STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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TECHNICAL REVIEW MEMORANDUM

Bureau of Water Quality

TO: **Billie J. MacLean, Project Manager – Land Use Planning Commission**
FROM: **Jeff Dennis, Biologist and David A. Waddell, Asst. Env. Eng. -- Division of Environmental Assessment, Bureau of Water Quality**
DATE: **December 7, 2017**
RE: **Irving Fish River Concept Plan**

Purpose:

The original purpose of this memorandum was to assess the feasibility of being able to develop the number of commercial and residential lots proposed for the development areas in the proposed Fish River Concept Plan without exceeding the per acre phosphorus allocations, as most recently estimated by DEP, for each of the lakes in question. This analysis, which is still included, suggests that, at least for the Cross Lake development areas, there would be insufficient allocation. Given this, a section has been added providing background information about the lakes, the issues, the options considered for limiting phosphorus additions to the lakes and some of the history of development and consideration of these options.

Background:

Water Quality. The water quality standards for Maine lakes require that they have a stable or decreasing trophic state, subject only to natural fluctuations, and must be free of culturally induced algal blooms that impair their use and enjoyment. Of the four lakes included in the proposed plan (Long Lake, Mud Lake, Cross Lake and Square Lake), only Cross Lake fails to meet these standards. Cross Lake has for many years supported mid-summer blue green algal blooms that reduce measured secchi disc transparency, in most years, to 2.0 m or less. Long Lake is a productive lake that, in past years has supported algal blooms, but is currently exhibiting a promising trend of decreasing trophic state. Mud Lake is a productive lake with an apparent stable trophic state, though little water quality data has been collected on the lake in recent years. Square Lake is a moderately productive lake with a stable trophic state.

While the principle reason for impairment of Cross Lake is inputs of phosphorus from agricultural activities located primarily in the Dickey Brook watershed, runoff from roads and harvesting operations also contribute to the problem. Any additional phosphorus load to the lake has the potential to increase the duration and intensity of the algal blooms, so any new phosphorus sources or expansion of existing phosphorus sources should be treated with particular care.

The Phosphorus Standard and the General Standard. The Chapter 500 Stormwater Management Rules require that any project disturbing one acre or more of land and creating 20,000 sq ft or more (in Most at

Risk Lake watersheds) or one acre or more (in all other lake watersheds) of new impervious area either meet the Phosphorus Standard or the General Standards. The goal of both of these standards is to insure management and treatment of stormwater runoff sufficient to avoid significant cumulative impacts to downstream lakes. If a project in a lake watershed requires a Site Law permit, it is required to meet the Phosphorus Standard; the option of meeting the General Standard is not available.

The General Standards require that BMPs of approved type and sizing be incorporated such that they provide treatment for runoff from at least 95% of the project's impervious area and at least 80 % of the project's developed area. There are several possible exceptions to this, the most significant one dealing with linear portions of the project (i.e. roads). For a linear portion of the project the area required to be treated may be reduced to no less than 75% of the linear portions impervious cover and no less than 50% of its developed area. All projects are treated the same regardless of the nature of the waterbody to which they drain.

Under the Phosphorus Standard, the amount of phosphorus mitigation and/or stormwater treatment required for a given project is a function of the size of the parcel, the per acre phosphorus allocation for the lake watershed in which the project is located and the potential for the project to export phosphorus in its stormwater. Per acre phosphorus allocations are determined for each lake in a three step process: (1)an allowable increase in phosphorus load to the lake is estimated based on the hydrologic sensitivity of the lake to phosphorus loading, the water quality of the lake and its potential to recycle phosphorus from its sediments and to support cold water fisheries; (2)the area within the watershed that over time will be subject to development is predicted based on the anticipated growth rate in the watershed and the amount of land available for development; and (3)the allowable increase in phosphorus load (lbs P/yr) is divided by the expected area of growth in acres to get the per acre phosphorus allocation (lbs P/acre/year). To determine the phosphorus budget for a project (the Project Phosphorus Budget, PPB) the per acre allocation for the watershed is multiplied by the acreage of the parcel being developed. The project design must then incorporate enough appropriate mitigation measures and/or stormwater treatment BMPs to prevent the projects projected phosphorus export (PPE) from exceeding the project's phosphorus budget. Low density projects in relatively less sensitive watersheds are required to do less stormwater management and treatment than high density projects in sensitive watersheds.

The goal of this methodology is to provide protection sufficient to avoid increase in the lake's trophic state, and to distribute the burden of this protection over the watershed and over time, thus allowing for the maximum development potential within any watershed. This strategy works best in watersheds where most of the new sources of phosphorus are associated with development activities that are subject to regulation and required to meet some version of this standard. In watersheds with other significant, and potentially expanding, phosphorus sources (i.e. agriculture, harvesting roads) account for a substantial portion of the threat to the lake's water quality, the Phosphorus Standard is not likely to provide sufficient protection unless some of the allowable increase in phosphorus load is reserved for these un- or under-regulated sources.

Strategies for protecting lakes in Concept Plan type development. In the southern, more developed part of Maine the activity that is likely to result in increased phosphorus loading to lakes is watershed development, especially development that includes roads and other transportation infrastructure (i.e. parking, driveways, etc.). Usually this type of development is regulated, at least at the local level, and the parcels on which the development takes place are relatively small, not much more than is required for the proposed development. In this situation implementation of the Phosphorus Standard is likely to be

effective. In LUPC jurisdiction, especially in cases of Concept Plan and Planned Development districts, this is not the case. The parcels involved are very large, orders of magnitude bigger than that required for the proposed level of development, and, unlike in the more developed portions of the state, may encompass large parts of, or even the entire watershed of the lake(s) involved. In this case the owner of the land involved in the Concept Plan or Planned Development has complete control of what happens on these lands, and the plan poses a course of management and development that will avoid unacceptable impacts to natural resources. Since the landowner controls much if not all of the watershed it seems reasonable to allocate an appropriate portion of the allowable increase in lake phosphorus loading, call it the Plan's phosphorus budget, to the owner, and let him or her decide how that allocation should be applied within the Plan area, provided that the total net addition of phosphorus to the lake associated with activities in the Plan area does not exceed the Plan phosphorus budget.

This is the strategy that was applied in both the Saddleback Plan andthe Plum Creek. In the case of Saddleback, it has worked well, with Saddleback's consultants keeping track of the magnitude of additional phosphorus sources from new development projects as well as the reduction of phosphorus export resulting from retrofitting stormwater management BMPs on many existing, grandfathered sources. As long as the net increase phosphorus load does not exceed the Plan phosphorus budget, Saddleback is in compliance with its Plan requirements. In the case of Saddleback, most, if not all of the potential increased phosphorus load to the lake is associated with new development activities that were regulated under the plan, so there was no issue of not dealing with other potential uncontrolled sources in the watershed.

When we at DEP were initially questioned about the Fish River Lake Concept Plan, we suggested the same strategy be applied, but with a recognition that much of the potential for future phosphorus sources is associated not with proposed development activities, but with unregulated road construction and enhancement servicing harvesting operations. The following table is one developed in 2012 by DEP staff and Conway Elkins, who was working with Irving at the time. It presents a phosphorus allocation proposal where the plan's phosphorus budget is based on the percentage of the lakes' watersheds that were within the plan area, and where a significant portion of the budget was reserved for future harvesting activity and for other potential uncontrolled future sources.

Fish River Chain of Lakes												
P Allocation Discussion Meeting 1/19/12												
Lake	Phosphorus allocated to total direct watershed per ppb in lake (lbs) [F]	Acceptable increase in lake's phosphorus concentration in ppb [C]	Allowable increase in annual phosphorus load to the lake (lb/year) [FC]	Direct Watershed per Town Pak (acres)	Direct Watershed per GIS (acres)	Irving Ownership in Direct Watershed per GIS (acres)	Irving Ownership in Direct Watershed per GIS (%)	Possible Irving Allocation for Direct Watershed (lb/yr)	Net Increase due to Proposed Development	Net Increase due to New Roads since 2000	% of Allocation Used	Remaining Allocation
Long Lake	707	0.75	530.25	48,260	49,450	19,449	39%	208.55	9.67	52	29.6%	146.88
Mud Lake	115.5	1.00	115.5	7,502	7,404	6,651	90%	103.75	3.28	17	19.5%	83.47
Cross Lake	398	0.50	199	34,654	37,267	15,392	41%	82.19	19.05	3	26.8%	60.14
Square Lake	728	0.75	546	44,558	48,402	40,613	84%	458.14	22.39	58	17.5%	377.75
								852.63	54.39	130	21.6%	668.24

This table is very similar to Table 3 on page 10 in the Shoreland Criteria section (Question #14) of Volume 1 (Part C) of the Concept Plan shown below.

TABLE 3
PHOSPHOROUS EXPORT BY DEVELOPMENT AREA ON/ADJACENT TO EACH LAKE

Lake	P allocated to total dir. watershed per ppb in lake (lbs) [F]	Acceptable increase in lake P conc. in ppb [C]	Allowable increase in ann. P load to lake (lbs/year) [FC]	Direct Watershed per GIS (acres)	Irving Ownership in Direct Watershed per GIS (acres)	Irving Ownership in Direct Watershed per GIS (%)	Possible Irving Allocation for Direct Watershed (lbs/yr)	Net Increase due to allowed Development	Net Increase due to New Roads since 2000	% of Allocation Used	Remaining Allocation
Long	707	0.75	530.25	49,450	19,449	39%	208.55	14.02	52	**31.7**	142.53
Mud	115.5	1	115.5	7,404	6,651	90%	103.75	0.58	17	**19**	84.07
Cross	398	0.5	199	37,267	15,392	41%	82.19	21.3	3	**30.5**	57.14
Square	728	0.75	546	48,402	40,613	84%	458.14	22.39	58	**17.5**	377.75
						TOTALS	852.63	58.29	130	**22.4**	662.24

The strategy discussed above works well in the case of the Saddleback Planned Development District in part because Saddleback is the developer of each of the projects implemented under the plan. They therefore determine how much of their available phosphorus budget will be applied to the project (the magnitude of the project and the level of stormwater management applied to it), and have an understanding of what remains available for future projects. In the proposed Fish River Concept Plan a different development process is involved. Rather than acting as the developer of the proposed developed areas, Irving plans to sell the developed areas to other entities to develop as they intend within the limitations (e.g. number of lots) described in the plan. Another difference is that LUPC no longer has jurisdiction over Site Law projects in the Unorganized Territories. They are now handled by DEP, and will be required to meet the phosphorus allocation for the parcel being permitted. Unless Irving is willing to decide up front how much of the Concept Plan's phosphorus budget is allocated to each developed area and include that in the sales agreement and deed restrictions, the buyers will not know the potential for development in the area they are purchasing, and the DEP will not know what the phosphorus budget is for the parcel.

Since this type of internal allocation was not proposed in the plan, DEP staff developed a straight up per acre allocation for each township's share of each lake's watershed (including lands both within and outside the Concept Plan's boundaries), and assumed a relatively high growth rate of 25% since, in these watersheds, development activities are likely to account for only a part, and probably a minority part, of the potential future increase in phosphorus load to the lake. The allocation and associated assumptions are presented in the table below.

Fish River Lake Concept Plan P Allocations

Lake Name	Town in which development is located	Watershed Area in Town (acres) DDA	Area not available for development (acres) ANAD	Area available for development (acres) AAD	GF	Expected developed area (acres) D	(lbP/y) F	Water Quality Category WQC	LOP	C	FC	Per acre phosphorus allocation (lb/acre/yr) P	Small Watershed Threshold (acres) SWT
Square Lake	T16R5 WELS	8287	1000	7287	0.25	1822	135.4	mod-sensitive	h	0.75	101.55	0.056	455
Cross Lake	T16R5 WELS	3014	300	2714	0.25	679	34.66	poor restorable	h	0.50	17.33	0.026	170
Cross Lake	Cross Lake Twp	18018	4300	13718	0.25	3430	207.13	poor restorable	h	0.50	103.57	0.030	857
Long Lake	T17R3 WELS	8203	400	7803	0.25	1951	120.28	mod-sensitive	h	0.75	90.21	0.046	488
Long Lake	T17R4 WELS	10182	500	9682	0.25	2421	149.3	mod-sensitive	h	0.75	111.98	0.046	605
Mud Lake	T17R4 WELS	5715	400	5315	0.25	1329	88.02	mod-sensitive	h	0.75	66.02	0.050	332
Mud Lake	T17R5 WELS	1433	250	1183	0.25	296	22.07	mod-sensitive	h	0.75	16.55	0.056	74

The following section evaluates the feasibility of potential development scenarios for each development area, with the phosphorus budget for the development area defined as the product of the developed areas acreage minus any NWI wetlands and the appropriate per acre allocation in the table above (highlighted in yellow).

Analysis of feasibility of proposed development densities in the developed areas:

Proposed under the Irving Concept Plan are 6 Commercial Development areas and 11 Residential Unit areas, one with potential for a multi-unit recreational facility. Evaluation of the plan for its total phosphorous impacts on the four major lakes in the plan area is challenging due to the large amount of land in the plan and difficulty of assessing future phosphorus loads from activities that fall under typical forest management, including roads. The simplest way of looking at the proposed development is to address the areas that are specifically being proposed for development and restricting evaluation of the phosphorous impacts to those areas. The following analysis does that with assumptions as to how development might proceed.

Commercial Development Areas CD-1, CD-2, CD-3A, CD-3B, CD-3C, CD-4.

To analyze the commercial development areas some assumptions about the development were needed. These areas only specified the number of lots and the kind of development i.e. a mix of commercial, light industrial, civic, or multi-unit residential complexes for senior or affordable housing development. The phosphorous methodology only differentiates between cover types. The mix of possibilities would be endless and will come out as specifics of the developments are proposed. For these areas three scenarios were evaluated:

- 20% Lawn, 30% Parking, 50% Roof
- 20% Lawn, 50% Parking, 30% Roof
- 100% Impervious (for comparison)

Also, these scenarios were then adjusted for the use of the Chapter 500 standard suite of Best Management Practices of Storm Water Quality Control (60% phosphorous treatment.)

CD-1

CD-1 sets aside 281 Acres for the development of 30 lots. This lot is divided between Mud Lake and Long Lake. An existing road is on this lot and appears to have been recently upgraded for development. For this analysis, the lake specific Project Phosphorous Budgets (PPB) have been added together. The combined Long Lake and Mud Lake portions have a Project Phosphorous Budget of 7.937 lb/YR of "P". This is reduced by 0.763 lb/YR for the upgraded road.

The following table shows the amount of developable acreage allowed by each scenario.

	Scenario 1	Scenario 2	Scenario 3
w/o BMPs	9.630 Ac	8.016 Ac	5.739 Ac
w/ Standard BMPs	15.408 Ac	12.826 Ac	9.183 Ac

With 30 lots the amount of developable acreage per lot is between 0.191 and 0.514 Acres.

CD-2

CD-2 sets aside 167 Acres for the development of 30 lots. This lot is in the Mud Lake watershed. Wetlands along Rte 162 appear to prevent direct access to the lots. A 1500' access road has been assumed. The Project Phosphorous Budget (PPB) for CD-2 is 6.830 lb/YR of "P".

This is reduced by 1.888 lb/YR for the road w/o treatment. This would be 0.755 lb/YR if treated with standard BMPs. Assume the road is treated.

The following table shows the amount of developable acreage allowed by each scenario.

	Scenario 1	Scenario 2	Scenario 3
w/o BMPs	8.154 Ac	6.788 Ac	4.860 Ac
w/ Standard BMPs	13.047 Ac	10.861 Ac	7.776 Ac

The developable acreage per lot is between 0.162 and 0.435 Acres.

CD-3A

CD-3A allows for 11 acres divided into 4 potential lots. This parcel is in the Cross Lake watershed. The Project Phosphorous Budget is 0.330 lb/YR of "P". It was assumed that the lot would directly access the existing road.

The following table shows the amount of developable acreage allowed by each scenario.

	Scenario 1	Scenario 2	Scenario 3
w/o BMPs	0.443 Ac	0.369 Ac	0.264 Ac
w/ Standard BMPs	0.709 Ac	0.590 Ac	0.422 Ac

The developable acreage per lot is between 0.066 and 0.177 Acres.

CD-3B

CD-3B allows for 6 acres divided into 4 potential lots. This parcel is in the Cross Lake watershed. The Project Phosphorous Budget is 0.180 lb/YR of "P". It was assumed that the lot would directly access the existing road.

The following table shows the amount of developable acreage allowed by each scenario.

	Scenario 1	Scenario 2	Scenario 3
w/o BMPs	0.242 Ac	0.201 Ac	0.144 Ac
w/ Standard BMPs	0.387 Ac	0.322 Ac	0.230 Ac

The developable acreage per lot is between 0.036 and 0.097 Acres.

CD-3C

CD-3C allows for 11 acres divided into 4 potential lots. This parcel is in the Cross Lake watershed. The Project Phosphorous Budget is 0.330 lb/YR of "P". It was assumed that the lot would directly access the existing road.

The following table shows the amount of developable acreage allowed by each scenario.

	Scenario 1	Scenario 2	Scenario 3
w/o BMPs	0.443 Ac	0.369 Ac	0.264 Ac
w/ Standard BMPs	0.709 Ac	0.590 Ac	0.422 Ac

The developable acreage per lot is between 0.066 and 0.177 Acres.

CD-4

The remaining parcel is 73 acres, with a Project Phosphorous Budget of 2.104 lb/YR of "P". This would be divided into 30 lots. It is hard to determine if the road access needs to be upgraded from the information presented and no reduction was made for upgrades but this would reduce the amount of development the lot could have.

The following table shows the amount of developable acreage allowed by each scenario.

	Scenario 1	Scenario 2	Scenario 3
w/o BMPs	2.824 Ac	2.351 Ac	1.683 Ac
w/ Standard BMPs	4.518 Ac	3.762 Ac	2.693 Ac

Divide by 30 lots the amount of developable acreage per lot is between 0.056 and 0.151 Acres.

Phosphorus export from Commercial Development Areas. The above analysis of the Commercial Development Areas looks at the potential amount of developed land (under 3 scenarios) that could be created in each development area without exceeding the phosphorus budget for the developed area. It does not give any indication of how much phosphorus export would likely be created if all lots were "fully developed". As stated earlier, this is because there are too many possibilities for types and intensities of development on these lots. In an attempt to provide some perspective on this, we have attempted conservative estimates based on an evaluation of the amount and type of impervious area associated with some typical existing commercial parcels in the local area. Looking at 9 such parcels, it was determined that 0.909 acres of non-roof impervious area and 0.139 acres of building area represented the average for the parcels. This translates into 1.031 lb P/yr being exported from a typical commercial lot. Obviously less is possible and much more is also possible. One large industrial site could export 10 times this amount.

In the Cross Lake Watershed, 42 commercial lots are proposed for 43.3 lb P/yr of impact without treatment and 17.3 lb P/yr with standard best management practices. The new road that would have to be constructed to access lots in CD4 would likely export around 4.5 lb P/yr without treatment and 2.0 lb with standard treatment, though this would depend on the size distribution and arrangement of the lots.

In Mud Lake Watershed, 50 lots are proposed for 53.4 lb P/yr of impact without treatment and 21.3. lb P/yr with standard best management practices.

In Long Lake Watershed, 10 lots are proposed for 10.3 lb P/yr of impact without treatment and 4.1 lb P/yr with standard best management practices.

Residential Development Areas: Long Lake A, B, C; Cross Lake A, B, C ,D ,E; Square E, W; Yerxas

Evaluation of the residential areas is a little easier. The phosphorous methodology (in table 3.2) has defined allocations of individual lots based on the hydrologic soil class. This allocation includes a 150-foot maximum length driveway. Driveways longer than 150 feet need to be assessed as road. The table is further divided by lot restrictions or not. Lots with restrictions are limited on the amount of cleared opening for development and a maximum amount of driveway and parking. It is assumed that the option of 75% drive way buffers being applied is not used due to the complications of making this work on each lot. Calculations then were used to apply standard treatment BMPs that provide 60% removal of phosphorous for use as a comparison.

Access roads were determined by both the length of the road necessary to accommodate a minimum lot frontage of 100', if existing roads were available, if upgrades of the road were necessary, and anticipation of the most desirable lot locations. Upgraded roads were assumed to be 12 foot existing and upgraded to 20' with shoulders and ditches.

Long Lake "A"

Long Lake "A" uses 129 acres of HSG "C" soils to accommodate 50 lots with a PPB of 5.934 lb/YR. Road Conditions are unknown and it is assumed that upgrading will be necessary.

	w/o restrictions	w/ restrictions
w/o standard BMPs	14.500 lb/YR	10.000 lb/YR
w/ standard BMPS	5.800 lb/YR	4.000 lb/YR

Potential road upgrade: 0.431 to 1.726 lb/YR.

Lots and road with treatment would be acceptable for this lot number.

Long Lake "B"

Long Lake "B" caps the lots at 15 and uses 56 acres of HSG "C" soils to do so. With a PPB of 2.576 lb/YR, the lots are only applied as the road access other cottages and should be to a reasonable standard.

	w/o restrictions	w/ restrictions
w/o standard BMPs	4.350 lb/YR	3.000 lb/YR
w/ standard BMPS	1.740 lb/YR	1.200 lb/YR

Lots with treatment or restrictions would be acceptable.

Long Lake "C"

Long Lake "C" uses 120 acres of HSG "C" soils to accommodate 25 lots along a higher ridge. No existing road accesses these lots and a new road is assumed necessary. This road would appear to need to be 3000' at a minimum. PPB of 5.520 lb/YR.

	w/o restrictions	w/ restrictions
w/o standard BMPs	7.250 lb/YR	5.000 lb/YR
w/ standard BMPS	2.900 lb/YR	2.000 lb/YR

Potential road upgrade: 1.096 to 2.739 lb/YR.

Lots and road with treatment would be acceptable for this lot number.

Long Lake "overall cap"

Long Lake impacts are capped at 75 lots for all the projects. To evaluate this all of the PPBs can be added for the parcels and the lots applied with no consideration for road upgrades. This is a combined PPB of 14.030 lb/YR.

	w/o restrictions	w/ restrictions
w/o standard BMPs	21.750 lb/YR	15.000 lb/YR
w/ standard BMPS	8.700 lb/YR	6.000 lb/YR

Lots with treatment would be acceptable for this lot number and total property.

Cross Lake "A"

Cross Lake "A" uses 110 acres of HSG "C" and "D" soils to accommodate 30 lots with a PPB of 3.300 lb/YR. There is limited access off the existing road and an access road seems necessary: minimum of 1500 feet.

	w/o restrictions	w/ restrictions
w/o standard BMPs	9.450 lb/YR	6.450 lb/YR
w/ standard BMPS	3.780 lb/YR	2.580 lb/YR

Access road: 0.559 to 1.398 lb/YR.

Lots and road with treatment, and restrictions on the lots would be acceptable for this lot number. For no restrictions or treatment on the lots or road the parcel would more likely allow for 6 lots.

Cross Lake "B"

Cross Lake "B" has better HSG "B" soils and access off or an existing road. The 91 acres yields a PPB of 2.730 lb/YR to accommodate 30 lots.

	w/o restrictions	w/ restrictions
w/o standard BMPs	7.200 lb/YR	5.100 lb/YR
w/ standard BMPS	2.880 lb/YR	2.040 lb/YR

Lots with treatment and restrictions would be acceptable for this lot number. For no restrictions or treatment on the lots this parcel would accommodate 11 lots.

Cross Lake "C"

Cross Lake "C" uses 57 acres of HSG "C" and "D" soils to accommodate 30 lots with a PPB of 1.710 lb/YR. Access off of the existing road can accommodate 12 lots. A second road on the parcel closer to the lake could accommodate remaining lots with upgrades.

	w/o restrictions	w/ restrictions
w/o standard BMPs	9.450 lb/YR	6.450 lb/YR
w/ standard BMPS	3.780 lb/YR	2.580 lb/YR

Potential road export assumed at 1.000 lb/YR.
Road upgrade with treatment and lots with treatment and restrictions allow for 15 lots. Road and lot without restrictions or treatment would allow for 2 lots.

Cross Lake "D"

Cross Lake "D" uses 187 acres to accommodate 35 lots. A 16% of the lot is deducted for the steep slopes that are considered non-buildable or very high export potential under the methodology. Consisting of HSG B, C, and D" soils the PPB of the parcel is 4.108 lb/YR. Access off the existing road is assumed. Lots are apportioned as 11 in B soils, 18 in C soils and 6 in D soils.

	w/o restrictions	w/ restrictions
w/o standard BMPs	9.900 lb/YR	6.850 lb/YR
w/ standard BMPS	3.960 lb/YR	2.740 lb/YR

Well distributed lots with treatment will fit in this area.

Cross Lake "E"

To accommodate 60 lots, Irving has set aside 163 acres for Cross Lake "E". 11% of the lot is deducted for the steep slopes and wetlands that are considered non-buildable. Consisting of HSG "C" soils the PPB of the parcel is 3.770 lb/YR. A new access road of 4000' is required.

	w/o restrictions	w/ restrictions
w/o standard BMPs	17.400 lb/YR	12.000 lb/YR
w/ standard BMPS	6.960 lb/YR	4.800 lb/YR

Potential road upgrade: 1.460 to 3.652 lb/YR.

Road upgrade with treatment and lots with treatment and restrictions allow for 28 lots. To have lots without restrictions the road would need to be significantly shortened and the number of lots reduced to 10 or less.

Cross Lake "overall cap"

Cross Lake impacts are capped at 125 lots for all the projects. To evaluate this all of the PPBs can be added for the parcels and the lots applied with no consideration for road upgrades. This is a combined PPB of 15.618 lb/YR. Assume C/D soils for lots

	w/o restrictions	w/ restrictions
w/o standard BMPs	39.375 lb/YR	26.875 lb/YR
w/ standard BMPS	15.750 lb/YR	10.750 lb/YR

Lots with treatment and restrictions and roads would be acceptable for this total property.

Square Lake "East"

Square Lake "East" uses 278 acres of HSG "C" soils to accommodate 85 lots with a PPB of 15.568 lb/YR. Road upgrades are necessary. Assuming a 100' frontage, 4250 feet of road is necessary.

	w/o restrictions	w/ restrictions
w/o standard BMPs	24.650 lb/YR	17.000 lb/YR
w/ standard BMPS	9.860 lb/YR	6.800 lb/YR

Potential road upgrade: 1.534 to 3.835 lb/YR.

Lots w/ BMPs and road would be acceptable.

Square Lake "West"
Square lake "West" uses 121 acres of HSG "C" soils to accommodate 30 lots with a PPB of 6.776 lb/YR. It is assumed that upgrading will be necessary on the road for 3000 ft.

	w/o restrictions	w/ restrictions
w/o standard BMPs	8.700 lb/YR	6.000 lb/YR
w/ standard BMPS	3.480 lb/YR	2.400 lb/YR

Potential road upgrade: 1.096 to 2.739 lb/YR.

Lots with treatment and roads would be acceptable.

Square Lake "Yerxas"
The Yerxas lot is more complicated due to the chance for a blended residential setup with either lots or "camps" with amenities, or lodge like areas. The combination would be limitless. To that end, three scenarios have been looked at to provide a basis for evaluation. The parcel is 51 acres of HSG "C" soils. Deducting 3.4 acres of wetland, the PPB is 2.666lb/YR. The parcel is set aside for 67 housing "units". It should be noted that the roads with in the parcel will not accommodate the minimum frontage requirements but this should be expected.

- Senario One. As in the commercial lots above, a weighted average for development was developed to determine how much acreage could be developed for the lot using a "20% Lawn, 40% Parking, 40% Roof" weighting.

  Assume a 1000-foot access road: w/ BMPs = 0.365 lb/YR, w/o = 0.913 lb/YR.

  This results in between 2.13 acres and 2.79 aces of development. 48,600 sqft of building and 48,600 of parking with landscaping and lawn.
- Senario Two. Building off scenario one, set aside 30 units of 20' x 30' camps and use the remaining allocation for a lodge. Assume the same road impacts (with treatment)."
  This results in 30 camps and a lodge of 2.55 acres (landscape, roof, parking). (Note this does not include landscaping around camps or additional access road to camps but is to give a general idea of the impacts and potentials.)
- Scenario Three. 67 "units" could be interpreted as lots. This would be difficult to meet the frontage standard without additional road.

	w/o restrictions	w/ restrictions
w/o standard BMPs	19.430 lb/YR	13.400 lb/YR
w/ standard BMPS	7.772 lb/YR	5.360 lb/YR

For this impact a minimum of 96 acres of land would be necessary.

It should be noted that in the analysis above not all of the myriad of lot configurations or limitation or treatment options have been investigated. Developments could have some lots with treatment and restrictions and some with none, or any combination thereof. Also, the political realities of treatment structures should be considered. Potential problems of long-term maintenance and the responsibility for that maintenance need to be worked out. Policing lot clearing maximums has caused problems in the past and is hard to mitigate once the lot has been cleared. It may make far more sense to reduce the number of lots for these parcels to fit within the allocation restrictions.

Assumptions about road impacts were conservative and possibly less than realistic. Offsite access roads were not assessed nor looked at for upgrade requirements. These impacts will need to be considered and balance against the lot development on the parcels. Offsite road construction or upgrades within the lakes' watersheds that are required to access these development areas have as much potential to impact the lake as those within the developed area. Since it would be difficult to determine an appropriate area to define an allocation for this linear off site activity, a possible option would be to require these roads to meet either the General Standards in Chapter 500, or perhaps more reasonably, a natural hydrology standard that insures that runoff from uphill sides of the road would be efficiently distributed on the downhill side of the road with no diversion of uphill runoff to different intermittent catchments. This will require, in most instances, much more frequent culverting than is typically applied, and level spreaders or other distribution devices at culvert outlets.

Evaluation of possible phosphorus loadings from developed areas.

Phosphorus Export Comparisons					
Lake	Development Area	lb P/yr w/out restrictions or treatment	lb P/yr with restrictions and treatment	Concept Plan allocation for watershed (lb P/yr) from Table 3	Concept Plan net increase due to proposed development from Table 3
Long	Commercial Areas	10.3	4.1		
	Residential Areas	21.8	6		
	total	32.1	10.1	209	14
Mud	Commercial Areas	53.4	21.3		
	total	53.4	21.3	104	0.6
Cross	Commercial Areas	47.8	19.3		
	Residential Areas	39.4	10.8		
	total	87.2	30.1	82	21
Square	Residential Areas	52.7	22.6		
	total	52.7	22.6	458	22

The table above shows a summation of the likely increase in phosphorus load from proposed development in the development areas in each lake watershed either with or without restrictions and treatment. It is a very conservative estimate in that it assumes light development on the lots in CD4 and it does not include any export from new or improved roads to access the developed areas. For comparison purposes the table also shows the possible allocation (the Plan Phosphorus Budget) for each watershed and the expected increase in phosphorus load due to development as presented in Table 3 in Voume1(Part C) of the Concept Plan. The only lake that jumps out as a particular concern is Cross Lake. If all proposed lots in the Development Areas in the Cross Lake watershed were developed without restrictions or treatment increase in phosphorus load to the lake would exceed the plan's phosphorus budget, even without taking into account all the increases in phosphorus export that would likely occur over time within the Concept Plan area but outside of the developed areas. If all of the proposed lots

incorporated strict restrictions and relatively high level stormwater BMPs the likely increase in load would use up just less than 40% of the Budget leaving 60% to be allocated for access roads and harvesting related road upgrades. This sounds promising, but implementing and overseeing the long term maintenance of the phosphorus mitigation required to achieve this may not be feasible.

Conclusions:

It appears that the level of development envisioned in the plan is feasible, particularly in the Long, Mud and Square watersheds. Fitting the level of development that is proposed into the Cross Lake watershed will present very significant challenges.

Given the fact that Irving intends to sell the developed areas to other individuals or entities, it will have to be worked out how much of the Plan's Phosphorus Budget will be allocated to each developed area and how much will be reserved to cover future increases in load from other sources outside the developed areas.

In conclusion, it appears that the parcels and lot expectations are not un-realistic with adjustments. Particularly in the Cross Lake watershed, it will be necessary to apply sophisticated BMPs to most of the development activity, unless the number of lots created is significantly reduced. Long term lake health would then hinge on the correct application of the treatment BMPs, good erosion control, and maintenance of both, along with the other non-development specific impacts throughout the watershed whether in the control of Irving or not. This is a tall order left in the hands of LUPC staff, even if relying on third party partners to monitor.