



ITEM FOR ENVIRONMENTAL BOARD AGENDA

BOARD MEETING

DATE REQUESTED: April 4, 2012

**NAME & NUMBER
OF PROJECT:** TOP GOLF
SP-2011-0216C

**NAME OF APPLICANT
OR ORGANIZATION:** Bury & Partners, Inc.
[Contact: Jonathan Neslund-(512) 328-0011]

LOCATION: 11301 Burnet Rd

PROJECT FILING DATE: July 28, 2011

**PDR/ENVIRONMENTAL
STAFF:** Jim Dymkowski, 974-2707
james.dymkowski@austintexas.gov

**PDR/
CASE MANAGER:** Nikki Hoelter, 974-2863
Nikki.Hoelter @austintexas.gov

WATERSHED: Walnut Creek - Suburban
Desired Development Zone

ORDINANCE: Comprehensive Watershed Ordinance (current Code)
REQUEST: Variance request is as follows:
1. To allow fill greater than 4 feet, not to exceed 18 feet
[LDC Section 25-8-342].
2. To allow cut greater than 4 feet, not to exceed 8 feet
[LDC Section 25-8-341]. (Administrative Variance)

STAFF RECOMMENDATION: Recommend for consent approval with conditions.

**REASONS FOR
RECOMMENDATION:** Findings of fact have been met.



MEMORANDUM

TO: David Sullivan, Chairperson
Members of the Planning Commission

FROM: Jim Dymkowski, Environmental Review Specialist Sr.
Planning and Development Review Department

DATE: April 4, 2012

SUBJECT: Top Golf – SP-2011-0216C

Variance Requests: To allow fill not to exceed 18 feet (LDC 25-8-342)
To allow cut not to exceed 8 feet (LDC 25-8-341) (Administrative)

Description of Project Area

The proposed development is 14.23 acres and is located approximately .5 mile north of the intersection of Burnet Road and Braker Lane on the south side of Burnet Road. The site is within the City's full purpose jurisdiction. It is in the Walnut Creek Watershed, which is classified as Suburban. It is not in the Edward's Aquifer Recharge or Contributing Zone. It is in the Desired Development Zone. In December of 2011, this approximately 14 acre site and the remaining lots within the IBM East Subdivision plat totaling 39.5 acres were rezoned and included in the North Burnet/Gateway (NBG) Master Regulating Plan. The Master Plan indicates the site falls within a Transit Oriented Development (TOD) Sub-District. This TOD sub-district is the most intensively developed land use zone and will typically be used for high density residential, office, and retail. This project is currently bordered by such development with the Domain site across Burnet Rd to the west, a high tech campus, government office, and storage to the to the north and east, and additional proposed high intensity residential apartments to the south.

The Master Plan also modified the waterway classification section of the Land Development Code for Suburban waterways to treat all waterways within the plan boundaries as urban waterways. This requires a Critical Water Quality Zone Setback (CWQZ), but no Water Quality Transition Zone (WQTZ) Setback on all tributaries with a drainage area of greater than 64 acres. This (CWQZ) would extend a minimum of 50' to a maximum of 400' from the centerline of a waterway based on the limits of the City of Austin fully developed 100 year floodplain line. This varies the standard Suburban watershed requirement of three size classes (minor CWQZ 50-100', intermediate CWQZ 100-200', and major 200-400') from the centerline of a waterway based on the limits of the City of Austin fully developed 100 year floodplain line. The Water Quality Transition zones (100, 200, & 300' respectively) are removed. An accompanying site location map (pg. 25 of this packet) highlights its location in relation to all of the affected tributaries and their setbacks.

The project consist of a 70,941sf, three story, commercial and outdoor entertainment building, with associated parking, drives, utilities, landscaping, and driving range. The maximum allowable impervious cover for this watershed is 80%, or approximately 11.37 acres for this site. The North Burnet/Gateway Plan also adopted 80% impervious cover allowed for commercial development but supersedes LDC for Suburban Watersheds 25-8-394(C) for Single Family and Multi-family to also allow 80% to encourage maximum density uses. The applicant is proposing a total of 9.135 acres (or 64.28% net site area) of impervious cover. Since the project proposes greater then 20% impervious cover, it will be meeting standard sedimentation/filtration water quality and detention requirements. The applicant is proposing to manage storm water run-off through overland flow and inlet collected runoff from both the parking area and the proposed driving range area to the water quality / detention pond. This will allow the run-off to be discharged in the existing drainages to the east with flows no greater than what is discharged under existing conditions. The quantity of proposed cut to accomplish the development individually is ~ 402,336 cubic feet (or) ~14,900 cubic yards. The quantity of proposed fill to accomplish the development is ~ 752,970 cubic feet (or) ~27,880 cubic yards.

Vegetation

The Environmental Assessment documents that this property was formerly used for livestock grazing. That activity appeared to have ceased by 1990 and woody vegetation began to occupy the site that has sat undeveloped except for an overhead utility easement and access drive for an adjacent development. The dominant woody vegetation onsite is Ashe Juniper with some Sugarberry and Chinaberry. There is some herbaceous vegetation consisting of Silver and King Ranch Bluestem.

Critical Environmental Features

An Environmental Assessment was performed on in December 2011. There were no CEF's found on-site.

Water/Wastewater

This project will receive its water and wastewater from the City of Austin along the south side of the site, from within the new Esperanza Crossing ROW.

Variance Request

1. A variance from LDC Section 25-8-342, to allow fill greater then 4 feet not to exceed 18 feet.
2. A variance from LDC Section 25-8-341, to allow cut greater then 4 feet not to exceed 8 feet (Administrative)

The applicant is proposing to construct a three story, commercial and outdoor entertainment building, with associated parking, drives, utilities, landscaping, and driving range. The demolition of an existing access drive to the IBM facility east and the relocation of this access drive, along with the construction of a portion of the Esperanza Crossing extension, will also occur. The slope of the lot varies in two directions approximately 1/3 of the way into the site from the West. That third of the site slopes south to north while the remaining 2/3's of the site slopes from west to east. There is approximately 25 feet of fall for that west/east portion. The project is required to adhere to North Burnet Gateway (NBG) Master Plan design standards for building location, orientation, etc. This includes placing the building toward the front of the site off the Esperanza Crossing roadway section. The building can only be oriented in the proposed direction to accommodate the development. The site orientation is further constrained by the new public roads and private access drive within the overall development of which this project is only one part. These roads and drives are also adhering to the same Master Plan standards that have determined their locations. The 200 foot LCRA power line easement to the south and Railroad ROW easement to the east further dictate the layout of the site. As a result, the

maximum cut of 8 feet will be required toward the west end of the proposed driving field and a maximum of 18 feet of fill will be required towards the far east of the driving field. The cut up to 8 feet is typically an administrative variance but has been included for review along with the formal fill variance request. The applicant has worked with staff in an attempt to balance the overall earthwork as much as possible while assuring that positive drainage flows are maintained to the water quality/detention pond.

Similar Cases

The following project had similar construction issues and received recommendations from the Environmental Board that were subsequently approved by the Zoning and Platting Commission:

Bird's Nest Airport: Terminal Area Development – Phase 1; SP-2009-0153D

Cut not to exceed 20'

Fill not to exceed 20'

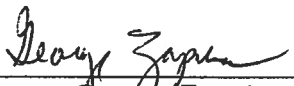
Recommendations

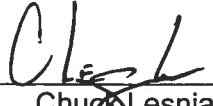
The findings of fact have been met. Staff recommends approval of this variance with the following conditions:

1. The project will provide native tree mitigation at a required percentage of 562%, or 280" of trees. These trees will be used to re-vegetate, help to stabilize, and to soften the 5:1 and 3:1 slopes created by the cut/fill.
2. Slopes shall be no steeper than 3:1 and revegetated per the City of Austin 609-S Native seed/planting requirement.
3. Seventy-five percent of the site's disturbed pervious areas shall be revegetated per the City of Austin 609-S Native seed/planting requirement.
4. The project will implement an Integrated Pest Management Plan.
5. In an attempt to minimize the duration of earthwork activities this site and the concurrent Esperanza Crossing roadway project will be utilizing the same contractor.

If you have any questions or need additional information, please feel free to contact me at 974-2707.

Jim Dymkowski, Environmental Review Specialist Senior
Planning and Development Review Department

Development Services Manager: 
George Zapalac

Environmental Officer: 
Chuck Lesniak



**Planning and Development Review Department
Staff Recommendations Concerning Required Findings
Water Quality Variances**

Application Name: Top Golf
Application Case No: SP-2011-0216C
Code Reference: LDC Section 25-8- 342
Variance Request: To allow fill up to 18 feet

A. Land Use Commission variance determinations from Chapter 25-8, Subchapter A – Water Quality of the City Code:

1. The requirement will deprive the applicant of a privilege or the safety of property given to owners of other similarly situated property with approximately contemporaneous development.

Yes. Strict adherence to the code would deprive the applicant of the ability to develop the property. This is due to the unique site topography, North Burnet Gateway Master Plan design standards (including required location of adjacent public roads, building placement, and orientation), the LCRA/AE easement to the south and the Railroad easement to the east. In order to meet these design requirements to allow for a functional driving range and to assure positive drainage to the regional water quality detention pond the applicant proposes fill up to 18 feet at the far east end of the site.

2. The variance:

- a) Is not based on a condition caused by the method chosen by the applicant to develop the property, unless the development method provides greater overall environmental protection than is achievable without the variance;

Yes. Strict adherence to the code would deprive the applicant of the ability to develop the property. This is due to the unique site topography, North Burnet Gateway Master Plan design standards (including required location of adjacent public roads, building placement, and orientation), the LCRA/AE easement to the south and the Railroad easement to the east. In order to meet these design

requirements to allow for a functional driving range and to assure positive drainage to the regional water quality detention pond the applicant proposes fill up to 18 feet at the far east end of the site. The project will also be providing

- 1. Tree mitigation at a required percentage of 562% with all native trees.**
- 2. Slopes shall be no steeper than 3:1 and revegetated per the City of Austin 609-S Native seed/planting requirement.**
- 3. Seventy-five percent of the site's disturbed pervious areas shall be revegetated per the City of Austin 609-S Native seed/planting requirement**
- 4. The project will implement an Integrated Pest Management Plan.**
- 5. In an attempt to minimize the duration of earthwork activities this site and the concurrent Esperanza Crossing roadway project will be utilizing the same contractor.**

- b) Is the minimum change necessary to avoid the deprivation of a privilege given to other property owners and to allow a reasonable use of the property;

Yes. The applicant has worked with staff in an attempt to balance the overall earthwork as much as possible while assuring that positive drainage flows are maintained to the water quality/detention pond.

- c) Does not create a significant probability of harmful environmental consequences; and

Yes. This variance will not increase harmful environmental consequences. The proposed fill will allow the driving range outfield to drain to the proposed regional water quality /detention pond. Until this positive flow is achieved, a temporary sediment basin will be installed per the erosion and sediment control plan to handle runoff from that portion of the site. The fill will be contained within the driving range field, beneath the synthetic grass surface. Finished slopes off the fill will be between 5:1 and 3:1 and will be revegetated per the City of Austin 609-s native seed and planting standards. The project will also provide tree mitigation at 562% or 280 inches of trees.

3. Development with the variance will result in water quality that is at least equal to the water quality achievable without the variance.

Yes. Development with the variance will result in water quality that is at least equal to the water quality achievable without the variance. The fill area will allow a larger portion of the site flow to and be treated by the single water quality pond.

- B. Additional Land Use Commission variance determinations for a requirement of Section 25-8-393 (Water Quality Transition Zone), Section 25-8-423 (Water Quality Transition Zone), Section 25-8-453 (Water Quality Transition Zone), or Article 7, Division 1 (Critical Water Quality Zone Restrictions):

1. The above criteria for granting a variance are met;

N/A.

2. The requirement for which a variance is requested prevents a reasonable, economic use of the entire property; and

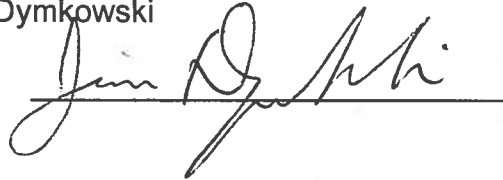
N/A.

3. **The variance is the minimum change necessary to allow a reasonable, economic use of the entire property.**

N/A.

Reviewer Name: Jim Dymkowski

Reviewer Signature:

A handwritten signature in black ink, appearing to read "Jim Dymkowski", is written over a horizontal line.

Date: March 5, 2012

Staff may recommend approval of a variance after answering all applicable determinations in the affirmative (YES).



**Planning and Development Review Department
Staff Recommendations Concerning Required Findings
Water Quality Variances**

Application Name: Top Golf
Application Case No: SP-2011-0216C
Code Reference: LDC Section 25-8- 341
Variance Request: To allow cut up to 8 feet (Administrative)

C. Land Use Commission variance determinations from Chapter 25-8, Subchapter A – Water Quality of the City Code:

1. The requirement will deprive the applicant of a privilege or the safety of property given to owners of other similarly situated property with approximately contemporaneous development.

Yes. Strict adherence to the code would deprive the applicant of the ability to develop the property. This is due to the unique site topography, North Burnet Gateway Master Plan design standards (including required location of adjacent public roads, building placement, and orientation), the LCRA/AE easement to the south and the Railroad easement to the east. In order to meet these design requirements to allow for a functional driving range and to assure positive drainage to the regional water quality detention pond the applicant proposes cut up to 8 feet at the west end of the driving range. Typically up to 8 feet of cut in the Desired Development Zone could be reviewed administratively by Staff. But it has been included for your review with the formal fill variance request.

2. The variance:

- d) Is not based on a condition caused by the method chosen by the applicant to develop the property, unless the development method provides greater overall environmental protection than is achievable without the variance;

Yes. Strict adherence to the code would deprive the applicant of the ability to develop the property. This is due to the unique site topography, North Burnet Gateway Master Plan design standards (including required location of adjacent

public roads, building placement, and orientation), the LCRA/AE easement to the south and the Railroad easement to the east. In order to meet these design requirements to allow for a functional driving range and to assure positive drainage to the regional water quality detention pond the applicant proposes cut up to 8 feet at the west end of the driving range. The project will also be providing

- 1. Tree mitigation at a required percentage of 562% with all native trees.**
- 2. Slopes shall be no steeper than 3:1 and revegetated per the City of Austin 609-S Native seed/planting requirement.**
- 3. Seventy-five percent of the site's disturbed pervious areas shall be revegetated per the City of Austin 609-S Native seed/planting requirement**
- 4. The project will implement an Integrated Pest Management Plan.**
- 5. In an attempt to minimize the duration of earthwork activities this site and the concurrent Esperanza Crossing roadway project will be utilizing the same contractor.**

- e) Is the minimum change necessary to avoid the deprivation of a privilege given to other property owners and to allow a reasonable use of the property;

Yes. The applicant has worked with staff in an attempt to balance the overall earthwork as much as possible while assuring that positive drainage flows are maintained to the water quality/detention pond.

- f) Does not create a significant probability of harmful environmental consequences; and

Yes. This variance will not increase harmful environmental consequences. The proposed cut will allow the driving range outfield to drain to the proposed regional water quality /detention pond and help balance the overall earthwork on the property. The cut will be contained within the driving range field, beneath the synthetic grass surface. Finished slopes off the cut will be between 5:1 and 3:1 and will be revegetated per the City of Austin 609-s native seed and planting standards. The project will also provide tree mitigation at 562% or 280 inches of trees.

3. Development with the variance will result in water quality that is at least equal to the water quality achievable without the variance.

Yes. Development with the variance will result in water quality that is at least equal to the water quality achievable without the variance.

- D. Additional Land Use Commission variance determinations for a requirement of Section 25-8-393 (Water Quality Transition Zone), Section 25-8-423 (Water Quality Transition Zone), Section 25-8-453 (Water Quality Transition Zone), or Article 7, Division 1 (Critical Water Quality Zone Restrictions):

4. The above criteria for granting a variance are met;

N/A.

5. The requirement for which a variance is requested prevents a reasonable, economic use of the entire property; and

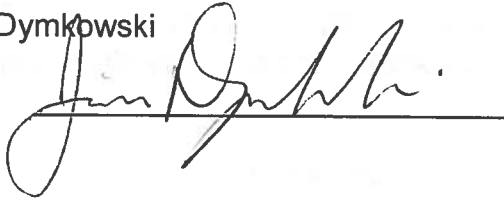
N/A.

6. **The variance is the minimum change necessary to allow a reasonable, economic use of the entire property.**

N/A.

Reviewer Name: Jim Dymkowski

Reviewer Signature:



Date: March 5, 2012

Staff may recommend approval of a variance after answering all applicable determinations in the affirmative (YES).

February 17, 2012

Mr. Dave Sullivan
Chair
City of Austin Planning Commission
301 West 2nd Street

Austin, Texas 78701

Re: TopGolf USA, Inc.
11301 Burnet Road
Austin, Travis County, Texas
SP-2011-0216C
Environmental Variance Letter for Fill

Dear Mr. Sullivan:

On behalf of our client, Bury + Partners, Inc. is requesting an Environmental Variance from Section 25-8-342 of the City of Austin Land Development Code for the TopGolf USA, Inc. Site Plan (SP-2011-0216C) located at 11301 Burnet Road in Austin, Travis County, Texas. The entire Top Golf site (approximately 14 acres) is within the City of Austin's full purpose jurisdiction and within the Walnut Creek Watershed, which is classified as a Suburban Watershed by the City of Austin. No portion of the site lies within the Edwards Aquifer Recharge Zone or within the 100-year floodplain as determined by the FEMA FIRM panel 48453C0265H, dated September 26, 2008 for Travis County, Texas.

The ~ 14 acre Top Golf lot is a portion of the Resubdivision of Lot 1A, Block "A" Amended Plat of Lots 1 and 2, Block "A" IBM Subdivision East ("plat") which was approved at Planning Commission on February 14th. The entire plat is 39.510 acres.

In December 2011 the Top Golf site was rezoned to the North Burnet/Gateway-Neighborhood Plan-Commercial Mixed Use (NBG-NP-CMU). The NBG plan requires the 39.10 acre tract to provide Pedestrian priority Collector Streets through the property. These new streets and the existing railroad tracts to the east form the boundaries of the Top Golf lot.

BURY+PARTNERS
221 West Sixth Street, Suite 600
Austin, TX 78701

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FAX (512) 328-0325

www.burypartners.com
TBPE No. F-1048

To accommodate the Top Golf development an environmental variance to exceed four (4) feet of fill is being requested as shown on the provided cut/fill map. The site has been graded to balance the overall earthwork as much as possible and provide the applicant with the desired development. Due to the site constraints, which include:

- Existing topography
- Adhering to the North Burnet Gateway design standards for building location, orientation, etc
- Configuration of the new public roads to be built with the overall project
- A private drive for access to IBM campus (which will be converted to a public road in the future)
- Existing railroad tracts bordering the east end of the site
- Austin Energy and LCRA overhead power lines and 200' easement bordering the south of the site

Due to the use and these site constraints we are requesting a maximum fill of 18 feet on the east end of the property to support this development.

Per our discussions with City staff we have agreed to the following conditions to enhance the environmental aspects of the project:

- Implement an Integrated Pest Management Plan.
- Provide 235% (173") more trees and 562% (230") more mitigation inches then required by code.
- Utilizing native grassland seeding (COA specification 609-S) to revegetate 75% of the site's pervious areas.
- Utilize "Top-Golf Turf" for the outfield (driving range), which is four (4) acres, in lieu of grass which will eliminate the need for irrigation water in the outfield.
- The developer of Top Golf and the public roads will utilize the same earthwork contractor to minimize the duration of the earthwork construction.

Land Use Commission Variance:

- (1) The requirement will deprive the applicant of a privilege or the safety of property given to owners of other similarly situated property with approximately contemporaneous development

YES, if the variance was not provided, strict adherence to the requirements would deprive the owner from developing the property for the proposed use. This is due to the existing topography of the site, railroad tracks to the east, LCRA/AE easements, NBG design standards and required public roads which border the lot. In order to achieve a functional outfield for a driving range and ensure positive drainage to the regional water quality and

detention pond for the outfield area, a maximum of 18 feet of fill would need to be installed on the low end (east side) of the site as shown on the cut / fill map.

- (2) Is not based on a condition caused by the method chosen by the applicant to develop the property, unless the development method provides greater overall environmental protection than is achievable without the variance.
- *YES, the proposed development will provide greater overall environmental protection than is achievable without the variance. The project will be providing 235% (173") more trees and 562% (230") more mitigation inches then required by code. We will also be implementing an Integrated Pest Management Plan (IPM) to the site. This will ensure that any invasive pests do not compromise the integrity of any proposed landscaping. We will be implementing artificial turf grass for the outfield area. This will significantly reduce the amount of water consumed for irrigation purposes as well as provide better infiltration than the existing conditions improving drainage to the proposed water quality pond. The project will also be utilizing native grassland seeding, City of Austin specification 609S, to re-vegetate approximately 75% of the pervious area. The developers of Top Golf and the public roads will utilize the same earthwork contractor to minimize the duration of the earthwork construction and the site will obtain a one star Austin Energy Green Building Rating.*
- (3) Is the minimum change necessary to avoid the deprivation of a privilege given to other property owners and to allow a reasonable use of the property.

YES, based on our site plans and calculations the proposed site plan provides the minimum amount of fill necessary to develop the property for the proposed use. The site has been graded to minimize the overall earthwork necessary to support the proposed development and satisfy the water quality and detention requirements for the project.

- (4) Does not create a significant probability of harmful environmental consequences.

YES, with the proposed development does not create a significant probability of harmful environmental consequences. The fill will allow the outfield to drain to the proposed water quality and detention pond. The other portion behind the backstop that will be graded at a slope not to exceed 3:1 and does not exceed a length of 150' therefore sheet flow will be maintained. During construction the slopes on the fill area will be compacted to according to the City of Austin specifications and erosion and sedimentation controls for this area will not be removed until adequate vegetation is established.

- (5) Development with the variance will result in water quality that is at least equal to the water quality achievable without the variance.

YES, the variance will result in water quality that is at least equal to the water quality achievable without the variance. The variance will allow for a larger portion of the site to be treated by the water quality pond,

Please contact our office should you have any questions or need additional information

Sincerely,

Joseph A Isaja, PE
Principal

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TBPE No. F-1048

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Watershed Variances - Findings of Fact

As required in LDC Section 25-8-41, in order to grant a variance the Planning Commission must make the following findings of fact: Include an explanation with each applicable finding of fact.

Project: TopGolf USA, Inc.

Ordinance Standard: LDC Section 25-8-342 Fill Requirements

JUSTIFICATION:

1. Are there special circumstances applicable to the property involved where strict application deprives such property owner of privileges or safety enjoyed by other similarly situated property with similarly timed development? YES/NO

If the variance was not provided, strict adherence to the requirements would deprive the owner from developing the property for the proposed use. This is due to the existing topography of the site, railroad tracks to the east, adhering to the North Burnet Gateway (NBG) design standards for building location, orientation, etc., and the Austin Energy and LCRA overhead power lines and 200' easements. In order to achieve a functional outfield for a driving range and ensure positive drainage to the regional water quality and detention pond for the outfield area, a maximum of eighteen (18) feet of fill would need to be installed on the low end (east side) of the site as shown on the cut / fill map.

2. Does the project demonstrate minimum departures from the terms of the ordinance necessary to avoid such deprivation of privileges enjoyed by such other property and to facilitate a reasonable use, and which will not create significant probabilities of harmful environmental consequences? YES/NO

Based on our site plans and calculations the proposed site plan provides the minimum amount of fill necessary to develop the property for the proposed use. The site has been graded to minimize the overall earthwork necessary to support the proposed development and satisfy the water quality and detention requirements for the project.

3. The proposal does not provide special privileges not enjoyed by other similarly situated properties with similarly timed development, and is not based on a special or unique condition which was created as a result of the method by which a person voluntarily subdivided land. YES/NO

The lots shape is a function of the public roads required by the NBG zoning, the existing railroad tracks to the east, and existing Austin Energy and LCRA overhead power lines and associated 200' easement to the south. Based on our site plans and calculations the proposed site plan provides the minimum amount of fill necessary to develop the property for the proposed use. The site has been graded to minimize the overall earthwork necessary to support the proposed development and satisfy the water quality and detention requirements for the project.

4. Does the proposal demonstrate water quality equal to or better than would have resulted had development proceeded without the variance? YES/NO

The variance will result in water quality that is at least equal to the water quality achievable without the variance. The variance will allow for a larger portion of the site to be treated by the water quality pond.

5. For a variance from the requirements for development within the Critical Water Quality Zone and/or Water Quality Transition Zone: Does the application of restrictions leave the property owner without any reasonable, economic use of the entire property? YES/NO

Not applicable. There is no development within the Critical Water Quality Zone or Water Quality Transition Zone.

February 17, 2012

Mr. Dave Sullivan
Chair
City of Austin Planning Commission
301 West 2nd Street

Austin, Texas 78701

Re: TopGolf USA, Inc.
11301 Burnet Road
Austin, Travis County, Texas
SP-2011-0216C
Environmental Variance Letter for Cut

Dear Mr. Sullivan:

On behalf of our client, Bury+Partners, Inc. is requesting an Environmental Variance from Section 25-8-341 of the City of Austin Land Development Code for the TopGolf USA, Inc. Site Plan (SP-2011-0216C) located at 11301 Burnet Road in Austin, Travis County, Texas. The entire Top Golf site (approximately 14 acres) is within the City of Austin's full purpose jurisdiction and within the Walnut Creek Watershed, which is classified as a Suburban Watershed by the City of Austin. No portion of the site lies within the Edwards Aquifer Recharge Zone or within the 100-year floodplain as determined by the FEMA FIRM panel 48453C0265H, dated September 26, 2008 for Travis County, Texas.

The ~14 acre Top Golf lot is a portion of the Resubdivision of Lot 1A, Block "A" Amended Plat of Lots 1 and 2, Block "A" IBM Subdivision East ("plat") which is scheduled to be heard at Planning Commission on February 14th. The entire plat is 39.510 acres.

In December 2011 the Top Golf site was rezoned to the North Burnet/Gateway-Neighborhood Plan-Commercial Mixed Use (NBG-NP-CMU). The NBG plan requires the 39.10 acre tract to provide Pedestrian priority Collector Streets through the property. These new streets and the existing railroad tracts to the east form the boundaries of the Top Golf lot.

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221 West Sixth Street, Suite 600
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www.burypartners
TBPE No. F.

To accommodate the Top Golf development an environmental variance to exceed four (4) feet of cut is being requested as shown on the provided cut/fill map. This cut variance request is being requested in conjunction with the fill request submitted to your attention. The site has been graded to balance the overall earthwork as much as possible and provide the applicant with the desired development. Due to the site constraints, which include:

- Existing topography
- Adhering to the North Burnet Gateway design standards for building location, orientation, etc
- Configuration of the new public roads to be built with the overall project
- A private drive for access to IBM campus (which will be converted to a public road in the future)
- Existing railroad tracts bordering the east end of the site
- Austin Energy and LCRA overhead power lines and 200' easement bordering the south of the site

Due to the use and these site constraints we are requesting a maximum cut of 8 feet in the middle of the property to support this development.

Typically a cut of this amount (under eight (8) feet) is an administrative variance, but due to fill variance being over eight (8) feet, both requests are required to be presented to the Planning Commission.

Per our discussions with City staff we have agreed to the following conditions to enhance the environmental aspects of the project:

- Implement an Integrated Pest Management Plan.
- Provide 235% (173") more trees and 562% (230") more mitigation inches then required by code.
- Utilizing native grassland seeding (COA specification 609-S) to revegetate 75% of the site's pervious areas.
- Utilize "Top-Golf Turf" for the outfield (driving range), which is four (4) acres, in lieu of grass which will eliminate the need for irrigation water in the outfield.
- The developer of Top Golf and the public roads will utilize the same earthwork contractor to minimize the duration of the earthwork construction.

Land Use Commission Variance:

- (1) The requirement will deprive the applicant of a privilege or the safety of property given to owners of other similarly situated property with approximately contemporaneous development

YES, if the variance was not provided, strict adherence to the requirements would deprive the owner from developing the property for the proposed use. This is due to the existing topography of the site, railroad tracks to the east, LCRA/AE easements, NBG design standards and required public roads which border the lot. In order to achieve a functional outfield for a driving range and ensure positive drainage to the regional water quality and detention pond for the outfield area, a maximum of eight (8) feet of cut would need to be installed in the middle of the site as shown on the cut / fill map.

(2) Is not based on a condition caused by the method chosen by the applicant to develop the property, unless the development method provides greater overall environmental protection than is achievable without the variance.

- *YES, the proposed development will provide greater overall environmental protection than is achievable without the variance. The project will be providing 235% (173") more trees and 562% (230") more mitigation inches then required by code. We will also be implementing an Integrated Pest Management Plan (IPM) to the site. This will ensure that any invasive pests do not compromise the integrity of any proposed landscaping. We will be implementing artificial turf grass for the outfield area. This will significantly reduce the amount of water consumed for irrigation purposes as well as provide better infiltration than the existing conditions improving drainage to the proposed water quality pond. The project will also be utilizing native grassland seeding, City of Austin specification 609S, to re-vegetate approximately 75% of the pervious areas on the site. The developers of Top Golf and the public roads will utilize the same earthwork contractor to minimize the duration of the earthwork construction and the site will obtain a one star Austin Energy Green Building Rating.*

(3) Is the minimum change necessary to avoid the deprivation of a privilege given to other property owners and to allow a reasonable use of the property.

YES, based on our site plans and calculations the proposed site plan provides the minimum amount of cut necessary to develop the property for the proposed use. The site has been graded to minimize the overall earthwork necessary to support the proposed development and satisfy the water quality and detention requirements for the project.

(4) Does not create a significant probability of harmful environmental consequences.

YES, with the proposed development does not create a significant probability of harmful environmental consequences. The cut will allow the outfield to drain to the proposed water quality and detention pond and help balance the overall earthwork on the property.

(5) Development with the variance will result in water quality that is at least equal to the water quality achievable without the variance.

YES, the variance will result in water quality that is at least equal to the water quality achievable without the variance.

Please contact our office should you have any questions or need additional information

Sincerely,

Joseph A Isaja, PE
Principal

Watershed Variances - Findings of Fact

As required in LDC Section 25-8-341, in order to grant a variance the Planning Commission must make the following findings of fact: Include an explanation with each applicable finding of fact.

Project: TopGolf USA, Inc.

Ordinance Standard: LDC Section 25-8-341 Cut Requirements

JUSTIFICATION:

1. Are there special circumstances applicable to the property involved where strict application deprives such property owner of privileges or safety enjoyed by other similarly situated property with similarly timed development? YES/NO

If the variance was not provided, strict adherence to the requirements would deprive the owner from developing the property for the proposed use. This is due to the existing topography of the site, railroad tracks to the east, adhering to the North Burnet Gateway (NBG) design standards for building location, orientation, etc., and the Austin Energy and LCRA overhead power lines and 200 foot easements. In order to achieve a functional outfield for a driving range and ensure positive drainage to the regional water quality and detention pond for the outfield area, a maximum of eight (8) feet of cut would need to be installed in the middle of the site as shown on the cut / fill map.

2. Does the project demonstrate minimum departures from the terms of the ordinance necessary to avoid such deprivation of privileges enjoyed by such other property and to facilitate a reasonable use, and which will not create significant probabilities of harmful environmental consequences? YES/NO

Based on our site plans and calculations the proposed site plan provides the minimum amount of cut necessary to develop the property for the proposed use. The site has been graded to minimize the overall earthwork necessary to support the proposed development and satisfy the water quality and detention requirements for the project.

3. The proposal does not provide special privileges not enjoyed by other similarly situated properties with similarly timed development, and is not based on a special or unique condition which was created as a result of the method by which a person voluntarily subdivided land. YES/NO

The lots shape is a function of the public roads required by the NBG zoning, the existing railroad tracks to the east, and existing Austin Energy and LCRA overhead power lines and associated 200 foot easement to the south. Based on our site plans and calculations the proposed site plan provides the minimum amount of cut necessary to develop the property for the proposed use. The site has been graded to minimize the overall earthwork necessary to support the proposed development and satisfy the water quality and detention requirements for the project.

4. Does the proposal demonstrate water quality equal to or better than would have resulted had development proceeded without the variance? YES/NO

The variance will result in water quality that is at least equal to the water quality achievable without the variance.

5. For a variance from the requirements for development within the Critical Water Quality Zone and/or Water Quality Transition Zone: Does the application of restrictions leave the property owner without any reasonable, economic use of the entire property? YES/NO

Not applicable. There is no development within the Critical Water Quality Zone or Water Quality Transition Zone.

**Top Golf
SP-2011-0216C
Driving Directions**

**Beginning at the Austin City Hall
301 W 2nd St
Austin, TX 78701**

- | | |
|--|--------|
| 1. Take W Cesar Chavez St | 1.3 mi |
| 2. Keep right at the fork, follow signs for TX-1 Loop N and merge onto Loop 1 N | 9.5 mi |
| 3. Take the exit toward TX-1325 S/Burnet Rd/Duval Rd | 0.2 mi |
| 4. Merge onto N Mo-Pac Expy | 0.5 mi |
| 7. Turn right onto Duval Rd/Farm to Market 1325 S
Continue to follow Farm to Market 1325 S as it merges into Burnet Rd.
Destination will be on the left | 0.6 mi |

**11301 Burnet Rd
Austin, TX 78758**

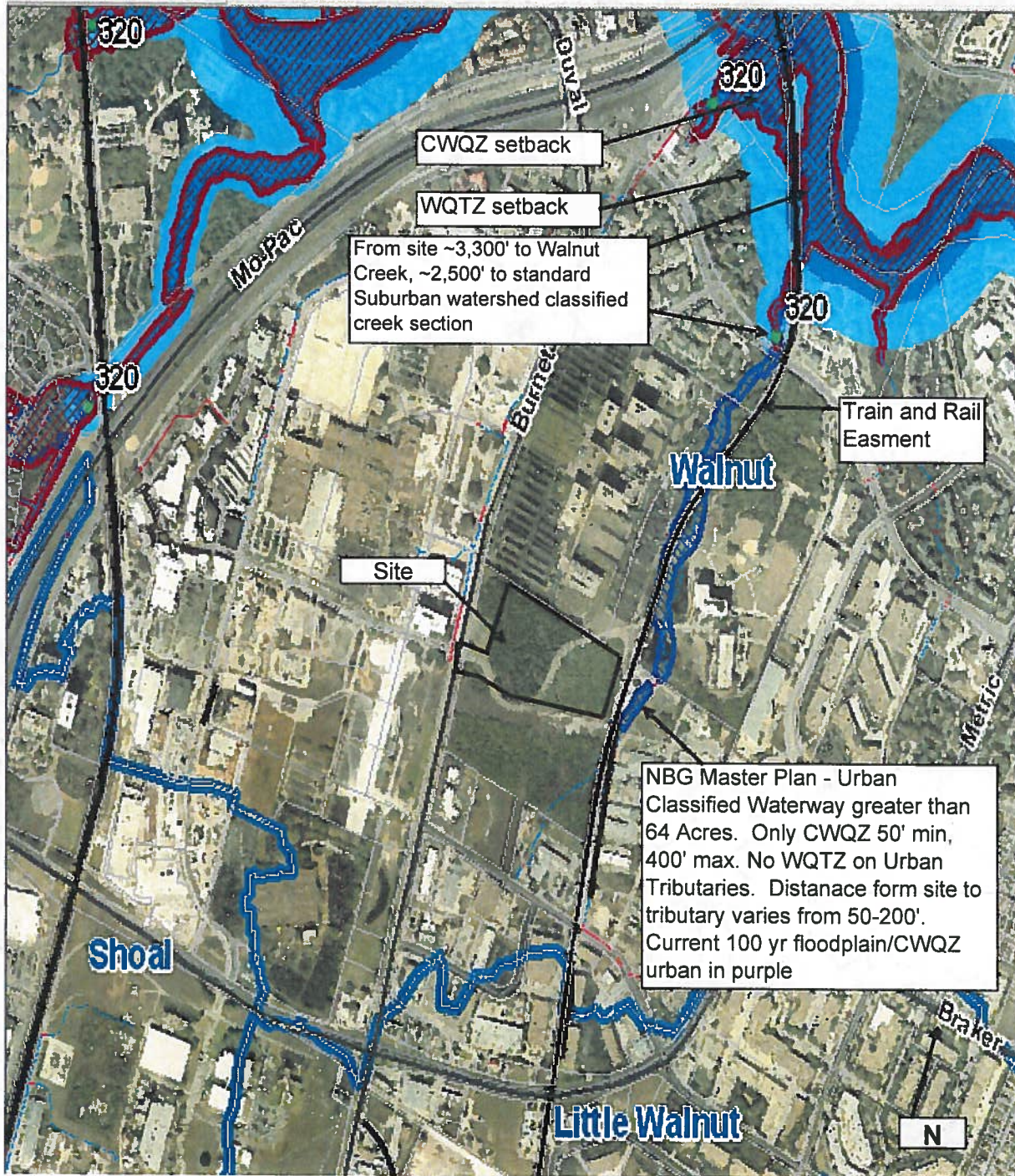
Top Golf SP-2011-0216C

Site location



- The proposed development is located approximately .5 mile north of the intersection Burnet Rd. and Braker Ln. on the East side of Burnet Road. The site is within the City of Austin Full Purpose Jurisdiction.

Top Golf SP-2011-0216C Site Location



Top Golf
SP-2011-0216C
Existing Site Conditions Fill Area Looking South to North



**Top Golf
SP-2011-0216C
Existing Site Conditions Cut Area Looking South to North**



Walnut Creek Update Report

Mateo Scoggins
City of Austin
Watershed Protection and Development Review Department
Environmental Resource Management Division

SR-10-16. May 2010.

Abstract

One of the few large perennial streams in the Austin area, Walnut Creek was monitored intensely from 1996-2008, including chemical, physical and biological measures. This report provides a cursory overview of general water quality status of the watershed, looking at spatial changes from headwaters in Northwest Austin to it's confluence with the Colorado River downstream of Longhorn Dam, as well as temporal changes that have occurred since the watershed was designated as part of the "desired development zone". Although there are some areas of concern, and there is quite a bit of future development pressure, water quality measures generally indicate that the catchment is in fairly good health, and appears to have improved slightly during the study period.

Introduction

Walnut Creek is approximately 23 miles in length and has a drainage area of 56.5 square miles. The stream flows from north-south, crossing from the Central Texas Plateau ecoregion on the western side of Austin to the Blacklands Prairie on the eastern side of Austin and finally draining into the Colorado River downstream of Longhorn Dam. The upper portion of the watershed, to the Northwest, is heavily developed with commercial and residential land uses and recharges the Northern Edwards Aquifer in its headwaters. It is characterized by Edwards limestone outcropping and bedrock, springs, bluffs and rimrock, as well as typical hill country vegetative cover and steep canyons. The lower part of the watershed transitions into deeper soils, large hardwood bottomlands, rolling hills and a relatively deep, incised channel with a robust and diverse riparian zone. This section is less developed, but is classified under City of Austin regulations as being in the Desired Development Zone (DDZ) and is expected to see intensive growth over the next 20 years.

One of the four large, perennial streams in Austin, along with Barton, Onion, and Bull creeks, Walnut has been monitored extensively for the past 12 years by Environmental Resource Management (ERM) staff. During this time we have made over 350 site visits, collecting 274 water chemistry samples, 84 biological samples (bugs and diatoms) and 12 habitat assessments, for an average of about 5 visits per year to each of the 5 study sites in the watershed. This report is a cursory review of the entire Walnut Creek data set, from 1996 to 2008, including biological, chemical and physical constituents over both spatial and temporal scales in an effort to summarize current status and trends.

Methods

Site selection and watershed characteristics

Site selection is based on drainage area, hydrological influences (tributaries, recharge areas), land use patterns and accessibility. Data in this report reflects four mainstem reaches of Walnut Creek, including the intervening drainage areas upstream of each of the mainstem sites (WLN sites) and one reach on the major tributary, Wells Branch (WLS site). Generally speaking, there are three sites in the upper section of the watershed, representing the Central Texas Plateau ecoregion, and 2 sites in the lower section of the watershed, representing the transition to the Blackland Prairie ecoregion (Figure 1). Although we have sporadically collected data at other locations in the watershed, these are the sites with the most robust and longest period of record and are the focus of this report.

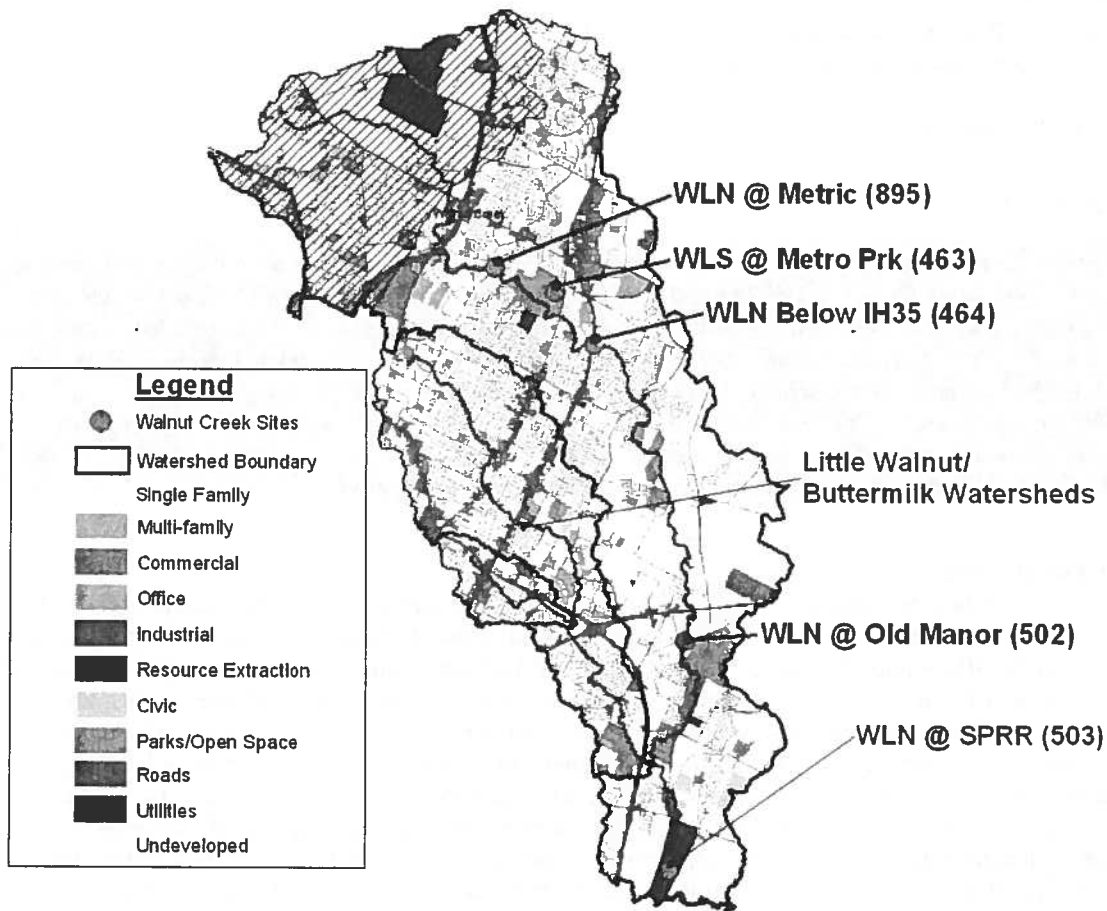


Figure 1. Walnut Creek watershed land use (2006) and 5 study sites assessed in this report. The Little Walnut Creek and Buttermilk watersheds are also shown for reference purposes. The Northern Edwards Aquifer recharge zone is shown in cross-hatch.

Walnut Creek at Metric Boulevard (WLN@Metric) is at the downstream end of the densest residential development in the watershed but has relatively perennial flow due to ground water inputs down-gradient from the Northern Edwards recharge zone (cross-hatch). Total impervious cover in this upper reach, calculated from 2006 land use estimates, is 32%. The Wells Branch tributary of Walnut (WLS @ Metro Park) drains older residential and commercial development along I35 and is typical of Central Texas Plateau geology and ecology, with abundant limestone and clear water. Total impervious cover at this site

is 38%. Walnut at U.S. Interstate 35 (WLN@I35) is just downstream from a large metropolitan park and is essentially the dividing line between the Central Texas Plateau and Blackland Prairie ecoregions and has a reach impervious cover of 33%. The next site, traveling downstream, Walnut at Old Manor Road (WLN@Old Manor) represents the least developed stretch of the watershed as land use shifts from residential to rural/agricultural with large sections of undeveloped land. Impervious cover in this reach is the lowest, at 14%. The farthest downstream site, Walnut at Sewage Plant Rail Road (WLN@SPRR) is approximately 1.5 miles from Walnut's confluence with the Colorado River, but is the last accessible location. It represents the accumulation of the entire watershed drainage area, including the large and heavily urbanized Little Walnut tributary. Impervious cover in this lower, relatively undeveloped reach is only 16%, while cumulative watershed impervious cover at this mouth site is 26%

Land use in the watershed (Fig. 1) is currently dominated by single family residential (22 %), followed by transportation (17%), undeveloped land (13%), agricultural and industrial (both 11%), and a mix of multifamily, commercial, parkland, civic and office (all <7%). Urban development generally occurred first in the northern or upper section of the watershed as Austin growth moved North in the 1960's, culminating in a total watershed impervious cover of 28.5% in 2008 (Fig 2a). Development has generally been more dense and grown faster in the northern part of the watershed (WLN@Metric, WLS@Metro Park and WLN@I35), increasing from approximately 20% to 35% impervious cover during our study period, versus the lower part of the watershed (WLN@Old Manor, WLN@SPRR) which went from about 10 to 15% impervious cover over the same period(Fig. 2b).

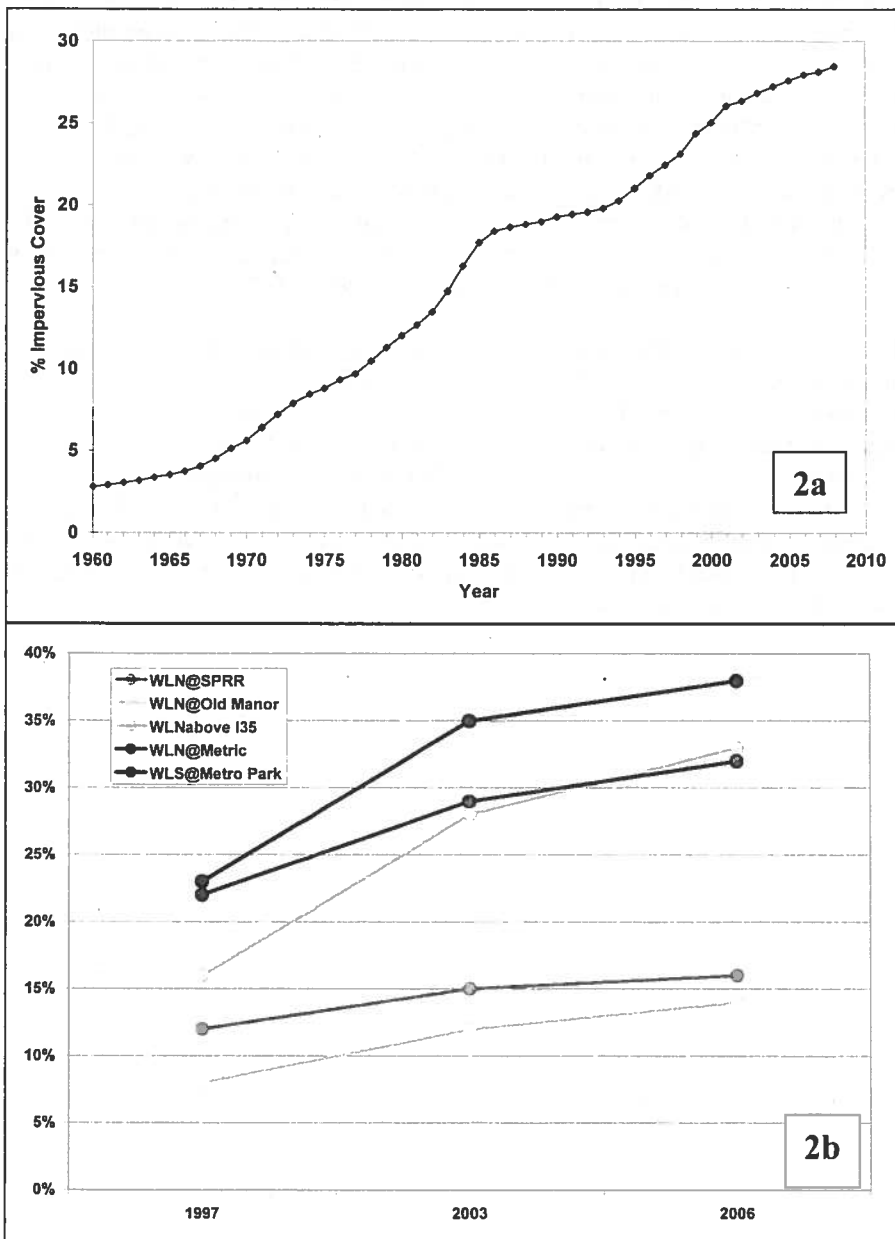


Figure 2. Impervious cover changes in the Walnut watershed from 1960-2008 (2a, from Herrington, 2010) and at each Walnut study reach during our study period (2b).

Since about 1986, when the Comprehensive Watershed Ordinance was adopted, environmental protection became more rigorous and regulated, with a proliferation of water quality controls for new commercial and residential development (Fig 3), resulting in 45% of the development in the Walnut watershed being treated by some kind of control structure by 2008 (about 9,000 acres of development treated).

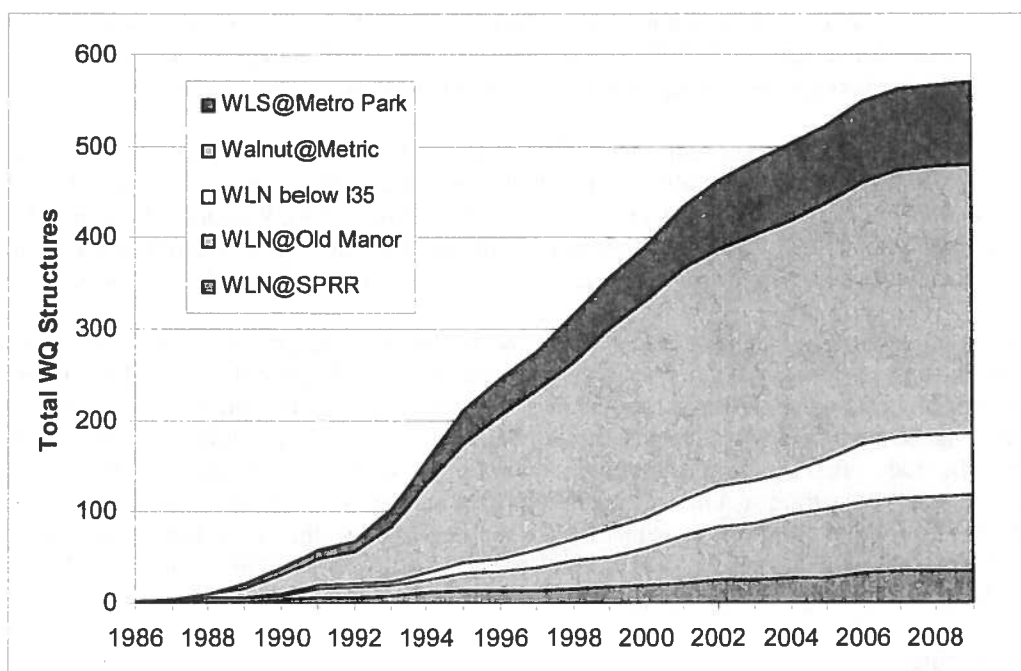


Figure 3. Increase in number of water quality structures (sand filters, ponds) installed in each of the study reaches on Walnut Creek since 1986, when regulations began requiring stormwater treatment.

Water Chemistry Monitoring

Water chemistry via instream grab samples was collected according to standard procedures (WRE SOP 2008) approximately 3 times per year at all sites. All lab parameters (Table 1) were analyzed by the Walnut Creek Analytical Lab Services through 2005 and then the Lower Colorado River Authority Environmental Lab from 2005 to the present. Both labs were EPA/NELAC certified. In addition to site samples, replicates, splits and blank samples were collected to assess both field and lab accuracy and precision. Although quality assurance data will not be presented or assessed in this report, all data included in this analysis complied with City of Austin quality assurance objectives (WRE SOP section 3.4) and generally followed the States (TCEQ) guidance on Quality Assurance Project Plans (QAPPs). Field parameters were measured at all site visits using a multi-probe (Hydrolab Datasonde) and included dissolved oxygen (mg/l), temperature(°C), Conductivity (µS/cm), and pH (standard units).

Table 1. Laboratory and field constituents sampled during periodic water chemistry surveys at five Walnut Creek sites.

Laboratory Analysis	Field Measurements
Nitrate + Nitrite (mg/l)	Flow (cfs)
Ammonia (mg/l)	Temp (°C)
Orthophosphorus (mg/l)	pH (St. Units)
Total Suspended Solids (mg/l)	Conductivity (uS/cm)
E. Coli Bacteria (mpn/100ml)	Dissolved Oxygen (mg/l)

Biological Monitoring

Standard rapid bioassessment methods, Level III (WRE SOP 2010 section 5.3, Barbour et al. 1999) were followed in the collection and processing of benthic macroinvertebrate community samples with the following exceptions:

- All organisms were sorted and preserved in the field, as opposed to the laboratory.

- Samples were generally sorted in their entirety, as opposed to sub-sampling to a fixed-count.
- High abundance samples (>1000 organisms) were subsampled using a Caton subsampler.
- Surber samplers (0.1 m², 500um mesh net) were used instead of 1m² kick nets.

Three replicate surbers were collected from each riffle, composited and sorted in the field. Organisms from each sample were enumerated and identified to the lowest practicable taxonomic unit, usually genus, by City of Austin taxonomists using the keys of Merritt and Cummins (2008), Wiggins (1996), Epler (1996), Thorp and Covich (1991), Pennak (1989) and Berner & Pescador (1988). The following groups were not identified to genus: Chironomidae, Ostracoda, Hydracarina, Hirudinea, and Oligochaeta.

Diatoms are single celled algae that have been shown to be an excellent indicator of environmental health due to their predictable response to a variety of anthropogenic stressors. Routine diatom collections are sampled from periphyton from rocks (epilithon) in the same study riffle that benthic macroinvertebrates are collected using standard field procedures (WRE SOP 2010 section 5.4). Generally, three rocks are collected from the study riffle, scraped clean of periphyton using a stainless steel bristle brush, composited and preserved with formalin. Collected periphyton samples are processed and diatoms were enumerated and identified to the species level by B. Winsborough. All benthic macroinvertebrate and diatom counts were tabulated and used to calculate uni-variate metrics (WRE SOP 2010 Section 9.7, 9.8) to assess spatial and temporal patterns.

Habitat Monitoring

Physical characterization of the stream sites, including riffle, reach and instream cover assessment was completed three times, in 2005, 2006 and 2007, using a modified version of the EMAP habitat assessment method (WRE SOP 2008). In addition, during each benthic macroinvertebrate survey, the EPA RBP visual Habitat Quality Index sheet was used to generally inventory habitat quality (Barbour et al. 1999). Both of these data sets are used to compare overall habitat quality and spatial differences among sites in the interpretation of the biological data.

Analysis

Most analysis in this report focuses on the four mainstem Walnut Creek sites (excluding the Wells Branch Tributary), due to the longer and more comprehensive data sets at these sites. If clear spatial differences or temporal trends were noted at this site, they are reported in the appropriate sections.

The most recent City of Austin's Environmental Integrity Index (EII) score was calculated for each watershed in Austin. The EII score is a combination of a water quality, sediment, contact recreation, non-contact recreation, physical integrity, aquatic life, algae cover, benthic macroinvertebrate, diatom, and fish scores. Watersheds are not sampled for EII every year. Thus years that the scores were calculated for ranged from 2006 to 2008 depending on the watershed. Scores were ranked, compared between watersheds, and placed in categories. EII scores range from 0 to 100 and are grouped in the following categories:

0-12.5 = Very Bad	12.6-25 = Bad	25.1-37.5 = Poor	37.6-50 = Marginal
50.1-62.5 = Fair	62.6-75 = Good	75.1-87.5 = Very Good	87.6-100 = Excellent

The most recent overall watershed EII score was graphed for all watersheds. The EII sediment score for Walnut Creek was plotted over time.

Spatial analysis was performed on water quality data, benthic macroinvertebrate metrics, and diatom metrics from samples collected beginning in 1996 to 2008 on Walnut Creek. Water quality parameters included nutrients, *E. coli*, and field measurements. Benthic macroinvertebrate metrics included number

of taxa, number of diptera taxa, number of ephemeroptera taxa, number of ept taxa, number of intolerant taxa, percent dominance (top 3 taxa), hilsenhoff biotic index, percent of total as chironomidae, percent of total as elmidae, percent of total as ept, percent of total as collector/gatherer, percent of total as predator, percent of total as filterers, percent of total as grazers, ratio of intolerant to tolerant organisms, percent of total as tolerant organisms, and TCEQ qualitative aquatic life use score. Diatom metrics included number of taxa, pollution tolerance index, cymbella richness, percent motile taxa, and percent similarity to a reference condition.

The distribution of water quality, benthic macroinvertebrate, and diatom data was checked for normality by the Shapiro-Wilk test in SAS. Analysis of Variance was carried out on the parameters with a normal distribution while a Kruskal-Wallis test was performed on the non-normally distributed parameters to examine whether or not a difference existed between sites for a given parameter. To examine which sites were significantly different for each parameter a Tukey-HSD multiple comparison test was performed on parameters where a significant difference existed according to an ANOVA. The minimum p-value multiple comparison test was performed on parameters where a significant difference existed according to a Kruskal-Wallis test. All alpha levels were set to 0.05 for this analysis.

The water quality, benthic macroinvertebrate, and diatom data was analyzed for temporal trends from 1996 to 2008. The same parameters that were analyzed in the spatial analysis were analyzed for temporal trends. Parameter data that was normally distributed was analyzed using least-squares regression with the PROC REG procedure in SAS, while data that was non-normal was ranked first and then analyzed using general linear regression using the PROC GLM procedure in SAS. Water quality data that contained values below detection level were analyzed using Cox's proportional hazards regression in SAS using the PROC PHREG procedure. Alpha levels were set to 0.1 for temporal analysis. Only significant trends were presented in this report.

Intensive habitat surveys included 5 transects at each site that measured bank stability, vegetative protection, channel alteration, flow within the channel, embeddedness, epifaunal substrate, frequency of riffles, riparian zone width, sediment deposition, and the number of velocity/depth categories. Habitat data was compiled and placed into a matrix to calculate the Habitat Quality Index (HQI) for each site. A Kruskal-Wallis test was used to examine the difference between sites in HQI score. The minimum p-value multiple comparison test was used to determine which sites had significantly different HQI scores.

Results

General

The Walnut Creek watershed scored in the 78th percentile when compared to all other Austin-area watersheds in our most recent Environmental Integrity Index (EII) survey. With an overall score of 72 out of 100, it fell below 10 other watersheds (Figure 4). In four EII surveys over the past 12 years, Walnut has consistently scored in the "Good" category range (62.5-75), the highest score being 76 in 2000 and the lowest being 67 in 1996. These scores are a robust measure of overall environmental health, incorporating aquatic biology, water chemistry, sediment chemistry, habitat, and contact/non-contact recreation measures (COA-EII Methods, 1998).

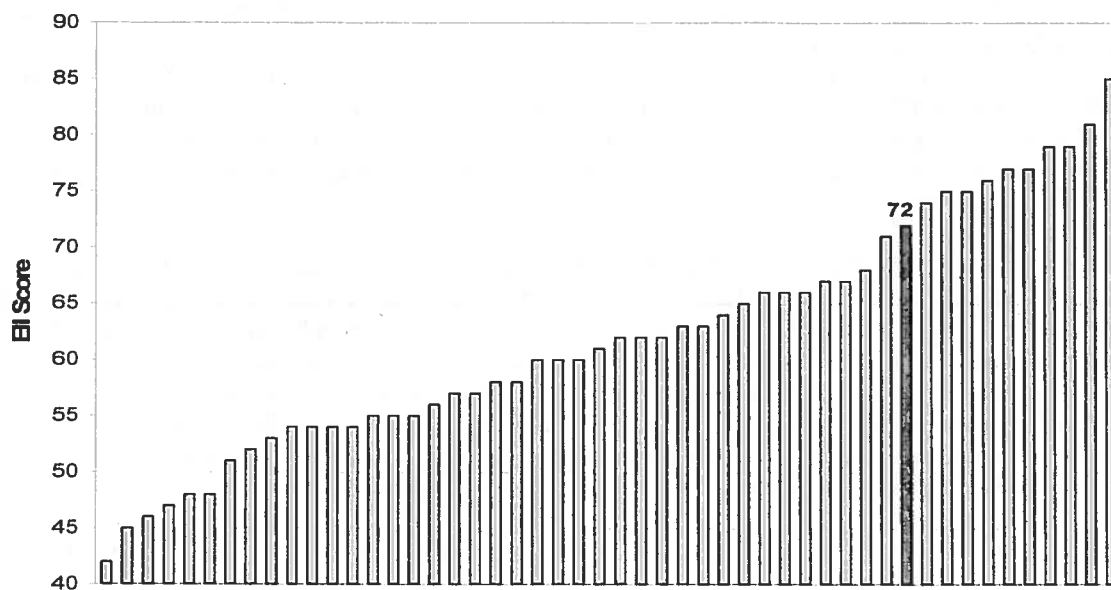


Figure 4. Overall EII scores from most recent surveys for all 50 monitored watersheds, with Walnut Creek score indicated in red.

The EII sediment score is a more specific, but also robust measure of watershed health that combines a wide range of chemical constituents (24) that accumulate from the entire watershed drainage area. Walnut sediment scores have remained in at least the “Very Good” category during all four EII surveys, with the 2000 data scoring in the “Excellent” category (Figure 5). . These scores reflect the long term accumulation of pollutants that cling to sediments (metals, polycyclic aromatic hydrocarbons and herbicides/pesticides) that can be significant stressors to aquatic life and tend to increase with increasing levels of urbanization.

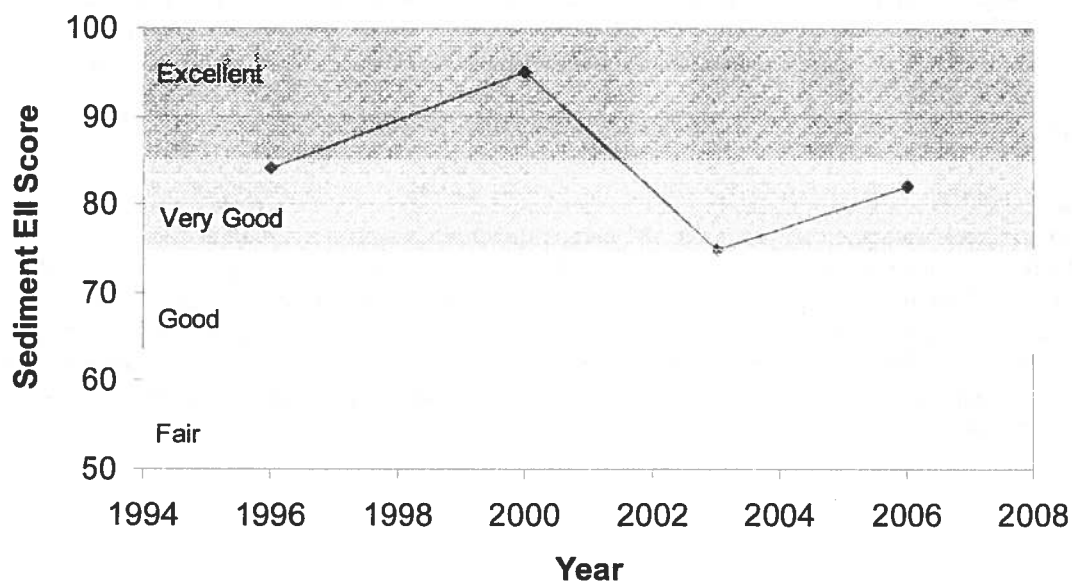


Figure 5. Sediment EII score for the Walnut Creek watershed for the four survey years, 1996, 2000, 2003 and 2006.

Water Chemistry

Spatial

The 12 year water chemistry data set shows very little significant difference among the four mainstem study sites (not including the Wells Branch tributary). Most parameters showed no difference among sites, but there were some general spatial patterns that emerged (Figure 6). As would be expected, flow increased from upstream to downstream (A), going from a mean of about 3 cfs at the upstream site (Metric Blvd) to a mean of 9 cfs at the downstream site (SP Railroad). The SP Railroad site was the only one with a significantly higher mean among the other sites. Conductivity was similar among sites, but the upstream site was elevated, although only significantly higher than the I35 and SP Railroad sites (B). E. coli bacteria, an indicator of contact recreation risk was much higher at the upstream Metric Blvd site than all other sites (C) and Total Suspended Solids, an indicator of erosion and fine sediment degradation, was significantly higher at the downstream SP Railroad site (D).

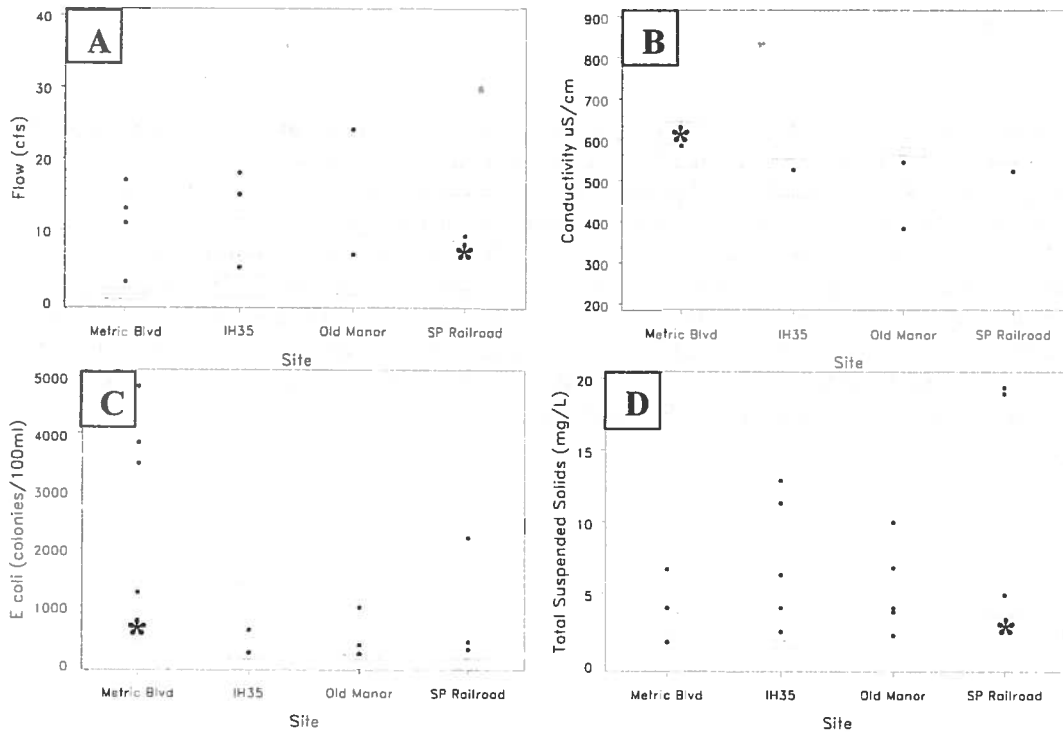


Figure 6. Examples of spatial patterns in Flow (A), Conductivity (B), E. Coli bacteria (C) and Total Suspended Solids (D) at four mainstem Walnut Study sites from upstream to downstream (left to right). An asterisk (*) indicates a site that is significantly different from the other sites.

Temporal

There were significant temporal trends in the water chemistry data among the Walnut study sites that indicate potentially important changes in the watershed. Conductivity (Figure 7) and Nitrate (Figure 8) had significant decreasing trends over time at multiple sites. In addition to these two parameters, there were also noted improvements in water chemistry measures at individual sites for orthophosphorus and phosphorus. In all, out of 11 chemistry measures, 4 showed a significant improvement over time at more than one site (Conductivity, Nitrate, Orthophosphorus and Phosphorus), 2 showed degradation over time at only one site (pH and Turbidity), and 5 showed no significant trends at any sites (Ammonia, Dissolved Oxygen, E.coli, Total Suspended Solids and Temperature). No water chemistry variables showed significant negative trends.

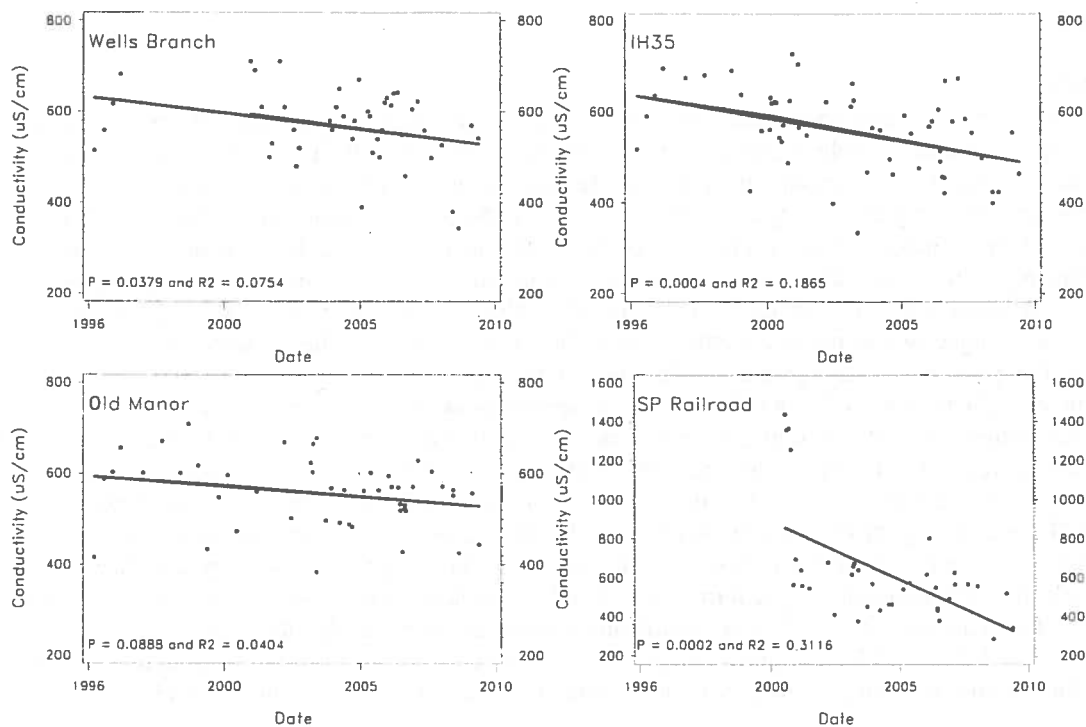


Figure 7. Examples of significant temporal patterns in conductivity at four Walnut Study sites. Alpha-level (p-value) and R² value are noted on each graph.

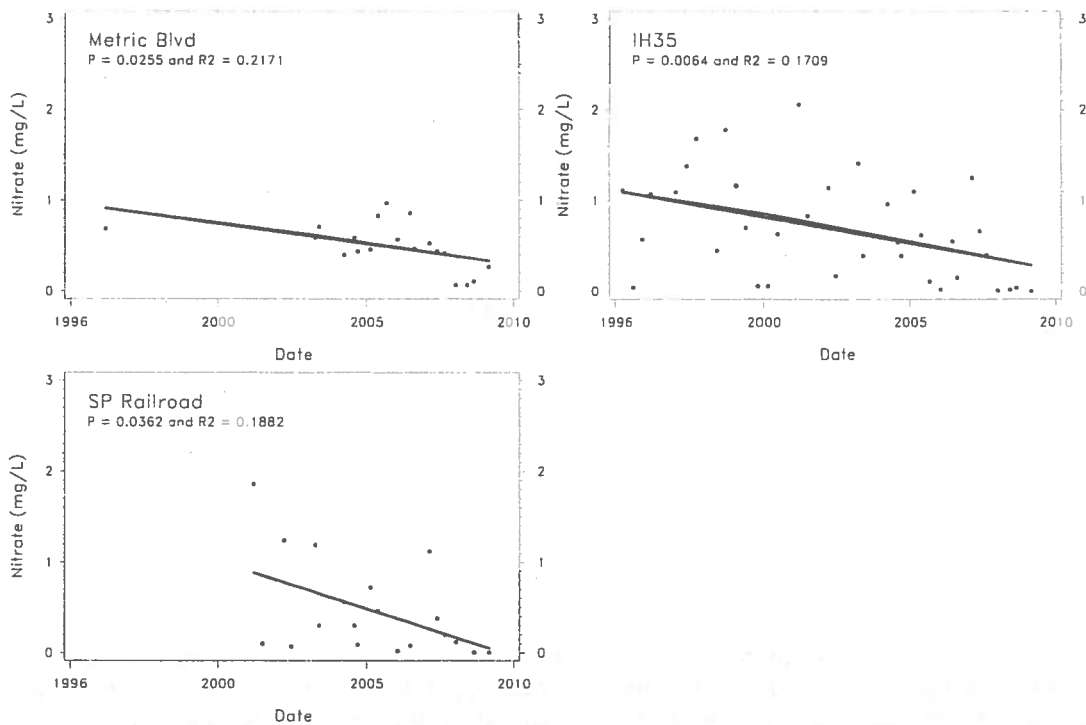


Figure 8. Examples of significant temporal patterns in Nitrate-N at three Walnut Study sites. Alpha-level (p-value) and R² value are noted on each graph.

Biology

Spatial

In general, similar to the water chemistry variables, the biological data did not strongly distinguish among study sites. The most notable spatial pattern on mainstem Walnut (not including the Wells Branch Trib), from an upstream to downstream direction, was degradation at the most upstream site and most downstream site compared to higher community health at the two midstream sites (Figure 9). The Hilsenhoff Biotic index measures sensitivity of the benthic macroinvertebrate community to organic enrichment, resulting in a score from 1-10, where 1 is an intolerant, low nutrient community (good) and 10 is an enriched, tolerant community (bad). In this analysis, the upstream site (Metric Blvd) had a significantly higher/worse mean score than any of the other sites (7A) while the downstream site (SP Railroad) appears to have a higher mean than the two mid-stream sites, but the difference was not significant. The ratio of Tolerant to Intolerant Organisms showed a similar pattern, where Metric and SP Railroad bridge were not different from each other, but the two midstream sites (IH35 and Old Manor) had better mean scores than the other sites (7B), indicating a higher portion of intolerant or sensitive benthic macroinvertebrates. One taxa, the riffle beetle family Elmidae, showed this same pattern very distinctly, with the upstream and downstream sites having significantly lower abundances of this organism than the two midstream sites (7C). This taxa is not known to be particularly sensitive, but does have narrow habitat tolerances which may be driven by hydrology. Only one diatom community metric, the Pollution Tolerance Index, showed significant differences among study sites (7D). This index is similar to the Hilsenhoff Biotic Index, compositing tolerance values for the entire diatom taxa list and indicating a more nutrient enriched, degraded community at the downstream site, SP Railroad.

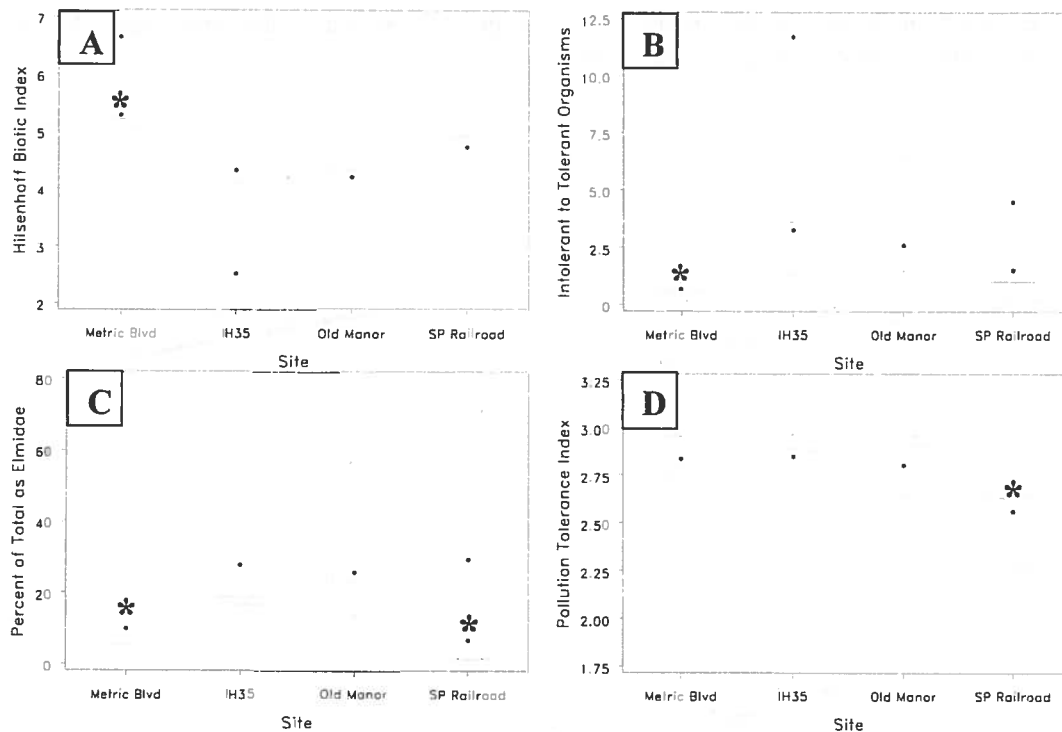


Figure 9. Examples of spatial patterns in biological metrics in the benthic macroinvertebrate (A, B, C) and diatom community (D) measures at four mainstem Walnut Study sites from upstream to downstream (left to right). An asterisk (*) indicates a site that is significantly different from the other sites.

Temporal

Out of the 22 biological measures evaluated at the four mainstem study sites, (17 benthic macroinvertebrate and 5 diatom metrics), 8 were significant (6 benthic macroinvertebrate measures, 2 diatom measures), all showing improvements over time for at least one study site. In general, there was a mix of different measures with significant trends at different sites from either the benthic macroinvertebrate community or the diatom community. However, some were relatively consistent watershed wide. The Hilsenhoff Biotic Index showed significant improvement over the study period at three of the four mainstem sites, starting at I35 and including all downstream sites (Figure 10). Other measures that are important, and showed significant improvement over time, but were not consistent among sites were: Number of Taxa at Metric Blvd, Percent Dominance (3 taxa) at Wells Branch, Number of Intolerant Taxa at I35 and the diatom Pollution Tolerance Index and the diatom Percent Motile both at I35.

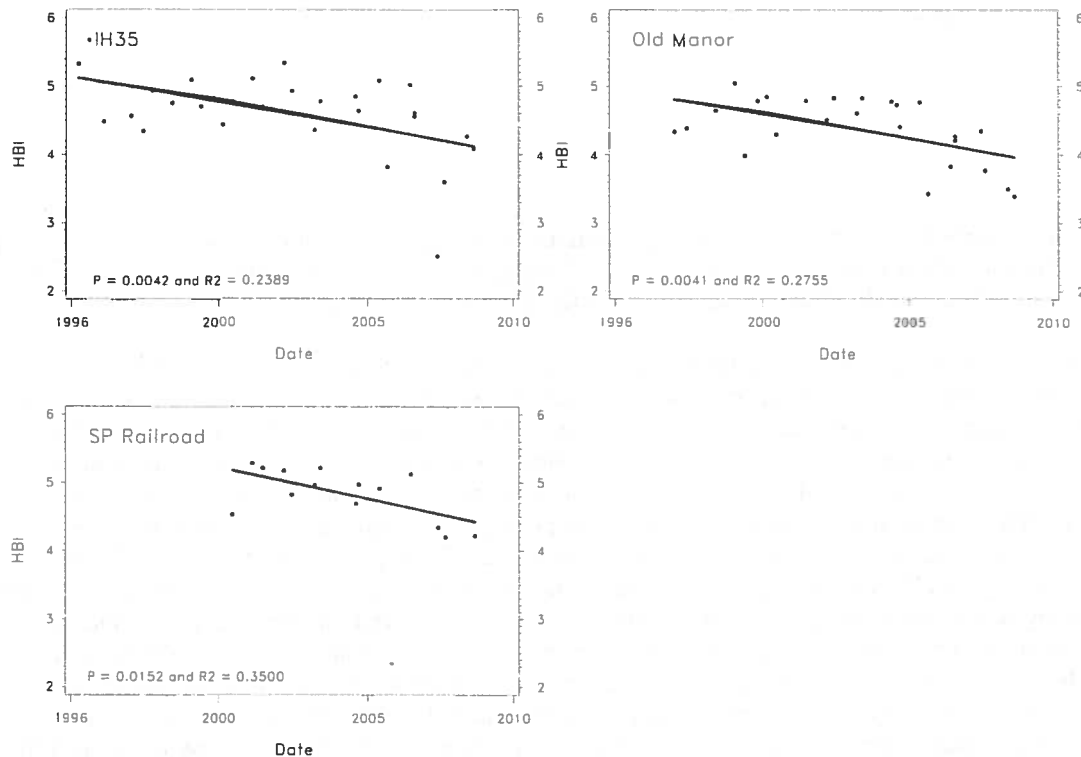


Figure 10. Examples of significant temporal patterns in the Hilsenhoff Biotic Index, all increasing in community health over time, at three Walnut Study sites. Alpha-level (p-value) and R^2 value are noted on each graph.

Habitat

Spatial

The visually-based Habitat Quality Index (Barbour et al. 1999) was used during biological surveys to assess general habitat quality, including in-channel, bank and riparian measures. The general pattern of habitat quality on Walnut creek was a decrease from upstream to downstream, with the Wells Branch Tributary (WLS@Metro Park) having the highest scoring reach followed by the most upstream Walnut site (WLN@Metric) and then decreasing at the downstream sites (Fig. 11). However, the only significant difference among these sites was that the two downstream sites (WLN@Old Manor, WLN@SPRR) scored lower than the three upstream sites. In general, they all fell within the sub-optimal range in the EPA scoring system.

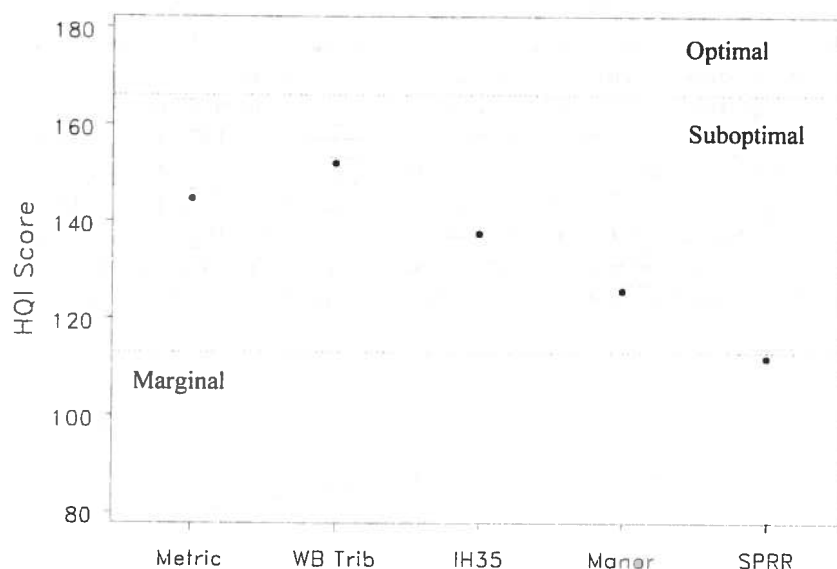


Figure 11. Distribution of HQI scores among 5 Walnut creek study sites, collected between 1996 and 2008. Box plots show mean (dot), Median (center line), quartiles (box) and range (whiskers) of all data for each site. Manor and SPRR sites are significantly different from Metric, WB Trib and IH35.

In addition to the HQI, quantitative habitat surveys were conducted three times in 2005-2008 to understand spatial variation among study sites and for interpretation of biological data. In general, habitat physical measures were predictably different from upstream headwater conditions at Walnut @ Metric to larger channel conditions toward the mouth, at Walnut @ SPRR. Canopy coverage was high upstream (86% at Walnut @ Metric) and got progressively lower as drainage area increased (16% at Walnut @ SPRR). Bed substrate size, as measured using a 100 point pebble count, generally decreased from upstream to downstream, with small cobble (65-128mm) dominating at the upstream sites (Walnut @ Metric, Walnut @ I35), coarse gravel (33-45mm) dominant at the midstream site (Walnut @ Old Manor) and finally sand (<2mm) dominant at the mouth site (Walnut @ SPRR). Instream cover, including woody debris, roots, undercut banks and aquatic vegetation, was highest at the upstream site (Walnut @ Metric) with about 30% total cover, while all the downstream sites had about 20% cover of aquatic habitat. Reach length at the study sites was established based on bankfull width (20 x Bankfull width) and increased predictably from upstream to downstream, going from 385 ft at Walnut @ Metric up to 1200 ft at Walnut @ SPRR. Stream habitat type was fairly consistent among study sites, with all sites having 2-3 each of riffle, run and pool habitats per site reach with the exception of the most downstream site, Walnut @ SPRR, which had 5 riffles, 3 runs and 4 pools in the study reach.

Discussion

Walnut Creek sites showed only minimal differences among them for our study variables. Water chemistry along Walnut Creek does not change very much, apart from higher *E. coli* bacteria levels at the most upstream site. Other physico-chemical differences can be accounted for by drainage area and the geologic changes that occur as Walnut goes from the Central Texas Plateau ecoregion and the Northern Edwards Aquifer recharge zone into the Blacklands Prairie ecoregion. Examples of this are increases in flow volume, increases in total suspended solids, and decreases in substrate particle sizes from upstream to downstream. Within the biological data, there is evidence that the headwaters and the mouth site are in worse shape than the middle two sites. This corresponds with density of development in the upper portion of the watershed, and the negative influence of heavily urbanized Little Walnut Creek, that enters Walnut mainstem above the mouth site. The two middle sites, particularly Old Manor, benefit from large riparian areas that are relatively intact and park and preserve land that is undeveloped, thus providing some area for “recovery”. This is an interesting pattern to note and worth keeping track of as development continues over the next 10 years.

Over our study period, we have documented some small but interesting trends. Water chemistry is not degrading over time at any sites, and for several measures, including conductivity, nitrates and phosphorus, we have observed significant improvement, or decreases in concentrations, at multiple sites during our study period. A similar pattern was observed in the biological measures, which in general, are a more robust measure of overall stream health. None of the indexed benthic macroinvertebrate or diatom metrics showed significant degradation over time, and several showed improvement over time at various sites. The Hilsenhoff Biotic Index, which is a measure of tolerance of the benthic macroinvertebrate community to organic enrichment, showed significant improvement at three sites.

These patterns of increased stream health over time are the opposite of what would be expected, considering the increased development and impervious cover that have occurred in this watershed during our study period (Fig 2). There are a couple possible explanations for this, but no clear answer. Walnut Creek was developed fairly intensely during the 70's and 80's (Fig 2a), and from analysis of flow and impervious cover, there was apparently a threshold hydrologic response (degradation) to that development that shows up between 13-18% impervious cover, which occurred between 1981-1986 (Herrington, 2010). It is possible that enough time has passed that the Walnut watershed is “relaxing” into this new hydrologic regime, adjusting it's channel size and sediment distribution, and starting to recover from the more extreme stress that occurred approximately 30 years ago.

The other possible explanation, which corresponds to the above hydrologic threshold, but is not directly related, has to do with the development conditions that have been in place during our study period. As noted (Fig 3), more rigorous structural controls were implemented in Austin starting just before this study began, in the early 90's. These controls are intended to remove solid and dissolved pollutants and in some cases, detain and “shave” peak flows. Austin has been on the forefront of development of stormwater controls, and it is possible that they have, in fact, mitigated the negative effects of development in the watershed to some extent. This would be impressive if the watershed showed no degradation over this period, but the fact that it shows improvement suggests that there is something else going on, probably related to legacy stressors as discussed above.

The water quality patterns in the Walnut Creek watershed, as presented here, appear to be a complex mix of spatial and temporal factors that include the quantity and quality of development that occurred long before this study started, the stormwater and construction related best management practices that have evolved over the past 30 years, and the ecological resilience of the watershed (geologically, hydrologically, and biologically). Considering the increased development pressure that this catchment

will see over the next 30 years, it is important to continue to mitigate any and all ecological stressors and protect and preserve as much open space as is feasible to maintain the currently positive trend we appear to be observing.

Recommendations

- Continue to monitor all four mainstem and the major tributary (Wells Branch) sites using the Environmental Integrity Index, on a biannual basis to evaluate long term trends and keep track of locally important spatial variation.
- Perform a special study to identify and remove the source of E. coli bacteria to the upstream site (WLN@Metric).
- Perform comprehensive riparian integrity study using the Index of Riparian Integrity to evaluate apparent recovery phenomenon at mid-watershed sites (WLN@I35 and WLN@Old Manor).

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