

July 8, 2016

Mr. Don Comins, Chairman  
Pend Oreille County Planning Commission  
Community Development Department  
P.O. Box 5066  
Newport, Washington 99156

Dear Chairman Comins and Planning Commissioners:

**Subject: Comments on the Proposed Amendment to the Future Land Use Map and Rezone (Wasatch Assoc. proposing to change the designation of 167 acres from NR-20 to R-5).**

Sent via email to: [Mlithgow@pendoreille.org](mailto:Mlithgow@pendoreille.org)

Thank you for the opportunity to comment on the proposed Comprehensive Plan amendment, amending the Future Land Use Map and rezoning 167 acres from Natural Resource Lands 20 (NR-20) to Rural 5 (R-5). As will be documented below, the property proposed by Wasatch Associates to be de-designated from NR-20 to R-5 continues to qualify for an NR-20 comprehensive plan designation and NR-20 zone. Therefore, we urge the Pend Oreille County Planning Commission to recommend denial of this application.

Futurewise is working throughout Washington State to create livable communities, protect our working farmlands, forests, and waterways, and ensure a better quality of life for present and future generations. We work with communities to implement effective land use planning and policies that prevent waste and stop sprawl, provide efficient transportation choices, create affordable housing and strong local businesses, and ensure healthy natural systems. We are creating a better quality of life in Washington State together. We have members across Washington State including Pend Oreille County.

## Summary

- The Wasatch Associates property continues to meet the Pend Oreille County criteria for the Natural Resource Lands 20 (NR-20) comprehensive plan designation and zone. Having been “[d]esignated as Timber, or Agricultural Lands,” the Wasatch Associates property meets the tax status criterion and the other comprehensive plan criteria as well. The Wasatch Associates’ surveyor misquotes the tax status criterion as we show below, so their argument that their land no longer meets the Natural Resource Lands 20 criteria fail. The Planning Commission should recommend denial of the application. Please see page 2 of this letter for more information.
- The Wasatch Associates property proposed to be de-designated continues to meet the Growth Management Act criteria for agricultural land of long-term commercial significance. Please see page 5 of this letter for more information.

- The designation and de-designation of agricultural lands requires an area-wide approach. The Wasatch Associates de-designation violates the Growth Management Act because the Natural Resource 20 comprehensive plan de-designation only considers part of the Wasatch Associates property and not all of the Natural Resource 20 land in the area. Please see page 10 of this letter for more information.
- The Wasatch Associates argument that “urban services” exist fails to justify the de-designation of Natural Resource Lands because that is not one of the criteria considered in designating and de-designating Natural Resource 20 land. Please see page 11 of this letter for more information.
- De-designating the Wasatch Associates farmland will increase costs to taxpayers and ratepayers because single-family homes pay less in taxes than they require in public services.<sup>1</sup> Please see page 12 of this letter for more information.

## Detailed Comments

### The Wasatch Associates property continues to meet the Pend Oreille County criteria for the NR-20 comprehensive plan designation and zone

The Natural Resource Lands 20 (NR-20) comprehensive plan designation is a natural resource lands of long-term commercial significance designation.<sup>2</sup> The *Pend Oreille County Comprehensive Plan* sets out three criteria for the NR-20 comprehensive plan designation and zone.<sup>3</sup> Here are the Natural Resource Lands 20 criteria quoted from the *Pend Oreille County Comprehensive Plan Table 2.1* (part) on page 17:

Factors	Natural Resource Lands 20
Density	1 dwelling unit/20 acres[.]
Relation to road system	Must have approved road access.
Tax Status	Designated as Timber, or Agricultural Lands, or currently in use as a mine.

<sup>1</sup> American Farmland Trust, Farmland Information Center *Fact Sheet: Cost of Community Services Studies* pp. 2 – 5 (August 2010) accessed on June 8, 2016 at: [http://www.farmlandinfo.org/sites/default/files/COCS\\_08-2010\\_1.pdf](http://www.farmlandinfo.org/sites/default/files/COCS_08-2010_1.pdf) and enclosed with this letter. Two of these studies were done in Washington State. *Id.* at p. 5.

<sup>2</sup> *Pend Oreille County Comprehensive Plan* pp. 36 – 37 (2014 Update, Adopted 6-09-2015) accessed on June 16, 2016 at: <http://pendoreilleco.org/wp-content/uploads/2015/08/Comp-Plan-Update-Adopted-06-09-2015.pdf> and on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Other Info” directory with the filename: “Comp-Plan-Update-Adopted-06-09-2015.pdf.”

<sup>3</sup> *Pend Oreille County Comprehensive Plan* p. 17 (2014 Update, Adopted 6-09-2015).

The Wasatch Associates property, Parcel Number 433708500005, is 426.78 acres and has three dwellings on it.<sup>4</sup> This is a density of one dwelling unit per 142 acres. Parcel Number 433708500005 has access onto Le Clerc Road North.<sup>5</sup> The property was formerly in the Agriculture (Open Space) tax status and in a Designated Forest Land tax status.<sup>6</sup> So Parcel Number 433708500005 meets the county's criteria for the NR-20 comprehensive plan designation and zone.

Some may argue by taking Parcel Number 433708500005 out of the Designated Forest Land and the current use agricultural taxation programs the land no longer meets the county's criteria for the NR-20 comprehensive plan designation and zone. But comprehensive plan's tax status criterion is "[d]esignated as Timber, or Agricultural Lands, or currently in use as a mine."<sup>7</sup> The comprehensive plan uses the past tense, "designated" for tax status.<sup>8</sup> And as was documented above, these properties were Designated Forest Land and in the agriculture current use taxation program. The comprehensive plan also provides that for mineral resource lands it has to be "currently in use as a mine."<sup>9</sup> So the comprehensive plan purposefully distinguishes between the past and present tenses in the designation criteria.

Use of the past tense for the tax status criterion is required by the Growth Management Act. In *Manke Lumber Co., Inc. v. Diehl* the court of appeals upheld using tax status as a criterion for designating forest land of long-term commercial significance because the criterion "relates back to tax classifications made as of January 31, 1992, thus precluding land owners' circumvention of [forest land of long-term commercial significance] designations by changing their tax classifications after the October 1, 1993, effective date of the county's [Interim Resource Ordinance, with which Mason County designated forest lands of long-term

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<sup>4</sup> Pend Oreille County Assessor & Treasurer - Property Details - 6 WASATCH ASSOCIATES III\IV for Year 2016 - 2017 pp. \*3 - 5 on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the "2016 Real Property Data" directory with the filename: "433708500005 Pend Oreille County Assessor & Treasurer - Property Details - WASATCH ASSOC.pdf." The map showing Parcel Number 433708500005 is on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the "2016 Real Property Data" directory with the filename: "433708500005 Map.pdf."

<sup>5</sup> Pend Oreille County Community Development Map showing an aerial image of the vicinity on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the "2016 Real Property Data" directory with the filename: "Aerial Dedesign Area.pdf."

<sup>6</sup> *Id.* at pp. \*5 - 6; Pend Oreille County Assessor & Treasurer Property Search Results > 6574 Wasatch Associates III\IV for Year 2013 - 2014 pp. 1 - 3 of 3 on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the "2014 Real Property Data" directory with the filename: "433709200001 Pend Oreille County Assessor & Treasurer Property Info.pdf;" Pend Oreille County Assessor & Treasurer Property Search Results > 6516 Wasatch Associates III\IV for Year 2013 - 2014 p. 3 of 3 on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the "2014 Real Property Data" directory with the filename: "433708500005 Pend Oreille Co Assessor & Treasurer Property Info.pdf." Aerial images of the properties are on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the "2014 Real Property Data" directory with the filename: "Aerial Image 433709200001 Aerial 2-28-2014 11-41-21 AM.pdf" and the filename: "433708500005 & Vicinity 2-28-2014 11-55-52 AM.pdf."

<sup>7</sup> *Pend Oreille County Comprehensive Plan* p. 17 (2014 Update, Adopted 6-09-2015).

<sup>8</sup> *Id.*

<sup>9</sup> *Id.*

commercial significance].”<sup>10</sup> If the Pend Oreille County Comprehensive Plan allowed potential developers to de-designate agricultural and forest land of long-term commercial significance by changing the land’s tax status, the comprehensive plan would be inconsistent with the court of appeals’ reasoning in the *Manke Lumber Co., Inc. v. Diehl* decision and, therefore, violate the Growth Management Act.

Further, the Pend Oreille County Assessor designated 184.78 acres of Parcel Number 433708500005 as “8100 Agriculture (Not Current Use).”<sup>11</sup> So this land continues to have an “agricultural lands” tax status designation.<sup>12</sup>

In arguing that their property does not meet this criterion, Wasatch Associates’ surveyor misstates its wording. Wasatch Associates’ surveyor states the criterion, citing to the *Pend Oreille County Comprehensive Plan* Table 2.1, as “[p]arcel(s) with Natural Resource designation must have a tax status as a designated Timber or Agricultural Land or currently in use in the as a mine.”<sup>13</sup> Despite the quotation marks, this is not a quote from the *Pend Oreille County Comprehensive Plan*. The language “[p]arcel(s) with Natural Resource designation must have a tax status as a” appears nowhere in the comprehensive plan<sup>14</sup> and nowhere in Table 2.1.<sup>15</sup> More critically, the Table 2.1 uses the past tense “[d]esignated as Timber, or Agricultural Lands . . .”<sup>16</sup> The Wasatch Associates’ surveyor’s misquote converts the Comprehensive Plan’s past tense to the present tense. The Planning Commission must reject this erroneous rewriting of the comprehensive plan. As we documented above, the Wasatch Associates’ farmland was “designated as Timber, or Agricultural Lands” as the comprehensive plan requires. And Wasatch Associates concedes this point writing “[a]t the time of re-designation to Natural Resource Lands (circa 2005), the lands in the entire Wasatch Associates holding have been taxed under Ag and Timber Exemption which met one of the criteria which allowed the lands to be placed into Natural Resource Lands designation, provided certain other criteria were considered (as outlined above).”<sup>17</sup>

So we see that Parcel Number 433708500005 continues to meet the Pend Oreille County criteria for the NR-20 comprehensive plan designation and zone. Since comprehensive plan amendments must be consistent with the other provisions of the comprehensive plan, the county should deny the proposed comprehensive plan amendment.<sup>18</sup> Rezones must also be

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<sup>10</sup> *Manke Lumber Co., Inc. v. Diehl*, 91 Wn. App. 793, 808, 959 P.2d 1173, 1181 (1998) *review denied Manke Lumber Co., Inc. v. Diehl*, 137 Wn.2d 1018, 984 P.2d 1033 (1999).

<sup>11</sup> Pend Oreille County Assessor & Treasurer - Property Details - 6 WASATCH ASSOCIATES III\IV for Year 2016 – 2017 p. \*5.

<sup>12</sup> *Pend Oreille County Comprehensive Plan* p. 17 (2014 Update, Adopted 6-09-2015).

<sup>13</sup> Glen D. Cash, Sr., Exhibit A Project Narrative Future Land Use Map Amendment/Rezone Request Mountain Springs Ranch p. 5 of 8. This misquote is repeated again on page 6 of 8 again with quotes implying that it is a quotation, not a rewrite. But repeating an inaccurate rewriting of the comprehensive plan does not make it true.

<sup>14</sup> *Pend Oreille County Comprehensive Plan* pp. 1 – 124 (2014 Update, Adopted 6-09-2015).

<sup>15</sup> *Pend Oreille County Comprehensive Plan* p. 17 (2014 Update, Adopted 6-09-2015).

<sup>16</sup> *Id.*

<sup>17</sup> Glen D. Cash, Sr., Exhibit A Project Narrative Future Land Use Map Amendment/Rezone Request Mountain Springs Ranch p. 6 of 8.

<sup>18</sup> RCW 36.70A.070.

consistent with the comprehensive plan so again the Planning Commission should recommend denial of the rezone.<sup>19</sup>

### The Wasatch Associates property proposed to be de-designated continues to meet the Growth Management Act criteria for agricultural land of long-term commercial significance

The Growth Management Act has a three-part test for designating agricultural lands. As the Washington State Supreme Court wrote:

¶ 17 In sum, based on the plain language of the GMA and its interpretation in *Benaroya I*, we hold that agricultural land is land: (a) not already characterized by urban growth (b) that is primarily devoted to the commercial production of agricultural products enumerated in RCW 36.70A.030(2), including land in areas used or capable of being used for production based on land characteristics, and (c) that has long-term commercial significance for agricultural production, as indicated by soil, growing capacity, productivity, and whether it is near population areas or vulnerable to more intense uses.<sup>20</sup>

We will now analyze each of these factors for the Wasatch Associates property proposed to be de-designated.

#### The land is not already characterized by urban growth

The Wasatch Associates property, Parcel Number 433708500005, is 426.78 acres and has three dwellings on it.<sup>21</sup> This is a density of one dwelling unit per 142 acres and is not an urban density. The *Pend Oreille County Comprehensive Plan* includes four rural comprehensive plan designations with a range of densities from one dwelling unit per 40 acres to one dwelling unit per five acres.<sup>22</sup> The density on Parcel Number 433708500005 is much lower than these rural densities and so houses at this density are not urban growth or urban development.<sup>23</sup> This

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<sup>19</sup> RCW 36.70A.130(1)(d).

<sup>20</sup> *Lewis County v. Western Washington Growth Management Hearings Bd.*, 157 Wn.2d 488, 502, 139 P.3d 1096, 1103 (2006) emphasis in the original.

<sup>21</sup> Pend Oreille County Assessor & Treasurer - Property Details - 6 WASATCH ASSOCIATES III\IV for Year 2016 – 2017 pp. \*3 – 5 on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “2016 Real Property Data” directory with the filename: “433708500005 Pend Oreille County Assessor & Treasurer - Property Details - WASATCH ASSOC.pdf;” the map showing parcel 433708500005 on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “2016 Real Property Data” directory with the filename: “433708500005 Map.pdf;” and the Pend Oreille County Community Development Map showing an aerial image of the vicinity on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “2016 Real Property Data” directory with the filename: “Aerial Dedesign Area.pdf.”

<sup>22</sup> *Pend Oreille County Comprehensive Plan* p. 17 (2014 Update, Adopted 6-09-2015).

<sup>23</sup> Pend Oreille County Assessor & Treasurer - Property Details - 6 WASATCH ASSOCIATES III\IV for Year 2016 – 2017 pp. \*1 – 6.

parcel also does not have other forms of urban development on it.<sup>24</sup> So this parcel is not characterized by urban growth.

### Primarily devoted commercial production of agricultural products

The Supreme Court has stated this criterion:

We hold land is “devoted to” agricultural use under RCW 36.70A.030 if it is in an area where the land is actually used or capable of being used for agricultural production. Indeed, support for this definition of “devoted to” is found in dictionary treatment of the term. One of the primary meanings of “devote” is to “set apart or dedicate by a solemn or formal act.” Random House Unabridged Dictionary 544 (2d ed. 1993). The land in this case was set apart for agricultural use by longstanding zoning. While the land use on the particular parcel and the owner's intended use for the land may be considered along with other factors in the determination of whether a parcel is in an area primarily devoted to commercial agricultural production, neither current use nor land owner intent of a particular parcel is conclusive for purposes of this element of the statutory definition.<sup>25</sup>

In *Benaroya I*, the land met the GMA definition of agricultural lands of long-term commercial significance because it was “both currently zoned agricultural and suitable by soil type for agricultural uses.”<sup>26</sup> The Wasatch Associates property, Parcel Number 433708500005, is currently zoned in an agricultural zone, the NR-20 zone.<sup>27</sup>

The Wasatch Associates property proposed to be de-designated also has soils suitable for agricultural uses. All of the soils on the land proposed to be de-designated are prime farmland or farmland of statewide significance soils.<sup>28</sup> “Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland,

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<sup>24</sup> Pend Oreille County Assessor & Treasurer Property Search Results > 6516 Wasatch Associates III\IV for Year 2013 – 2014 pp. 1 – 3 of 3; Pend Oreille County aerial photograph for Parcel Number 433708-50-0005.

<sup>25</sup> *City of Redmond v. Cent. Puget Sound Growth Mgmt. Hearings Bd. (Benaroya I)*, 136 Wn. 2d 38, 53, 959 P.2d 1091, 1097 – 98 (1998) (footnote omitted).

<sup>26</sup> *Benaroya I*, 136 Wn.2d at 58, 959 P.2d at 1100.

<sup>27</sup> Zoning Map Parcel Number 433708500005, in the on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “2016 Real Property Data” directory with the filename: “433708500005 Map.pdf.”

<sup>28</sup> USDA Natural Resources Conservation Service, Soil Map—Pend Oreille County Area, Washington (Wasatch Dededesignation 2016) p. 3 of 3; USDA Natural Resources Conservation Service, Map Unit Description: Angelen silt loam, 0 to 7 percent slopes – Pend Oreille County Area, Washington; USDA Natural Resources Conservation Service, Map Unit Description: Angelen silt loam, 7 to 15 percent slopes – Pend Oreille County Area, Washington; USDA Natural Resources Conservation Service, Map Unit Description. All included on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the filename: “20160616\_22012310816\_14\_Soil\_Map Wasatch 2016 Dededesignation.pdf.”

rangeland, forest land, or other land, but not urban built-up land or water).<sup>29</sup> Farmland of statewide importance “is land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops.”<sup>30</sup> “Generally, additional farmlands of statewide importance include those that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as prime farmlands if conditions are favorable.”<sup>31</sup>

Another measure of the land’s suitability for agriculture is the land capability rating system. As the soil map and soil descriptions enclosed on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Department documented, all of the land proposed to be de-designated has Land Capability 3 and 4 soils.<sup>32</sup> These are agriculturally productive soils.<sup>33</sup>

The aerial images and the current “agriculture” tax status show that this land is used for agriculture.<sup>34</sup> The Washington State Department of Agriculture’s (WSDA) Agricultural Land

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<sup>29</sup> 7 CFR § 657.5(a)(1). 7 CFR § 657.5(a), goes into detail on the criteria for prime farmland. 7 CFR § 657.5 was accessed on June 16, 2016 at: <https://www.gpo.gov/fdsys/pkg/CFR-2013-title7-vol6/pdf/CFR-2013-title7-vol6-sec657-5.pdf> and on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the filename: “CFR-2013-title7-vol6-sec657-5.pdf.”

<sup>30</sup> 7 CFR § 657.5(c).

<sup>31</sup> U.S. Department of Agriculture, Natural Resources Conservation Service, *National soil survey handbook, title 430-1/1* p. 622-16 (2013) accessed on June 16, 2016 at:

[http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2\\_054241](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054241) and on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the filename: “nrcs142p2\_052852.doc.”

<sup>32</sup> USDA Natural Resources Conservation Service, Soil Map—Pend Oreille County Area, Washington (Wasatch Dededesignation 2016) p. 3 of 3; USDA Natural Resources Conservation Service, Map Unit Description: Angelen silt loam, 0 to 7 percent slopes – Pend Oreille County Area, Washington; USDA Natural Resources Conservation Service, Map Unit Description: Angelen silt loam, 7 to 15 percent slopes – Pend Oreille County Area, Washington; USDA Natural Resources Conservation Service, Map Unit Description. All included on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the filename: “20160616\_22012310816\_14\_Soil\_Map Wasatch 2016 Dededesignation.pdf.”

<sup>33</sup> USDA Natural Resources Conservation Service Minnesota, *Land Capability Classes* webpage p. 1 accessed on June 17, 2016 at:

[http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mn/technical/dma/nri/?cid=nrcs142p2\\_023556](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mn/technical/dma/nri/?cid=nrcs142p2_023556) and on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the filename: “Land Capability Classes.pdf.”

<sup>34</sup> Pend Oreille County Assessor & Treasurer - Property Details - 6 WASATCH ASSOCIATES III\IV for Year 2016 – 2017 p. \*5 on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “2016 Real Property Data” directory with the filename: “433708500005 Pend Oreille County Assessor & Treasurer - Property Details - WASATCH ASSOC.pdf;” the map showing parcel 433708500005 is on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “2016 Real Property Data” directory with the filename: “433708500005 Map.pdf;” and the Pend Oreille County Community Development Map showing an aerial image of the vicinity is on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “2016 Real Property Data” directory with the filename: “Aerial Dededesign Area.pdf.”

Use inventory showed that this land was farmed in 2015, the most recent data available.<sup>35</sup> So the land proposed for being de-designated is primarily devoted to agricultural use.

### Long-term commercial significance

This term is defined by the Growth Management Act (GMA) in RCW 36.70A.030(10): “‘Long-term commercial significance’ includes the growing capacity, productivity, and soil composition of the land for long-term commercial production, in consideration with the land’s proximity to population areas, and the possibility of more intense uses of the land.” All of the soils on the land proposed to be de-designated are prime farmland or farmland of statewide significance soils.<sup>36</sup> All of the land proposed to be de-designated has Land Capability 3 and 4 soils.<sup>37</sup> So this land meets the growing capacity, productivity, and soil composition criterion.

Parcel Number 433708500005 is 426.78 acres.<sup>38</sup> Farms of this size are fairly common in Pend Oreille County.<sup>39</sup> Pend Oreille farmers have good access to markets, shipping 60 percent of

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<sup>35</sup> Accessed most recently on June 16, 2016 at <https://nras.maps.arcgis.com/apps/webappviewer/index.html?id=3d61db30686d467ea6f5e0197bc32b25> and enclosed on the data CD included with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the filename: “2015 WSDA Agricultural Land Use.” The WSDA “Agricultural Land Use” webpage summarizes how this data is obtained and was last accessed on June 16, 2016 at: <http://agr.wa.gov/pestfert/natresources/aglanduse.aspx> and is enclosed on the data CD included with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the filename: “aglanduse.pdf.”

<sup>36</sup> USDA Natural Resources Conservation Service, Soil Map—Pend Oreille County Area, Washington (Wasatch Dedesignation 2016) p. 3 of 3; USDA Natural Resources Conservation Service, Map Unit Description: Angelen silt loam, 0 to 7 percent slopes – Pend Oreille County Area, Washington; USDA Natural Resources Conservation Service, Map Unit Description: Angelen silt loam, 7 to 15 percent slopes – Pend Oreille County Area, Washington; USDA Natural Resources Conservation Service, Map Unit Description. All included on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the filename: “20160616\_22012310816\_14\_Soil\_Map Wasatch 2016 Dedesignation.pdf.”

<sup>37</sup> *Id.*

<sup>38</sup> Pend Oreille County Assessor & Treasurer - Property Details - 6 WASATCH ASSOCIATES III\IV for Year 2016 – 2017 p. \*5 on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “2016 Real Property Data” directory with the filename: “433708500005 Pend Oreille County Assessor & Treasurer - Property Details - WASATCH ASSOC.pdf;” the map showing parcel 433708500005 is on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “2016 Real Property Data” directory with the filename: “433708500005 Map.pdf;” and the Pend Oreille County Community Development Map showing an aerial image of the vicinity is on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “2016 Real Property Data” directory with the filename: “Aerial Dedesign Area.pdf.”

<sup>39</sup> United States Department of Agriculture, National Agricultural Statistics Service, *2012 Census of Agriculture Washington State and County Data Volume 1 • Geographic Area Series • Part 47 AC-12-A-47 Chapter 2 County Data Table 8: Farms, Land in Farms, Value of Land and Buildings, and Land Use: 2012 and 2007 p. 274 (May 2014).* Accessed on June 17, 2016 at: [http://www.agcensus.usda.gov/Publications/2012/Full\\_Report/Volume\\_1\\_Chapter\\_2\\_County\\_Level/Washington/](http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1_Chapter_2_County_Level/Washington/) and the *2012 Census of Agriculture Washington State and County Data Volume 1 • Geographic Area Series • Part 47 AC-12-A-47* is on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the filename: “wav1.pdf.”

their hay to foreign countries.<sup>40</sup> Pend Oreille farmers and ranchers have easy access to the livestock markets in the Spokane area.<sup>41</sup> The 2012 Census of Agriculture shows the market value of agricultural products sold in Pend Oreille County increased 40 percent between 2007 and 2012, going from \$2,818,000 in 2007 to \$3,954,000 in 2012.<sup>42</sup>

This area is 1.27 miles away from and across the river from the Town of Ione.<sup>43</sup> Due to a lack of water and other factors the more intense use of the land may not be possible.<sup>44</sup>

The Tri-County Economic Development District's *Comprehensive Economic Development Strategy 2013 – 2017* includes a cluster analysis that identifies agribusiness, food processing, and technology as one of the industries that Ferry, Pend Oreille, and Stevens Counties have “a reasonable likelihood of attracting and nurturing” to generate wealth for the regional economy.<sup>45</sup> So long-term economic trends are favorable for agricultural production in the region. Taking all of these factors into account, this land has long-term commercial significance for the production of agricultural products.

Some may argue that maintaining agricultural land in this area is not needed to protect Washington's agricultural industry. However, the Washington State Department of Agriculture's *Washington Agriculture Strategic Plan 2020 and Beyond* documents the need to

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<sup>40</sup> Stephanie Meenach, Eric L. Jessup, & Kenneth L. Casavant, *Transportation Characteristics and Needs of the Washington Hay Industry: Producers and Processors* p. 10 (Washington State University, School of Economic Sciences, SFTA Research Report #11: November 2004). Accessed on June 17, 2016 at:

[http://www.sfta.wsu.edu/research/reports/research\\_paper.htm](http://www.sfta.wsu.edu/research/reports/research_paper.htm) and on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the filename: “Rpt\_11\_Hay\_Study.pdf.”

<sup>41</sup> Stephanie Meenach, Eric L. Jessup, & Kenneth L. Casavant, *Transportation and Marketing Needs for the Washington State Livestock Industry* p. 5 (Washington State University, School of Economic Sciences, Strategic Freight Transportation Analysis (SFTA) Research Report #12: November 2004). Accessed on June 17, 2016 at: [http://www.sfta.wsu.edu/research/reports/research\\_paper.htm](http://www.sfta.wsu.edu/research/reports/research_paper.htm) and on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. letter in the “Ag Data” directory with the filename: “Rpt\_12\_Livestock.pdf.”

<sup>42</sup> 2012 *Census of Agriculture County Profile Pend Oreille County, Washington* p. \*1 accessed on June 17, 2016 at: [http://www.agcensus.usda.gov/Publications/2012/Online\\_Resources/County\\_Profiles/Washington/cp53051.pdf](http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Washington/cp53051.pdf) and on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the filename: “cp53051.pdf.”

<sup>43</sup> Google Earth 7/14/2013 image showing driving distance from the Ione, Washington on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Other Info” directory with the filename: “Google Earth Image w Distance from Town of Ione 3-5-2014 10-39-31 AM.pdf.”

<sup>44</sup> Washington State Department of Ecology Water Resources Program, *Focus on Water Availability Pend Oreille Watershed, WRLA 62* p. 1, p. 2, & p. 5 (Publication Number: 11-11-066 (08/11; rev. 08/12) accessed on June 17, 2016 at: <https://fortress.wa.gov/ecy/publications/documents/1111066.pdf> and on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Other Info” directory with the filename: “1111066.pdf.”

<sup>45</sup> Tri-County Economic Development District, *Comprehensive Economic Development Strategy 2013 – 2017* pp. 69 – 70 (Ferry County WA, Pend Oreille County WA, Stevens County WA: June 26, 2013, 2016 update) accessed on [http://tricityedd.com/wp-content/uploads/2013/03/CEDS-2013-2017\\_2016-Update\\_Final.pdf](http://tricityedd.com/wp-content/uploads/2013/03/CEDS-2013-2017_2016-Update_Final.pdf) and on the data CD enclosed with the paper original of Futurewise's June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Other Info” directory with the filename: “CEDS-2013-2017\_2016-Update\_Final.pdf.”

conserve agricultural lands to maintain the agricultural industry and the jobs and incomes the industry provides.<sup>46</sup> As the strategic plan concludes “[t]he future of farming in Washington is heavily dependent on agriculture’s ability to maintain the land resource that is currently available to it.”<sup>47</sup> That would include this farmland. So again, the Planning Commission should recommend denial of the application.

### **The Wasatch Associates de-designation violates the Growth Management Act because the Natural Resource 20 comprehensive plan de-designation does not take an area-wide approach**

In *Futurewise v. Benton County*, the Growth Management Hearings Board (Board) reversed a county de-designation of agricultural lands of long-term commercial significance to put the land in an urban growth area.<sup>48</sup> The Board wrote:

The Board considers Benton County’s de-designation of agricultural lands for this small section of land, in isolation from a much larger County or area-wide study to be inappropriate and, by de-designating lands that qualify as agricultural lands of long term commercial significance, the County violated WAC 365-190-050 and corresponding GMA sections RCW 36.70A.030, RCW 36.70A.050, and RCW 36.70A.170.<sup>49</sup>

Like 1,263 acres de-designated in *Futurewise v. Benton County*, the 167 acres that is proposed to be de-designated and rezoned from NR-20 to R-5 is part of a larger area. The data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Department in the “2016 Real Property Data” includes a series of maps identifying the zoning of the adjoin properties. As can be seen from those maps, the most of the adjoining land to the north, all of the adjoining land to the east, and some of the adjoin land to the south is currently zoned NR-20.<sup>50</sup> So just considering the de-designation of the 167 acres violates WAC 365-190-050 and corresponding Growth Management Act requirements just as the land de-designated in *Futurewise v. Benton County* did.

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<sup>46</sup> Washington State Department of Agriculture, *Washington Agriculture Strategic Plan 2020 and Beyond* pp. 50 – 52 (2009) accessed on June 17, 2016 at: <http://agr.wa.gov/fof/> and on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “Ag Data” directory with the with the filename: “FutureoffFarmingReport-PrinterFriendly.pdf.”

<sup>47</sup> *Id.* at p. 50.

<sup>48</sup> *Futurewise v. Benton County*, GMHB Case No. 14-1-0003, Final Decision and Order (Oct. 15, 2014), at 37 of 38 accessed on June 17, 2016 at: <http://www.gmhb.wa.gov/LoadDocument.aspx?did=3658>

<sup>49</sup> *Id.* at 35 of 38.

<sup>50</sup> On the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the “2016 Real Property Data” directory see these maps for the adjoining properties zoned NR-20 with the following file names: “433709300001 Map.pdf,” “433709000002 Map.pdf,” “433709000001 Map.pdf,” “433708400001 Map.pdf,” “433705448001 Map.pdf,” “433705400002 Map.pdf,” “433705099004 Map.pdf,” and “433704340001 Map.pdf.” In addition, also to the north is Pend Oreille County’s Ione gravel pit which is also a natural resource use. See the files “433705440002 Map.pdf,” “433704330001 Map.pdf,” and “Aerial Vicinity.pdf” in the “2016 Real Property Data” directory. The real property records for all of these properties are also enclosed in the “2016 Real Property Data” directory. Please see the file with the same parcel number.

So again, the Planning Commission should recommend denial of the proposed Future Land Use Map amendment and rezone.

### The Wasatch Associates argument that “urban services” exist fails to justify the de-designation of Natural Resource Lands

Wasatch Associates argues that urban services exist on the property proposed for de-designation and so the de-designation should be approved. This argument fails for three reasons. First, and most important, the *Pend Oreille County Comprehensive Plan* does use the presence or absence of “urban services” as a criterion for designating the Natural Resource Lands 20 comprehensive plan designation and zone.<sup>51</sup> So whether or not urban services are available to the site is irrelevant. The Planning Commission should not consider the claimed “urban services” in deciding on its recommendation.

Second, even if the Planning Commission could consider this argument, “urban services” cannot legally be extended onto land designated as either Natural Resource Lands 20 or Rural 5. The Growth Management Act confines urban services to urban growth areas with exceptions not relevant here.<sup>52</sup> So under both the existing and proposed designations “urban services” cannot be extended onto the Wasatch Associates land.

Third, most of what Wasatch Associates calls “urban services” are in fact “rural services.” RCW 36.70A.030(17) provides in full that:

(17) “Rural governmental services” or “rural services” include those public services and public facilities historically and typically delivered at an intensity usually found in rural areas, and may include domestic water systems, fire and police protection services, transportation and public transit services, and other public utilities associated with rural development and normally not associated with urban areas. Rural services do not include storm or sanitary sewers, except as otherwise authorized by RCW 36.70A.110(4).

The water system Wasatch Associates points to is actually a rural service.<sup>53</sup> Urban water systems typically have a gridded distribution system that the Aspen Reflections Landing system lacks.<sup>54</sup> The lines are smaller than an urban system, only three inches.<sup>55</sup> No urban street main should be less than six inches in diameter.<sup>56</sup> The county road and private streets also fit

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<sup>51</sup> *Pend Oreille County Comprehensive Plan* p. 17 (2014 Update, Adopted 6-09-2015).

<sup>52</sup> RCW 36.70A.110(4).

<sup>53</sup> Glen D. Cash, Sr., Exhibit A Project Narrative Future Land Use Map Amendment/Rezone Request Mountain Springs Ranch p. 5 of 8.

<sup>54</sup> Larz T. Anderson, *Planning the Built Environment* p. 36 (2000), Chapter 4 Water Supply and Distribution enclosed with this letter; Agreement between Wasatch Associates and Swank & Mcpoland p. \*1 (April 18, 1995) giving the location of the water lines on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the in “Other Info” directory with the filename “Aspen Reflection Covenants\_Wasatch.pdf.”

<sup>55</sup> Larz T. Anderson, *Planning the Built Environment* p. 36 & p. 39 (2000); Agreement between Wasatch Associates and Swank & Mcpoland p. \*1 (April 18, 1995).

<sup>56</sup> Larz T. Anderson, *Planning the Built Environment* p. 36 & p. 39 (2000).

Pend Oreille County Planning Commission  
July 8, 2016  
Page 12

the definition of rural services quoted above. Same for fire protection services. It is debatable whether a community septic tank and drain field system which is what serves the Aspen Reflections Landing subdivision is a rural or urban service.<sup>57</sup>

It is also doubtful that the water system and sewage disposal system can be expanded to serve the Wasatch Associates property. The systems were built to serve “up to 40 lots” and the Aspen Reflections Landing subdivision has 40 lots.<sup>58</sup>

### **The Wasatch Associates argument that the county will benefit from increased taxes is wrong**

Without citing to any evidence, the Wasatch Associates argue that the county will benefit from increased taxes. But studies show that the single-family homes Wasatch Associates want to build require more money to provide them with public services than they contribute in taxes. Farmland pays more in taxes than it requires in public services. In contrast, when farmland is paved over for housing, the housing pays less in taxes than it requires in public services.<sup>59</sup> A 2014 study calculated that each new dwelling in Okanogan County only generates “about 7% of the cost to provide services to the new dwelling” each year.<sup>60</sup> Recommending denial of the comprehensive plan amendment and rezone will save Okanogan County taxpayers and ratepayers money.

Thank you for considering our comments. If you require additional information please contact me at telephone 206-343-0681 Ext. 118 or email [tim@futurewise.org](mailto:tim@futurewise.org)

Very Truly Yours,



Tim Trohimovich, AICP  
**Director of Planning & Law**

Enclosures

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<sup>57</sup> Glen D. Cash, Sr., Exhibit A Project Narrative Future Land Use Map Amendment/Rezone Request Mountain Springs Ranch p. 5 of 8.

<sup>58</sup> Agreement between Wasatch Associates and Swank & McPoland p. \*2 (April 18, 1995); Aspen Reflections Landing plats on the data CD enclosed with the paper original of Futurewise’s June 17, 2016, letter to the Pend Oreille County Community Development Dept. in the in “Other Info” directory with the filename “Aspen Reflection Covenants\_Wasatch.pdf.”

<sup>59</sup> American Farmland Trust, Farmland Information Center *Fact Sheet: Cost of Community Services Studies* pp. 2 – 5 (August 2010) accessed on June 8, 2016. Two of these studies have been done in Washington State. *Id.* at p. 5.

<sup>60</sup> Julie Ann Gustanski, Ph.D., LLM and David Scarsella, M.S., *Economic Analysis of Conservation Efforts in Okanogan County* p. 44 (2014) accessed on July 7, 2016 at: <http://wdfw.wa.gov/publications/01605/>



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DESCRIPTION

Cost of Community Services (COCS) studies are a case study approach used to determine the fiscal contribution of existing local land uses. A subset of the much larger field of fiscal analysis, COCS studies have emerged as an inexpensive and reliable tool to measure direct fiscal relationships. Their particular niche is to evaluate working and open lands on equal ground with residential, commercial and industrial land uses.

COCS studies are a snapshot in time of costs versus revenues for each type of land use. They do not predict future costs or revenues or the impact of future growth. They do provide a baseline of current information to help local officials and citizens make informed land use and policy decisions.

METHODOLOGY

In a COCS study, researchers organize financial records to assign the cost of municipal services to working and open lands, as well as to residential, commercial and industrial development. Researchers meet with local sponsors to define the scope of the project and identify land use categories to study. For example, working lands may include farm, forest and/or ranch lands. Residential development includes all housing, including rentals, but if there is a migrant agricultural work force, temporary housing for these workers would be considered part of agricultural land use. Often in rural communities, commercial and industrial land uses are combined. COCS studies findings are displayed as a set of ratios that compare annual revenues to annual expenditures for a community's unique mix of land uses.

COCS studies involve three basic steps:

1. Collect data on local revenues and expenditures.
2. Group revenues and expenditures and allocate them to the community's major land use categories.
3. Analyze the data and calculate revenue-to-expenditure ratios for each land use category.

The process is straightforward, but ensuring reliable figures requires local oversight. The most complicated task is interpreting existing records to reflect COCS land use categories. Allocating revenues and expenses requires a significant amount of research, including extensive interviews with financial officers and public administrators.

HISTORY

Communities often evaluate the impact of growth on local budgets by conducting or commissioning fiscal impact analyses. Fiscal impact studies project public costs and revenues from different land development patterns. They generally show that residential development is a net fiscal loss for communities and recommend commercial and industrial development as a strategy to balance local budgets.

Rural towns and counties that would benefit from fiscal impact analysis may not have the expertise or resources to conduct a study. Also, fiscal impact analyses rarely consider the contribution of working and other open lands, which is very important to rural economies.

American Farmland Trust (AFT) developed COCS studies in the mid-1980s to provide communities with a straightforward and inexpensive way to measure the contribution of agricultural lands to the local tax base. Since then, COCS studies have been conducted in at least 151 communities in the United States.

FUNCTIONS & PURPOSES

Communities pay a high price for unplanned growth. Scattered development frequently causes traffic congestion, air and water pollution, loss of open space and increased demand for costly public services. This is why it is important for citizens and local leaders to understand the relationships between residential and commercial growth, agricultural land use, conservation and their community's bottom line.

COCS studies help address three misperceptions that are commonly made in rural or suburban communities facing growth pressures:

1. Open lands—including productive farms and forests—are an interim land use that should be developed to their "highest and best use."
2. Agricultural land gets an unfair tax break when it is assessed at its current use value for farming or ranching instead of at its potential use value for residential or commercial development.
3. Residential development will lower property taxes by increasing the tax base.

While it is true that an acre of land with a new house generates more total revenue than an acre of hay or corn, this tells us little about

SUMMARY OF COST OF COMMUNITY SERVICES STUDIES, REVENUE-TO-EXPENDITURE RATIOS IN DOLLARS

Community	Residential including farm houses	Commercial & Industrial	Working & Open Land	Source
<b>Colorado</b>				
Custer County	1 : 1.16	1 : 0.71	1 : 0.54	Haggerty, 2000
Sagauche County	1 : 1.17	1 : 0.53	1 : 0.35	Dirt, Inc., 2001
<b>Connecticut</b>				
Bolton	1 : 1.05	1 : 0.23	1 : 0.50	Geisler, 1998
Brooklyn	1 : 1.09	1 : 0.17	1 : 0.30	Green Valley Institute, 2002
Durham	1 : 1.07	1 : 0.27	1 : 0.23	Southern New England Forest Consortium, 1995
Farmington	1 : 1.33	1 : 0.32	1 : 0.31	Southern New England Forest Consortium, 1995
Hebron	1 : 1.06	1 : 0.47	1 : 0.43	American Farmland Trust, 1986
Lebanon	1 : 1.12	1 : 0.16	1 : 0.17	Green Valley Institute, 2007
Litchfield	1 : 1.11	1 : 0.34	1 : 0.34	Southern New England Forest Consortium, 1995
Pomfret	1 : 1.06	1 : 0.27	1 : 0.86	Southern New England Forest Consortium, 1995
Windham	1 : 1.15	1 : 0.24	1 : 0.19	Green Valley Institute, 2002
<b>Florida</b>				
Leon County	1 : 1.39	1 : 0.36	1 : 0.42	Dorfman, 2004
<b>Georgia</b>				
Appling County	1 : 2.27	1 : 0.17	1 : 0.35	Dorfman, 2004
Athens-Clarke County	1 : 1.39	1 : 0.41	1 : 2.04	Dorfman, 2004
Brooks County	1 : 1.56	1 : 0.42	1 : 0.39	Dorfman, 2004
Carroll County	1 : 1.29	1 : 0.37	1 : 0.55	Dorfman and Black, 2002
Cherokee County	1 : 1.59	1 : 0.12	1 : 0.20	Dorfman, 2004
Colquitt County	1 : 1.28	1 : 0.45	1 : 0.80	Dorfman, 2004
Columbia County	1 : 1.16	1 : 0.48	1 : 0.52	Dorfman, 2006
Dooly County	1 : 2.04	1 : 0.50	1 : 0.27	Dorfman, 2004
Grady County	1 : 1.72	1 : 0.10	1 : 0.38	Dorfman, 2003
Hall County	1 : 1.25	1 : 0.66	1 : 0.22	Dorfman, 2004
Jackson County	1 : 1.28	1 : 0.58	1 : 0.15	Dorfman, 2008
Jones County	1 : 1.23	1 : 0.65	1 : 0.35	Dorfman, 2004
Miller County	1 : 1.54	1 : 0.52	1 : 0.53	Dorfman, 2004
Mitchell County	1 : 1.39	1 : 0.46	1 : 0.60	Dorfman, 2004
Morgan County	1 : 1.42	1 : 0.25	1 : 0.38	Dorfman, 2008
Thomas County	1 : 1.64	1 : 0.38	1 : 0.67	Dorfman, 2003
Union County	1 : 1.13	1 : 0.43	1 : 0.72	Dorfman and Lavigno, 2006
<b>Idaho</b>				
Booneville County	1 : 1.06	1 : 0.84	1 : 0.23	Hartmans and Meyer, 1997
Canyon County	1 : 1.08	1 : 0.79	1 : 0.54	Hartmans and Meyer, 1997
Cassia County	1 : 1.19	1 : 0.87	1 : 0.41	Hartmans and Meyer, 1997
Kootenai County	1 : 1.09	1 : 0.86	1 : 0.28	Hartmans and Meyer, 1997
<b>Kentucky</b>				
Campbell County	1 : 1.21	1 : 0.30	1 : 0.38	American Farmland Trust, 2005
Kenton County	1 : 1.19	1 : 0.19	1 : 0.51	American Farmland Trust, 2005
Lexington-Fayette County	1 : 1.64	1 : 0.22	1 : 0.93	American Farmland Trust, 1999
Oldham County	1 : 1.05	1 : 0.29	1 : 0.44	American Farmland Trust, 2003
Shelby County	1 : 1.21	1 : 0.24	1 : 0.41	American Farmland Trust, 2005

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SUMMARY OF COST OF COMMUNITY SERVICES STUDIES, REVENUE-TO-EXPENDITURE RATIOS IN DOLLARS

Community	Residential including farm houses	Commercial & Industrial	Working & Open Land	Source
<b>Maine</b>				
Bethel	1 : 1.29	1 : 0.59	1 : 0.06	Good, 1994
<b>Maryland</b>				
Carroll County	1 : 1.15	1 : 0.48	1 : 0.45	Carroll County Dept. of Management & Budget, 1994
Cecil County	1 : 1.17	1 : 0.34	1 : 0.66	American Farmland Trust, 2001
Cecil County	1 : 1.12	1 : 0.28	1 : 0.37	Cecil County Office of Economic Development, 1994
Frederick County	1 : 1.14	1 : 0.50	1 : 0.53	American Farmland Trust, 1997
Harford County	1 : 1.11	1 : 0.40	1 : 0.91	American Farmland Trust, 2003
Kent County	1 : 1.05	1 : 0.64	1 : 0.42	American Farmland Trust, 2002
Wicomico County	1 : 1.21	1 : 0.33	1 : 0.96	American Farmland Trust, 2001
<b>Massachusetts</b>				
Agawam	1 : 1.05	1 : 0.44	1 : 0.31	American Farmland Trust, 1992
Becket	1 : 1.02	1 : 0.83	1 : 0.72	Southern New England Forest Consortium, 1995
Dartmouth	1 : 1.14	1 : 0.51	1 : 0.26	American Farmland Trust, 2009
Deerfield	1 : 1.16	1 : 0.38	1 : 0.29	American Farmland Trust, 1992
Deerfield	1 : 1.14	1 : 0.51	1 : 0.33	American Farmland Trust, 2009
Franklin	1 : 1.02	1 : 0.58	1 : 0.40	Southern New England Forest Consortium, 1995
Gill	1 : 1.15	1 : 0.43	1 : 0.38	American Farmland Trust, 1992
Leverett	1 : 1.15	1 : 0.29	1 : 0.25	Southern New England Forest Consortium, 1995
Middleboro	1 : 1.08	1 : 0.47	1 : 0.70	American Farmland Trust, 2001
Southborough	1 : 1.03	1 : 0.26	1 : 0.45	Adams and Hines, 1997
Sterling	1 : 1.09	1 : 0.26	1 : 0.34	American Farmland Trust, 2009
Westford	1 : 1.15	1 : 0.53	1 : 0.39	Southern New England Forest Consortium, 1995
Williamstown	1 : 1.11	1 : 0.34	1 : 0.40	Hazler et al., 1992
<b>Michigan</b>				
Marshall Twp., Calhoun County	1 : 1.47	1 : 0.20	1 : 0.27	American Farmland Trust, 2001
Newton Twp., Calhoun County	1 : 1.20	1 : 0.25	1 : 0.24	American Farmland Trust, 2001
Scio Twp., Washtenaw County	1 : 1.40	1 : 0.28	1 : 0.62	University of Michigan, 1994
<b>Minnesota</b>				
Farmington	1 : 1.02	1 : 0.79	1 : 0.77	American Farmland Trust, 1994
Independence	1 : 1.03	1 : 0.19	1 : 0.47	American Farmland Trust, 1994
Lake Elmo	1 : 1.07	1 : 0.20	1 : 0.27	American Farmland Trust, 1994
<b>Montana</b>				
Carbon County	1 : 1.60	1 : 0.21	1 : 0.34	Prinzing, 1997
Flathead County	1 : 1.23	1 : 0.26	1 : 0.34	Citizens for a Better Flathead, 1999
Gallatin County	1 : 1.45	1 : 0.16	1 : 0.25	Haggerty, 1996
<b>New Hampshire</b>				
Brentwood	1 : 1.17	1 : 0.24	1 : 0.83	Brentwood Open Space Task Force, 2002
Deerfield	1 : 1.15	1 : 0.22	1 : 0.35	Auger, 1994
Dover	1 : 1.15	1 : 0.63	1 : 0.94	Kingsley, et al., 1993
Exeter	1 : 1.07	1 : 0.40	1 : 0.82	Niebling, 1997
Fremont	1 : 1.04	1 : 0.94	1 : 0.36	Auger, 1994
Groton	1 : 1.01	1 : 0.12	1 : 0.88	New Hampshire Wildlife Federation, 2001
Hookset	1 : 1.16	1 : 0.43	1 : 0.55	Innovative Natural Resource Solutions, 2008
Lyme	1 : 1.05	1 : 0.28	1 : 0.23	Pickard, 2000
Milton	1 : 1.30	1 : 0.35	1 : 0.72	Innovative Natural Resource Solutions, 2005

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SUMMARY OF COST OF COMMUNITY SERVICES STUDIES, REVENUE-TO-EXPENDITURE RATIOS IN DOLLARS

Community	Residential including farm houses	Commercial & Industrial	Working & Open Land	Source
<b>New Hampshire (continued)</b>				
Mont Vernon	1 : 1.03	1 : 0.04	1 : 0.08	Innovative Natural Resource Solutions, 2002
Stratham	1 : 1.15	1 : 0.19	1 : 0.40	Auger, 1994
<b>New Jersey</b>				
Freehold Township	1 : 1.51	1 : 0.17	1 : 0.33	American Farmland Trust, 1998
Holmdel Township	1 : 1.38	1 : 0.21	1 : 0.66	American Farmland Trust, 1998
Middletown Township	1 : 1.14	1 : 0.34	1 : 0.36	American Farmland Trust, 1998
Upper Freehold Township	1 : 1.18	1 : 0.20	1 : 0.35	American Farmland Trust, 1998
Wall Township	1 : 1.28	1 : 0.30	1 : 0.54	American Farmland Trust, 1998
<b>New York</b>				
Amenia	1 : 1.23	1 : 0.25	1 : 0.17	Bucknall, 1989
Beekman	1 : 1.12	1 : 0.18	1 : 0.48	American Farmland Trust, 1989
Dix	1 : 1.51	1 : 0.27	1 : 0.31	Schuyler County League of Women Voters, 1993
Farmington	1 : 1.22	1 : 0.27	1 : 0.72	Kinsman et al., 1991
Fishkill	1 : 1.23	1 : 0.31	1 : 0.74	Bucknall, 1989
Hector	1 : 1.30	1 : 0.15	1 : 0.28	Schuyler County League of Women Voters, 1993
Kinderhook	1 : 1.05	1 : 0.21	1 : 0.17	Concerned Citizens of Kinderhook, 1996
Montour	1 : 1.50	1 : 0.28	1 : 0.29	Schuyler County League of Women Voters, 1992
North East	1 : 1.36	1 : 0.29	1 : 0.21	American Farmland Trust, 1989
Reading	1 : 1.88	1 : 0.26	1 : 0.32	Schuyler County League of Women Voters, 1992
Red Hook	1 : 1.11	1 : 0.20	1 : 0.22	Bucknall, 1989
Rochester	1 : 1.27	1 : 0.18	1 : 0.18	Bonner and Gray, 2005
<b>North Carolina</b>				
Alamance County	1 : 1.46	1 : 0.23	1 : 0.59	Renkow, 2006
Chatham County	1 : 1.14	1 : 0.33	1 : 0.58	Renkow, 2007
Henderson County	1 : 1.16	1 : 0.40	1 : 0.97	Renkow, 2008
Orange County	1 : 1.31	1 : 0.24	1 : 0.72	Renkow, 2006
Union County	1 : 1.30	1 : 0.41	1 : 0.24	Dorfman, 2004
Wake County	1 : 1.54	1 : 0.18	1 : 0.49	Renkow, 2001
<b>Ohio</b>				
Butler County	1 : 1.12	1 : 0.45	1 : 0.49	American Farmland Trust, 2003
Clark County	1 : 1.11	1 : 0.38	1 : 0.30	American Farmland Trust, 2003
Hocking Township	1 : 1.10	1 : 0.27	1 : 0.17	Prindle, 2002
Knox County	1 : 1.05	1 : 0.38	1 : 0.29	American Farmland Trust, 2003
Liberty Township	1 : 1.15	1 : 0.51	1 : 0.05	Prindle, 2002
Madison Village, Lake County	1 : 1.67	1 : 0.20	1 : 0.38	American Farmland Trust, 1993
Madison Twp., Lake County	1 : 1.40	1 : 0.25	1 : 0.30	American Farmland Trust, 1993
Madison Village, Lake County	1 : 1.16	1 : 0.32	1 : 0.37	American Farmland Trust, 2008
Madison Twp., Lake County	1 : 1.24	1 : 0.33	1 : .030	American Farmland Trust, 2008
Shalersville Township	1 : 1.58	1 : 0.17	1 : 0.31	Portage County Regional Planning Commission, 1997
<b>Pennsylvania</b>				
Allegheny Twp., Westmoreland County	1 : 1.06	1 : 0.14	1 : 0.13	Kelsey, 1997
Bedminster Twp., Bucks County	1 : 1.12	1 : 0.05	1 : 0.04	Kelsey, 1997
Bethel Twp., Lebanon County	1 : 1.08	1 : 0.17	1 : 0.06	Kelsey, 1992
Bingham Twp., Potter County	1 : 1.56	1 : 0.16	1 : 0.15	Kelsey, 1994
Buckingham Twp., Bucks County	1 : 1.04	1 : 0.15	1 : 0.08	Kelsey, 1996

AMERICAN FARMLAND TRUST · FARMLAND INFORMATION CENTER

SUMMARY OF COST OF COMMUNITY SERVICES STUDIES, REVENUE-TO-EXPENDITURE RATIOS IN DOLLARS

Community	Residential including farm houses	Commercial & Industrial	Working & Open Land	Source
<b>Pennsylvania (continued)</b>				
Carroll Twp., Perry County	1 : 1.03	1 : 0.06	1 : 0.02	Kelsey, 1992
Hopewell Twp., York County	1 : 1.27	1 : 0.32	1 : 0.59	The South Central Assembly for Effective Governance, 2002
Kelly Twp., Union County	1 : 1.48	1 : 0.07	1 : 0.07	Kelsey, 2006
Lehman Twp., Pike County	1 : 0.94	1 : 0.20	1 : 0.27	Kelsey, 2006
Maiden Creek Twp., Berks County	1 : 1.28	1 : 0.11	1 : 0.06	Kelsey, 1998
Richmond Twp., Berks County	1 : 1.24	1 : 0.09	1 : 0.04	Kelsey, 1998
Shrewsbury Twp., York County	1 : 1.22	1 : 0.15	1 : 0.17	The South Central Assembly for Effective Governance, 2002
Stewardson Twp., Potter County	1 : 2.11	1 : 0.23	1 : 0.31	Kelsey, 1994
Straban Twp., Adams County	1 : 1.10	1 : 0.16	1 : 0.06	Kelsey, 1992
Sweden Twp., Potter County	1 : 1.38	1 : 0.07	1 : 0.08	Kelsey, 1994
<b>Rhode Island</b>				
Hopkinton	1 : 1.08	1 : 0.31	1 : 0.31	Southern New England Forest Consortium, 1995
Little Compton	1 : 1.05	1 : 0.56	1 : 0.37	Southern New England Forest Consortium, 1995
West Greenwich	1 : 1.46	1 : 0.40	1 : 0.46	Southern New England Forest Consortium, 1995
<b>Tennessee</b>				
Blount County	1 : 1.23	1 : 0.25	1 : 0.41	American Farmland Trust, 2006
Robertson County	1 : 1.13	1 : 0.22	1 : 0.26	American Farmland Trust, 2006
Tipton County	1 : 1.07	1 : 0.32	1 : 0.57	American Farmland Trust, 2006
<b>Texas</b>				
Bandera County	1 : 1.10	1 : 0.26	1 : 0.26	American Farmland Trust, 2002
Bexar County	1 : 1.15	1 : 0.20	1 : 0.18	American Farmland Trust, 2004
Hays County	1 : 1.26	1 : 0.30	1 : 0.33	American Farmland Trust, 2000
<b>Utah</b>				
Cache County	1 : 1.27	1 : 0.25	1 : 0.57	Snyder and Ferguson, 1994
Sevier County	1 : 1.11	1 : 0.31	1 : 0.99	Snyder and Ferguson, 1994
Utah County	1 : 1.23	1 : 0.26	1 : 0.82	Snyder and Ferguson, 1994
<b>Virginia</b>				
Augusta County	1 : 1.22	1 : 0.20	1 : 0.80	Valley Conservation Council, 1997
Bedford County	1 : 1.07	1 : 0.40	1 : 0.25	American Farmland Trust, 2005
Clarke County	1 : 1.26	1 : 0.21	1 : 0.15	Piedmont Environmental Council, 1994
Culpepper County	1 : 1.22	1 : 0.41	1 : 0.32	American Farmland Trust, 2003
Frederick County	1 : 1.19	1 : 0.23	1 : 0.33	American Farmland Trust, 2003
Northampton County	1 : 1.13	1 : 0.97	1 : 0.23	American Farmland Trust, 1999
<b>Washington</b>				
Okanogan County	1 : 1.06	1 : 0.59	1 : 0.56	American Farmland Trust, 2007
Skagit County	1 : 1.25	1 : 0.30	1 : 0.51	American Farmland Trust, 1999
<b>Wisconsin</b>				
Dunn	1 : 1.06	1 : 0.29	1 : 0.18	Town of Dunn, 1994
Dunn	1 : 1.02	1 : 0.55	1 : 0.15	Wisconsin Land Use Research Program, 1999
Perry	1 : 1.20	1 : 1.04	1 : 0.41	Wisconsin Land Use Research Program, 1999
Westport	1 : 1.11	1 : 0.31	1 : 0.13	Wisconsin Land Use Research Program, 1999

**Note:** Some studies break out land uses into more than three distinct categories. For these studies, AFT requested data from the researcher and recalculated the final ratios for the land use categories listed in this table. The Okanogan County, Wash., study is unique in that it analyzed the fiscal contribution of tax-exempt state, federal and tribal lands.

American Farmland Trust's Farmland Information Center acts as a clearinghouse for information about Cost of Community Services studies. Inclusion in this table does not necessarily signify review or endorsement by American Farmland Trust.

# COST OF COMMUNITY SERVICES STUDIES

For additional information on farmland protection and stewardship contact the Farmland Information Center. The FIC offers a staffed answer service and online library with fact sheets, laws, sample documents and other educational materials.

[www.farmlandinfo.org](http://www.farmlandinfo.org)  
(800) 370-4879



AFT NATIONAL OFFICE  
1200 18th Street, NW, Suite 800  
Washington, DC 20036  
(202) 331-7300  
[www.farmland.org](http://www.farmland.org)



a community's bottom line. In areas where agriculture or forestry are major industries, it is especially important to consider the real property tax contribution of privately owned working lands. Working and other open lands may generate less revenue than residential, commercial or industrial properties, but they require little public infrastructure and few services.

COCS studies conducted over the last 20 years show working lands generate more public revenues than they receive back in public services. Their impact on community coffers is similar to that of other commercial and industrial land uses. On average, because residential land uses do not cover their costs, they must be subsidized by other community land uses. Converting agricultural land to residential land use should not be seen as a way to balance local budgets.

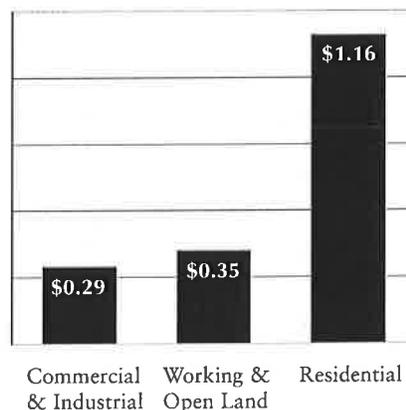
The findings of COCS studies are consistent with those of conventional fiscal impact analyses, which document the high cost of residential development and recommend commercial and industrial development to help balance local budgets. What is unique about COCS studies is that they show that agricultural land is similar to other commercial and industrial uses. In nearly every community studied, farmland has generated a fiscal surplus to help offset the shortfall created by residential demand for

public services. This is true even when the land is assessed at its current, agricultural use. However as more communities invest in agriculture this tendency may change. For example, if a community establishes a purchase of agricultural conservation easement program, working and open lands may generate a net negative.

Communities need reliable information to help them see the full picture of their land uses. COCS studies are an inexpensive way to evaluate the net contribution of working and open lands. They can help local leaders discard the notion that natural resources must be converted to other uses to ensure fiscal stability. They also dispel the myths that residential development leads to lower taxes, that differential assessment programs give landowners an "unfair" tax break and that farmland is an interim land use just waiting around for development.

One type of land use is not intrinsically better than another, and COCS studies are not meant to judge the overall public good or long-term merits of any land use or taxing structure. It is up to communities to balance goals such as maintaining affordable housing, creating jobs and conserving land. With good planning, these goals can complement rather than compete with each other. COCS studies give communities another tool to make decisions about their futures.

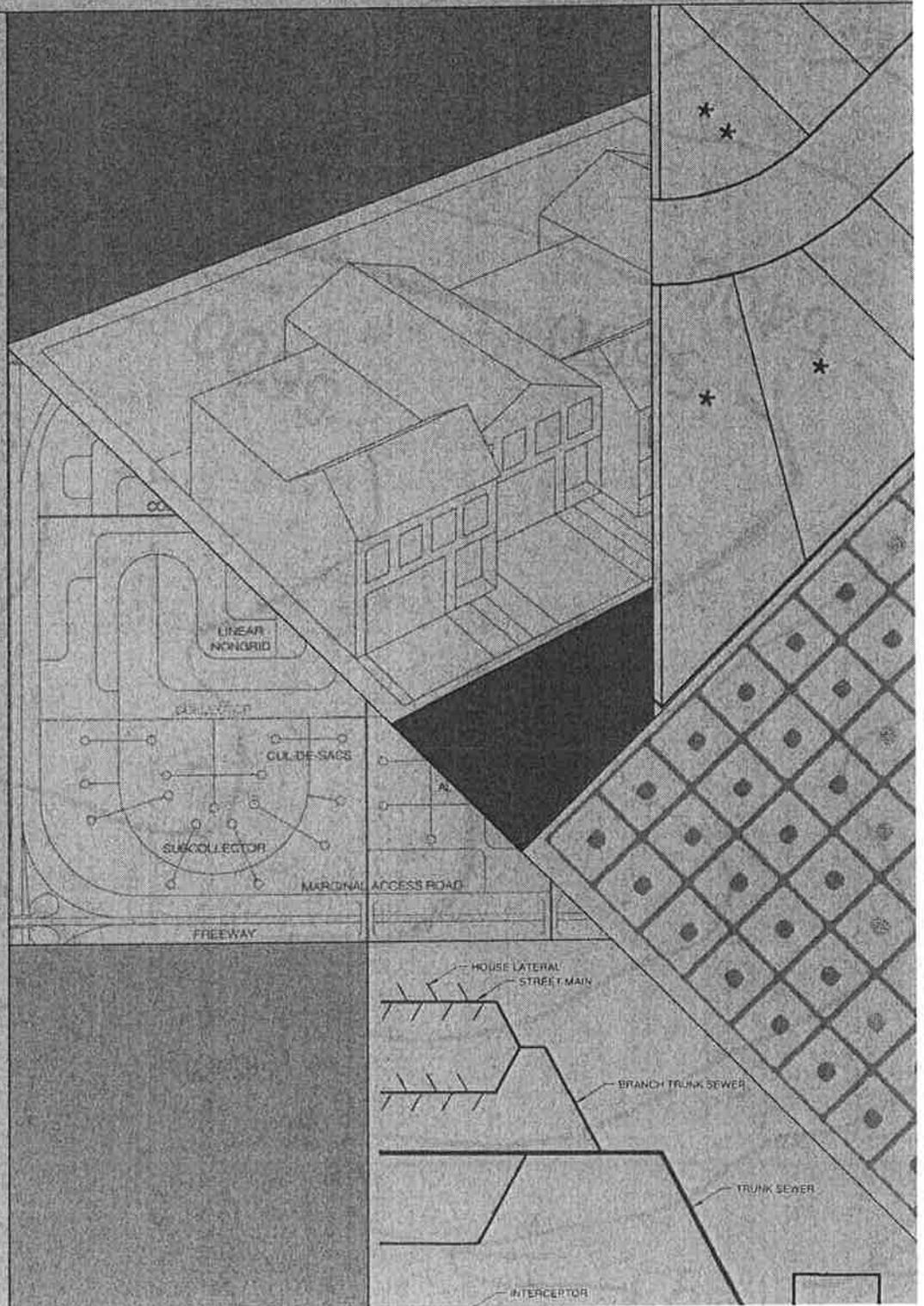
Median COCS Results



*Median cost per dollar of revenue raised to provide public services to different land uses.*

# Planning the Built Environment

Larz T. Anderson



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# Water Supply and Distribution

## A BRIEF HISTORY OF WATER SUPPLY AND DISTRIBUTION IN THE UNITED STATES

Philadelphia (Pennsylvania) was the first large city in the U.S. to establish a public water supply system; the city sank its first two public wells in 1682, and by 1744 had an excellent water system. The City of Winston-Salem (North Carolina), however, was the first city to install a city-wide system of pipes to distribute water, and had an effective network of bored-log pipes in operation in 1776. Wooden pipes were used for water distribution until the advent of pumps, when it was found that these pipes did not satisfactorily withstand the increased water pressure; therefore, the more expensive cast-iron pipes were substituted after 1800. Cast iron soon became the predominant material for water supply mains with reinforced concrete being used for large-diameter pipes. In recent years, plastic pipes have also come into widespread use.

Starting in 1832, the City of Richmond (Virginia) pioneered the use of sand filter beds to remove sediments and other impurities from

water supplies in the U.S. In 1857 Louis Pasteur announced the germ theory; this stirred many public-spirited people to become concerned with the quality of municipal water, and considerable attention was then given to water filtration and treatment. The chlorination of water was first undertaken in the U.S. in 1908 in Jersey City (New Jersey) as a means of making a water supply that had been tainted with sewage safe to drink. The addition of chlorine to water supplies has now become the most widely practiced method of disinfecting water in the U.S.

## THE BASIC WATER SUPPLY AND DISTRIBUTION SYSTEM

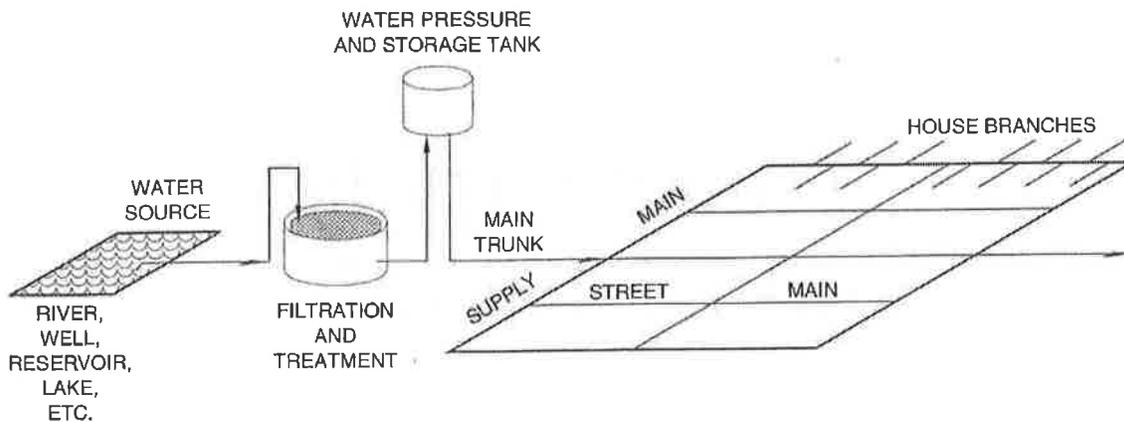
The basic water supply and distribution system is shown schematically in Figure 4.1.

### Sources of Water

Water comes from:

- underground sources such as wells or springs
- surface sources such as continuously flowing rivers
- natural or man-made reservoirs
- lakes

Figure 4.1. Schematic Diagram of a Typical Urban Water Distribution System



### Water Filtering and Treatment

A water filtering and treatment plant is usually required between the source of water supply and the water distribution system. A filtering system is used to filter out sediments and other solid materials. Water treatment is used to provide the water with a desirable chemical balance and to eliminate any undesirable biological contaminants.

### Pressure Tower and Storage

Water is pumped from the treatment plant to a pressure and storage tank. This tank may be in the form of an elevated tower, or a reservoir on (or under) the surface of the ground at an elevation well above the elevation of the water users. The purpose of this water pressure and storage tank is to establish adequate water pressure throughout the water system, and provide an adequate supply of water for normal use and fire fighting. The water supply must be available and usable not only under routine conditions but also at times

when no power is available to run water pumps.

### Local Distribution

Water leaves the pressure tower in a *main trunk* (the largest pipe in the system), which branches out into *supply mains*, then to *street mains* which, in turn, have *house branches* providing water to each building. Because the water is under pressure, water lines may go up and down hills, if consideration is given to the change of water pressure due to change of elevation.

### MACRO INFLUENCES OF WATER SUPPLY ON URBAN FORM

1. Where a source of water supply does not exist, urban development will not occur. Where supply is limited, urban development will be limited to the population which the water supply can serve.
2. Water quality can restrict urban development. Where supply sources are so polluted as to make them unpalatable,

they may be useless, or require such a great expenditure to make them potable as to be unsupportable. Pollution may be man-made or natural (such as sulfur springs).

3. Urban development usually occurs below the elevation of the water supply. Development can be located at an elevation near or above the elevation of the water source only if water towers (with pumped storage) are installed to provide adequate water pressure at the desired elevations.
4. Water trunks, mains, and branches must be protected from winter freezing and therefore must be located well below the surface of the ground in areas where winters are severe. If bedrock exists near the surface of the ground, the cost of excavation may be so great as to preclude water service, or delay it until the demand for the use of the land is sufficient to justify the increased costs.
5. The available water pressure at house branches will limit the development of sites. If pressure is adequate to serve only 2 floors of housing, the cost of serving 3- or 4-story housing will usually be too great to be justified. Multi-story buildings (6-22 stories), however, often provide auxiliary pumps and storage facilities at a justified cost.
6. Areas that are not served by a central water system may be served by individual springs or wells. Ground-water sources may be so meager as to make individual well service impossible, resulting in nondevelopment.
7. Where individual wells and sewerage systems (septic tanks and leaching fields) are used on one property, only low-density (large-lot) development

can be permitted to occur. This is because it is necessary to physically separate septic fields from water supply wells in order to prevent contamination of the wells.

8. Arid desert areas are difficult to urbanize because, among other reasons, there are usually inadequate water supplies. Frigid polar areas are also difficult to urbanize because, among other reasons, it is very difficult to establish a source of flowing water there and workable water distribution systems. Desalinization plants and water recirculation systems are technologically feasible and can provide water to desert, polar, and other waterless areas, but their current economic cost is so high that it prohibits their use except for very unusual situations, such as military outposts.

#### THE DEMAND FOR WATER

The primary uses of water in the United States are for agriculture, industry, and municipal water systems. Agriculture uses about 900 gallons per capita per day (gpcd), industry about 900 gpcd, and municipal water systems about 150 gpcd. The demand for agricultural water varies widely with location. In areas with heavy and reliable rainfall, little irrigation water is needed to raise crops. In the arid western section of the United States, however, agricultural areas use 90 percent of all the water produced. Of all the water used by agriculture, about 40 percent is returned to streams or aquifers; the remaining 60 percent enters the atmosphere through evaporation or transpiration.

The demand for industrial water also shows great variation from place to place and from industry to industry. Paper mills and steel mills use prodigious quantities of water, while fabricating industries use relatively lit-

tle. Most of the water used by industry comes directly from streams, lakes, or wells, rather than from municipal water systems. Approximately 98 percent of industrially used water flows back to streams or aquifers, with only 2 percent being evaporated to the atmosphere or consumed in the industrial process.

Per-capita water consumption by municipal water systems also varies. Water used in private homes typically ranges from 20 to 80 gpcd, with an average of about 40 gpcd. Municipal water systems usually supply local commercial uses, as well as small industries that do not have their own direct source of water; these customers typically use about 70 gpcd, with notable variation from place to place. Municipal use of water for fire fighting, street cleaning, and park watering averages about 10 gpcd. Losses from municipal water systems, even with careful management, generally run 20 percent or more. Therefore, the total water consumption for municipal water systems runs about 150 gpcd (40 gpcd to private homes; 70 gpcd to commerce and industry; 10 gpcd to public use; and 30 gpcd to unaccounted-for losses). About 90 percent of the water from municipal systems is returned to streams and aquifers, usually after some type of sewage treatment.

Water for fire fighting in urban areas almost always requires a substantially larger water storage capacity (and larger water mains) than does the normal day-to-day demand for water. The requirements for water for fire fighting are determined by reviewing the combustibility of specific areas of the city, and then calculating the flow of water that would be required to suppress a fire in that area.

### Example

A water supply system for a city (or part of a city) of 10,000 population would typically provide:

*Fire flow:* 3,000 gallons per minute for 10 hours = 1,800,000 gallons

*Municipal flow:* 150 gpcd  $\times$  10,000 persons  $\times$  peak demand factor of  $1.5 \times 10$  hours/24 hours = 937,500 gallons (round to 900,000 gallons)

*Total storage required:* 2,700,000 gallons

### WATER PRESSURE

A water pressure of about 50 pounds per square inch (psi) is usually required in the water system adjacent to each urban use. In some water systems the pressure may, however, be as low as 20 psi, or as high as 80 psi. If the water pressure in the system exceeds 80 or 90 psi, a "pressure-reducing valve" must be installed between the water system and the user. If the water pressure is less than 20 psi, each water user will need to install an on-site pump and storage system. Water pressure inside each building (in contrast to water pressure in the water main outside the building) should be at least 15 psi at each fixture (preferably 20 psi). This means that the designers of multistoried buildings must often plan for a fairly complex network of pumps, storage tanks, and pressure-reducing valves within individual buildings.

### DESIGN GUIDELINES FOR CENTRAL WATER SUPPLY SYSTEMS

Water mains peripheral to the area for residential development deliver water under pressure to the area. Water pipes carry this water onto the site and then to each dwelling unit. Unlike the storm sewer and sanitary sewer piping systems (which are gravity systems), the water supply piping system is a pressurized system.

In a gravity system of pipes, fluids flow downhill, propelled solely by the force of gravity. In a pressurized system, fluids are pushed through the pipes to produce a desired pressure at the point of release (for example, at the end of a fire hose), or it may be used to raise the fluid to a higher elevation. The water supply network of pipes serving residential areas should be in a grid or a loop pattern; they should include no long dead-end lines. See Figure 4.2.

The grid and loop patterns allow for segments of the water system to be closed off for repairs; the dead-end line does not. Dead-end lines sometimes experience serious pressure drops in periods of high water demand; they may also suffer from water stagnation in periods of low water demand. Water pipes may be curved or bent at virtually any angle. They must be laid deep enough in the ground so that they will not freeze in the wintertime (typically at least 4 feet below the surface of the ground in midwestern United States). Residential street branches of water supply pipes should be no less than 2 inches in diameter. No street main should be less than 6 inches in diameter, and no branch main should be less than 8 inches in diameter. Any water main that serves a fire hydrant should be at least 6 inches in diameter, because smaller pipes cause too great a pressure loss when fire-flow volumes pass through the pipes.

In earlier years, water supply lines were kept well separated from sanitary sewer lines; these days, a number of major building codes now approve of installing sanitary sewers and water supply lines in the same trench.<sup>1</sup> It is recommended, however, that the water line be placed at least 12 inches above the sewer line, with a lateral separation of 18 inches.

Fire hydrants should be located along all water lines at the location of each street inter-

section and between intersections as necessary to assure that hydrants are no more than 1,000 feet apart (500 feet between hydrants is more desirable because this reduces the pressure loss in small-diameter fire hoses). Fire hydrants should be located at least 50 feet from any structure, in order to assure their accessibility in the event that a nearby structure catches fire.

### CALCULATING THE POTENTIAL SERVICE AREA OF A WATER SUPPLY SYSTEM

If you build a water storage tank on top of a hill—or erect a tank on top of a tall tower—what areas can be served by it?

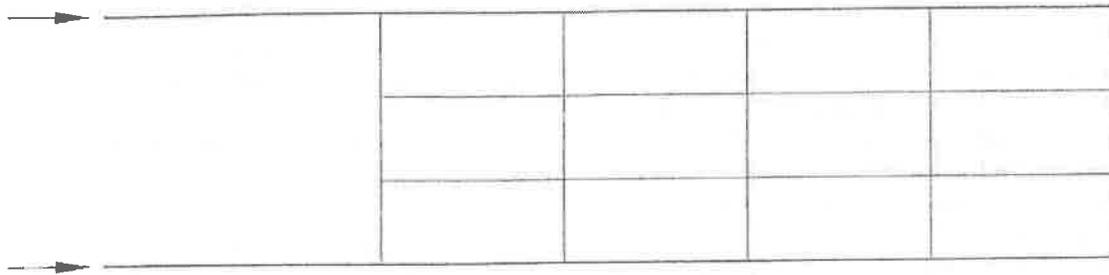
We know that water weighs 62.4 pounds per cubic foot. What amount of pressure does this water exert? If we visualize 1 cubic foot of water (a cube 12 × 12 × 12 inches), we note that the weight of the water (62.4 pounds) presses down on the bottom of the cube. Since the bottom of the cube measures 12 × 12 inches, its area is 144 square inches. We can therefore calculate that the water pressure at a depth of 1 foot is 62.4 pounds divided by 144 square inches, or .433 psi.

We also know that we must have some water pressure when we turn on the faucet in our house, or else the water won't flow out of the pipes. A frequently used figure for the minimum desirable water pressure is 20 psi.

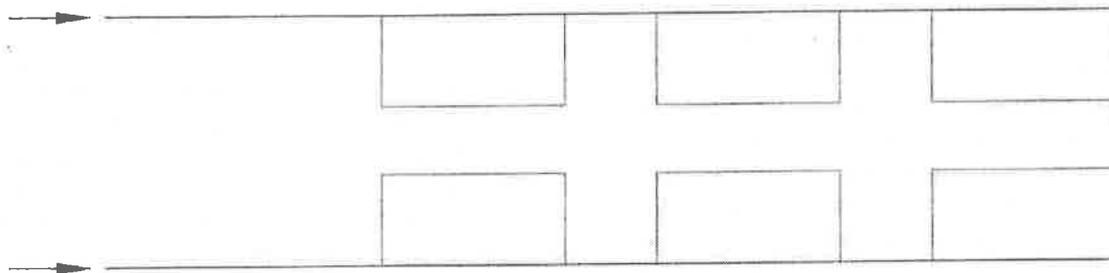
Suppose you build a two-story house right at the foot of the water tower. How high must the tower be in order to serve the second story of the house with water at 20 psi? We can set up a ratio:

$$\frac{1.00 \text{ foot height}}{.433 \text{ psi}} = \frac{X \text{ feet height}}{20 \text{ psi}}$$

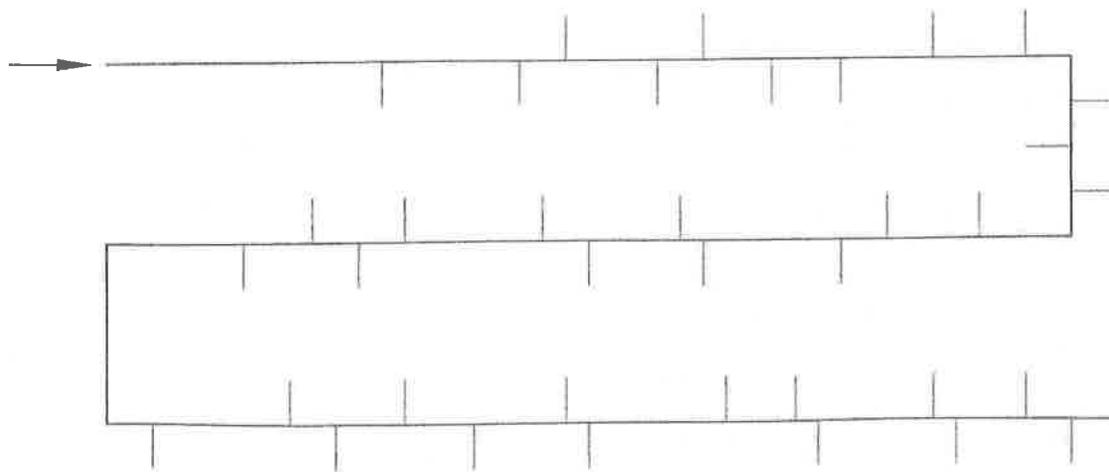
**Figure 4.2. Schematic Diagram of Grid, Looped, and Dead-End Water Distribution Systems**



The Grid System

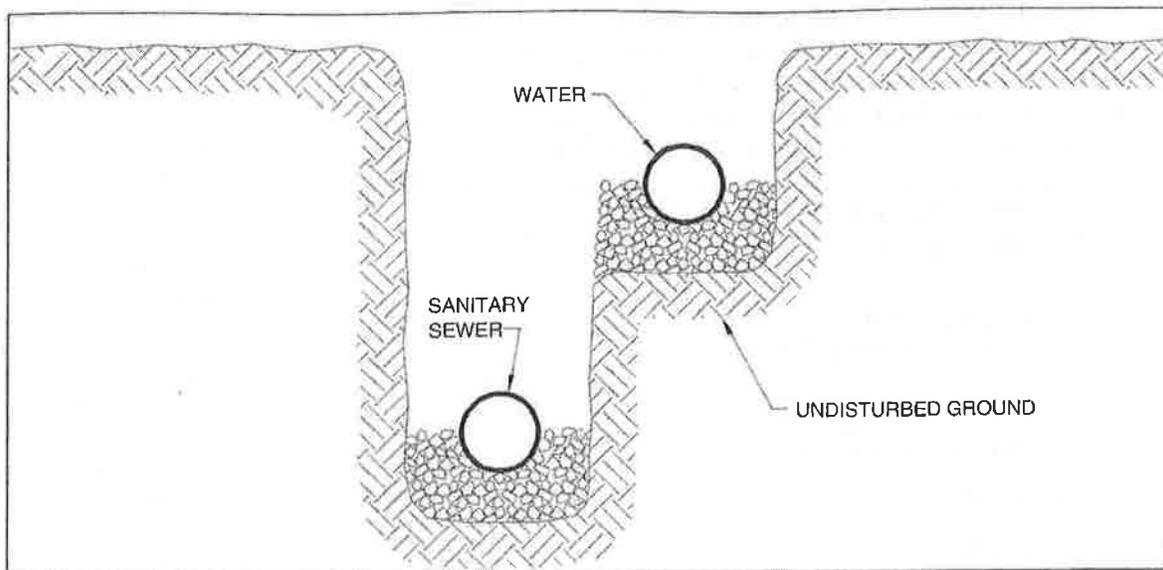


The Looped System



The "Dead-End" System

Figure 4.3. Recommended Separation of Water and Sewer Lines



Source: Dewberry and Davis. *Affordable Housing Development Guidelines for State and Local Government*. Washington, DC: U.S. Department of Housing and Urban Development, Office of Policy Development and Research, 1991, p. 109.

Solving for  $X$ ,

$$X = \frac{20}{.433}$$

= 46.2 feet (46 feet, with significant figures)

We now know that the bottom of the water tower must be at least 46 feet above the second story of the house. And how high is the second story of a house? As a rule of thumb, we can say that each story is about 10 feet high; therefore, the top of the second story of a house is about 20 feet. We can therefore deduce that the bottom of the water tank would have to be 46 feet + 20 feet, or 66 feet above the ground.

Suppose we move the house away from the bottom of the water tower. How far could we go before we run out of adequate water pressure? Theoretically, we could go an infinite

distance, so long as we didn't raise the elevation of the house. In reality, however, we would observe a loss in water pressure as the house is moved away from the water source. This loss of pressure is caused by conditions such as the friction of the water moving in pipes, going through valves, and making sharp turns. As a rule of thumb, engineers use the figure of a loss of 5 feet of "head" for every 1,000 feet of pipe, or 2.2 psi per 1,000 feet.

#### Sample Problem #1

A water tower is located on a totally flat plain; the bottom of the tank is 100 feet above the ground. What is the maximum service radius of the tower, if a residual pressure of 20 psi is required at the first floor of residences to be served?

**Solution**

We need 20 psi at 10 feet above grade. Pressure at the 10-foot elevation, disregarding line loss, would be equal to 90 feet of head (100 feet - 10 feet). 90 feet of head = 38.97 psi (90 feet × .433 psi/feet). Since we have 38.97 psi at the first story, and we need to retain only 20 psi, this means we can afford to lose 18.97 psi (38.97 - 20) in line loss. We can therefore set up the following ratio:

$$\frac{2.2 \text{ psi pressure loss}}{1,000 \text{ feet of water line}} = \frac{18.97 \text{ psi pressure loss}}{X \text{ feet of water line}}$$

Solving for X,

$$X = 8,622 \text{ feet}$$

We therefore say the service radius from the water tower is about 8,600 feet, under the conditions cited.

**Sample Problem #2**

A water tank is located on a continuous slope of 5 percent. The bottom of the tank is 160 feet above grade. Find the maximum extent of service to:

- A. downhill areas
- B. uphill areas
- C. areas at the same elevation as the base of the tank

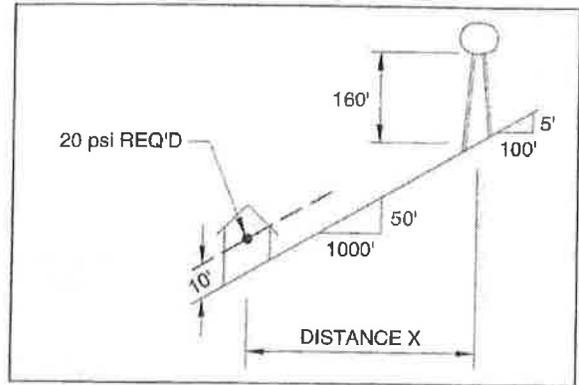
Assume that 20 psi is required on the first floor of each residence; this is 10 feet above the surrounding terrain. Also assume a line loss of 5 feet of head (2.2 psi) per 1,000 feet of distance from the base of the water tower.

Figure 4.4 diagrams the three design situations.

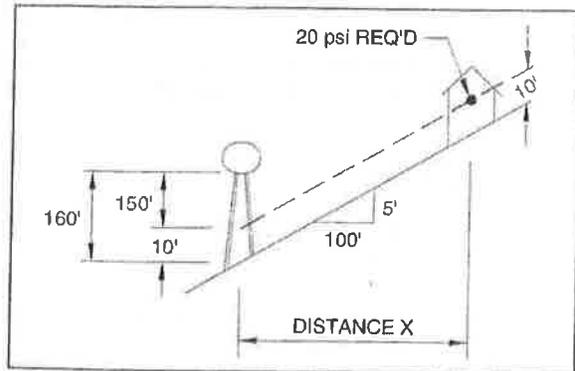
**Solutions (refer to Figure 4.4)**

*Situation (A): Service to areas downhill from the tank*—The difference in elevation

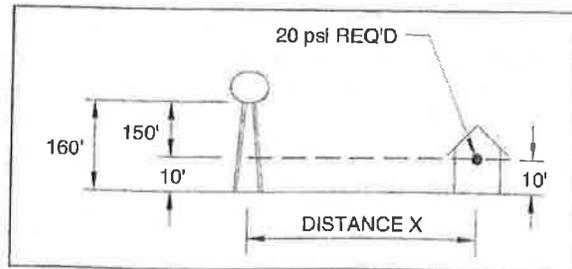
**Figure 4.4. Sketches of the Situations Described in Sample Problem #2**



**Situation A.** Water service to areas downhill from the water pressure tank



**Situation B.** Water service to areas uphill from the water pressure tank



**Situation C.** Water service to areas at the same elevation as the base of the water pressure tank

along the downhill slope is 5 percent, or 5 feet of vertical distance for every 100 feet of horizontal distance, or 50 feet of vertical distance for every 1,000 feet of horizontal distance.

This means that a water line running downhill for a distance of 1,000 feet will develop an added 50-foot "head" of water pressure, if pressure loss due to friction is disregarded. But, we know that there is a line loss of 5 feet of head for every 1,000 feet of pipe length. Therefore, if the pipe runs downhill a distance of 1,000 feet, the water pressure will increase by a head of 45 feet (50-foot increase less a 5-foot decrease). We can therefore conclude that there is no limit to the distance downhill from the tank that can be served since the water pressure increases the further downhill the pipe goes.

**Situation (B): Service to areas uphill from the tank**—We require 20 psi in the house 10 feet above the ground, from a water tank 160 feet high. This is equivalent to 20 psi at ground level from a tank 150 feet high. We can calculate the water pressure from a tank 150 feet high; it is 150 feet  $\times$  .433 psi/feet of height = 65 psi. We can afford a reduction from the original 65 psi down to 20 psi; the difference is a loss of pressure of 45 psi (65 - 20 = 45). This pressure loss may be from pipe friction, or change of elevation, or both.

Let us take a sample distance of 1,000 feet and see what our pressure losses are. Loss due to pipe friction will be 2.2 psi (a given approximation). Loss due to increase in elevation will be equal to a loss of head of 50 feet (1,000 feet  $\times$  5 percent grade = 50 feet). This is equal to 50 feet  $\times$  .433 psi/foot = 21.6 psi. So, in 1,000 feet we lose 2.2 + 21.6 psi = 23.8 psi. If we lose 23.8 psi in 1,000 feet, how far can we go before we lose 45 psi?

$$\frac{23.8 \text{ psi}}{1,000 \text{ feet}} = \frac{45 \text{ psi}}{X}$$

$$X = \frac{45 \times 1,000}{23.8}$$

$$= 1,890 \text{ feet (1,900 feet when rounded)}$$

**Situation (C): Service to areas at the same elevation as the base of the tank**—Water pressure in the house, disregarding pipe friction, is equal to a head of 150 feet (160 feet tank height less 10-foot elevation to water outlet in house). This head of 150 feet is equal to a water pressure of 150 feet  $\times$  .433 psi/foot = 65 psi. But, if a water pressure of 20 psi is required in the house, this means that we can afford to lose 45 psi in friction losses (our original 65 psi - 20 psi residual pressure in house = 45 psi). We know that we lose 2.2 psi in friction losses for every 1,000 feet of pipe length. How many feet of pipe length can we have before we lose 45 psi? We arrive at the answer by solving the equation:

$$\frac{2.2 \text{ psi loss}}{\text{in 1,000 feet}} = \frac{45 \text{ psi loss}}{\text{in } X \text{ feet}}$$

$$\text{so } X = \frac{45 \text{ psi} \times 1,000 \text{ feet}}{2.2 \text{ psi}}$$

$$= 20,000 \text{ feet}$$

The precise calculated answer is 20,454.545 feet, but we must round off our answer to two significant figures.

The foregoing examples of water system design were provided to illustrate basic concepts of how water distribution systems work. In actual practice, engineers use computer programs to assist in determining desirable pipe sizes, analyze the flow of water in a network of pipes and valves, and determine the optimum network.

## DEFINITIONS

*Acre-foot*—Unit quantity of water; an amount which would cover 1 acre to a depth of 1 foot; consists of 326,000 gallons.

*Aquifer*—A subsurface zone that yields economically important amounts of water to wells. (The word “aquifer” is synonymous with the term “water-bearing formation.”) An aquifer may be porous rock, unconsolidated gravel, fractured rock, or cavernous limestone.

*Domestic use*—Water use in homes and on lawns, including use for washing, cooking, flushing toilets, laundry, washing cars, air coolers, and swimming pools.

*Evaporation*—The process by which water is changed from a liquid to a gas or vapor.

*Flood*—Any relatively high stream flow overtopping the natural or artificial banks in any reach of a stream.\*

*Flood plain*—The lowland that borders a river, usually dry but subject to flooding when the stream overflows its banks.

*Ground water*—The water zone below the surface of the earth in which the rocks and soil are saturated, the top of which is the “water table.”

*Hydrology*—The science of the behavior of water in the atmosphere, on the surface of the earth, and underground.

*Impermeable strata*—A layer of soil or rock which is not permeable to the passage of water (e.g., clay).

*Infiltration*—The flow of a fluid into a substance through pores or small openings. The common use of the word is to denote the flow of water into soil material. (In sanitary engineering, the term refers to the flow of water from adjacent soils into a sewer line.)

*Leaching*—The removal into solution of soluble minerals from solids into percolating waters.

*Percolation*—The passage of water through the open pores of soils, or the fissures in rock.

*Permeability*—The property of soil or rock to pass water through it. This depends not only on the volume of the openings and pores, but also on how these openings are connected to one another.

*Saturated zone*—The zone of soil in which water occupies the pores between the solid soil particles.

*Sediment*—Fragmental mineral material transported or deposited by water or air.

*Transpiration*—The process by which water vapor escapes from the living plant and enters the atmosphere.\*

*Water table*—The upper surface of the saturated zone.

## Note

1. Dewberry and Davis.

Definitions marked with \* are adapted from the American Geological Institute, *Dictionary of Geological Terms*, 1976 ed. Reprinted with permission.

## Recommended Reading

Lynch, Kevin and Gary Hack. *Site Planning*. 3rd ed. Cambridge, MA: MIT Press, 1984, pp. 243-245, 463.

## Sources of Further Information

Colley, Barbara C. *Practical Manual of Land Development*. 3rd ed. New York: McGraw-Hill, 1998. See Chapter 10, “Water Supply Lines.”

De Chiara and Koppleman. *Urban Planning and Design Criteria*. 2nd ed. New York: Van Nostrand Reinhold, 1975, pp. 519-528.

Dewberry and Davis. *Affordable Housing Development Guidelines for State and Local Government*. Washington, DC: U.S. Department of Housing and Urban Development, Office of Policy Development and Research, 1991.

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## About the Author

Larz Anderson has 23 years' experience in city and county planning and private consulting. He taught urban planning for 15 years in the graduate programs of Ohio State University and Virginia Tech, where his courses emphasized physical design for urban areas. He is also the author of *Guidelines for Preparing Urban Plans*, published by Planners Press.

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