runoff and often are carrying water (irrigation and storm runoff) during flood events, limiting their capacity. Based on this assumption, the 100-year flood could reach elevation 5435.9, which would flood lots developed and undeveloped.

- The second scenario assumes that only the area west (downhill) of the Denver Highline Canal would contribute to the flooding during a 100-year storm event. Whereas this scenario is not strictly in accordance with drainage criteria, it recognizes that the canal carries minimal irrigation water and will likely be improved[6] to allow more stormwater to be carried during flood events. Based on this assumption, the 100-year flood could reach elevation 5432.8, which would flood a smaller number of lots developed and undeveloped.

Calculations performed during this investigation and used to determine the potential impacts are summarized in the appendix to this memorandum.

EVALUATION OF RESULTS

One of the major factors determining the depth of flooding for both scenarios is that the privacy wall has a limited size opening at Ravenswood Road, which restricts the flow causing it to backup into the neighborhood (see attached photos). A wider opening or more openings would reduce flood elevations.

Regardless of which assumption is used to determine possible flood elevations, there are varying degrees of probability and risks associated with each assumption. The more conservative scenario (i.e.: all tributary area) assumes that the canal is completely full during a rare event, the100-year flood, which has a 1% probability of occurrence each year. This assumption, therefore, stacks two low probability events, resulting in an even lower probability of occurrence.

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[4] WRC Engineering, Inc. 1985. *Arapahoe County Storm Drainage Design and Technical Criteria.*
[5] TCB 1997, p5.
[6] WRC Engineering May 2003. *Major Drainageway Planning of Highline Canal and Little Dry Creek Watershed (ArapCo), Phase A, Alternatives Evaluation Report*.

The less conservative scenario assumes that the canal is *completely* empty at the time of the flood and can convey *all* storm runoff from the area east of the canal, which is also a low probability. The more likely scenario is somewhere in between the two scenarios.

CONSIDERATIONS

Regardless of which scenario is the more likely occurrence, there is a higher risk of flooding to the neighborhood than anticipated by the original drainage analysis for Buell Mansion[7]. Possible ways to reduce this risk include:

1. For undeveloped lots, require that the finished floors and, if possible, the surrounding landscaping be elevated above the flood levels.

2. For developed lots determine which structures are the most vulnerable to flood damages and have the owners take corrective actions, such as blocking openings, berming, or even obtain flood insurance.

3. Investigate the feasibility of providing more openings in the privacy wall to lower flood elevations.

Attachments:

1. Figure 1 Tributary Watersheds

2. Figure 2 Flooding Limits

3. Photographs

Calculation Appendix

[7] TCB 1997.

CALCULATION APPENDIX

Spill through wall opening

Flood contained by privacy wall

Flood Limits with area below DHC only, elevation = 5432.8

Flood limits (all tributary area) elevation 5435.9

Ravenswood Road

Black Swan Lane

Wildrose Trail

Buell Mansion Pkwy

WETLANDS PERIMETER

NOTES:

1. Contours on this map within the lots represent pre-development elevations and may not be representative of actual conditions.
2. Flooding conditions are based on 100-year storm event covering all tributary area or just the area downstream of the Denver Highline Canal.
3. Flood elevations controlled primarily by opening in privacy wall at Ravenswood Road.
4. Spill through Hampden entrance may occur during 100-year flood event, regardless of tributary area.

FIGURE 2

BUELL MANSION WETLAND POND ANALYSIS

FLOODING LIMITS

DECEMBER 31,2004